



CDMA – Next G™ Coverage Equivalence

Report to the Minister for Broadband, Communications and
the Digital Economy under the *Carrier Licence Conditions*
(*Telstra Corporation Limited*) Declaration 1997



Australian Government
**Department of Broadband,
Communications and the Digital Economy**

Note from the Department of Broadband, Communications and the Digital Economy

Content identified by Telstra as being commercial-in-confidence has been removed from this version of the report. At this point only the main body of the report is being made available. The Department will consult with Telstra to review the extent to which the full report can be made public.

18 January 2008

© Commonwealth of Australia 2008

This work is copyright. Apart from any use as permitted under the *Copyright Act 1968*, no part may be reproduced by any process without prior written permission from the Commonwealth. Requests and inquiries concerning reproduction and rights should be addressed to the Manager, Communications and Publishing, Australian Communications and Media Authority, PO Box 13112 Law Courts, Melbourne Vic 8010.

Published by the Australian Communications and Media Authority

Canberra Central Office
Purple Building, Benjamin
Offices
Chan Street, Belconnen
PO Box 78,
Belconnen ACT 2616
Tel: 02 6219 5555
Fax: 02 6219 5200

Melbourne Central Office
Level 44, Melbourne Central
Tower
360 Elizabeth Street, Melbourne
PO Box 13112 Law Courts
Melbourne Vic 8010
Tel: 03 9963 6800
Fax: 03 9963 6899
TTY: 03 9963 6948

Sydney Central Office
Level 15, Tower 1 Darling Park
201 Sussex Street, Sydney
PO Box Q500
Queen Victoria Building NSW
1230
Tel: 02 9334 7700, 1800 226
667
Fax: 02 9334 7799

Contents

CHAPTER ONE. INTRODUCTION.....	1
Consultation with Telstra.....	1
Report Outline.....	2
CDMA and Wideband CDMA Technology.....	3
CHAPTER TWO. ACMA’S FINDINGS, CONCLUSION AND REASONS.....	4
Findings.....	4
Chapter Six.....	4
Chapter Seven.....	5
Chapter Eight.....	6
Conclusion and reasons.....	7
Coverage using an external aerial.....	7
Coverage in handheld mode.....	8
Alternative conclusion in the event Telstra’s construction of ‘appropriate handset’ is the correct one	9
CHAPTER THREE. LEGAL FRAMEWORK.....	10
Legislative basis.....	10
Telstra’s carrier licence conditions.....	10
ACMA’s role in relation to carrier licence conditions.....	10
The CDMA – Next G TM carrier licence condition.....	10
Minister’s decision.....	11
ACMA’s reporting obligation.....	12
Key Concepts.....	12
coverage.....	12
“... equivalent to or better ...”.....	13
Fortuitous coverage.....	13
Matters ACMA “must have regard to”.....	14
ACMA interpretation of the clause 15(7)(a) criteria.....	15
Appropriate handsets.....	15
ACMA draft view.....	15
Telstra’s view.....	16
Telstra’s Blue Tick and the Next G TM network.....	17
ACMA’s approach on ‘appropriate handset’.....	18
1 June Assessment Date.....	20

Matters outside the scope of ACMA’s report.....	21
Data Services.....	21
Retail Services.....	21
CHAPTER FOUR. METHODOLOGY FOR DETERMINING EQUIVALENCE.....	22
Assessing coverage equivalence.....	22
Actual Coverage.....	22
Drive Surveys.....	23
Relationship of Drive Surveys to the licence condition.....	23
Coverage in particular areas.....	23
CDMA network on 1 June 2007.....	24
Handset sensitivity testing.....	24
Determining handheld coverage.....	25
Telstra’s Coverage Maps.....	25
CHAPTER FIVE. APPROACH TO DRIVE SURVEYS OF COVERAGE.....	26
Background to drive surveys.....	26
Overview of the survey process.....	27
Drive Survey Route.....	27
Details on the drive survey method.....	28
Vehicle Set Up.....	28
Checking and configuration.....	28
Handsets.....	29
Software.....	30
Recorded Parameters.....	30
Data processing.....	30
Factors Potentially Affecting Survey Results.....	31
Factors attributed to propagation.....	31
Cell Breathing.....	31
Network congestion and cell outages.....	34
Vegetation and Terrain.....	34
Weather conditions.....	34
Effect of diplexers, antenna occlusion and antenna coupling.....	34
Interference.....	35
Frequency Selective Fading.....	36
Analysis of Measurement Uncertainties.....	36
Uncertainty factors attributed to the survey method.....	36
Idle Mode Acquisition time.....	36
Non-Synchronisation of calls during the survey.....	37
CDMA uplink limited.....	37
CHAPTER SIX. ANALYSIS OF DRIVE SURVEY RESULTS.....	39

CDMA network on 1 June 2007.....	40
Sub routes	41
Analysis of sub routes where Next G TM coverage deficiency exceeds three kilometres	44
Conclusions on Next G TM coverage discrepancies greater than three kilometres.....	48
Overall conclusion on coverage with an external antenna	49
CHAPTER SEVEN. MOBILE PHONE HANDSETS AND THEIR EFFECT ON COVERAGE	51
Introduction to handset sensitivity	52
Factors that determine handset sensitivity.....	53
Internal antenna	54
Human Interaction with the Handset	54
External Antennae	54
ACMA’s information on handset sensitivity levels and their effect on coverage	54
ACMA’s position in the draft report	54
telstra’s response and additional evidence	56
discussion.....	58
Conclusion on handset sensitivity.....	60
Market share	62
Blue Tick Handsets	64
CHAPTER EIGHT. COMPARISON OF COVERAGE MAPS	67
Introduction	67
Limitations of coverage predictions.....	67
General limitations	67
Telstra’s coverage predictions	68
Categories of mapped coverage deficiency	68
Forecasting anomalies.....	68
Data Errors	69
Configuration Differences.....	70
Engineering Errors.....	75
Comparison of coverage maps with drive survey results	76
GLOSSARY.....	77
LIST OF ATTACHMENTS.....	80

Chapter One. Introduction

This report had been produced to provide the Minister for Broadband, Communications and the Digital Economy with certain advices from ACMA on whether Telstra's Next GTM network provides coverage equivalent to or better than the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007.

In September 2007, the Attorney-General, on behalf of the Minister, amended Telstra's carrier licence condition through the *Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997 (Amendment No. 1 of 2007)*.

The effect of the carrier licence condition, and Telstra's subsequent notification to the Minister that its Next GTM and CDMA networks are equivalent, is that the Minister has until 21 January 2008 to determine whether he is satisfied that the Next GTM network provides coverage and retail services equivalent to or better than the CDMA network. It also requires ACMA to prepare this report for the Minister on whether Telstra has met the coverage standard described in the carrier licence condition.

Consultation with Telstra

At regular intervals during 2007 Telstra representatives met with ACMA and Departmental staff met to discuss issues relating to the closure of the CDMA network. Among other things, these meetings involved discussion of ACMA's drive survey exercise.

In early December 2007 ACMA provided Telstra with a copy of its drive survey methodology – this document set out the process involved in completing the drive survey. Telstra was invited to provide any comments on this document.

In mid December 2007 ACMA notified Telstra of some apparent coverage deficiencies arising from its drive survey. Telstra made some submissions to ACMA in response to these matters later in December 2007.

During the drive survey, various issues arose which were the subject of consultation between Telstra representatives and ACMA staff.

In preparation of aspects of this report relating to the testing of handset sensitivity and comparison of predictive maps of coverage, there was extensive consultation with Telstra representatives who were asked to provide assistance and information to ACMA. Telstra cooperated fully with each of ACMA's requests and provided the requested material in a timely and helpful manner.

ACMA also acknowledges the role of Departmental officers in assisting in the analysis of Telstra's predictive maps.

Consistent with procedural fairness principles, a draft of this report was provided to Telstra on 24 December 2007 and Telstra was invited to review it and provide any comments or other material to ACMA for it to consider before the report was finalised.

The Chairman of ACMA and senior ACMA staff had a teleconference with senior Telstra Executives on 31 December 2007 and several ACMA staff visited Telstra's Parramatta testing facility on 2 January 2008 to witness a demonstration of testing of handset sensitivity performance. Between 2 and 4 January 2008 Telstra and ACMA lawyers conferred with each other about advice Telstra had obtained from Senior Counsel on a key legal issue. On 3 January 2008 Telstra provided ACMA with comprehensive and helpful submissions together with a copy of advice from Senior Counsel. On 4 January 2008 the advice from Senior Counsel was supplemented by a further response to some additional questions raised by ACMA's lawyers.

On 3 January 2008 Ms Patricia Scott, Secretary, Department of Broadband, Communications and the Digital Economy wrote to the Chairman of ACMA. A copy of this letter was provided to Telstra and on 6 January 2008 Telstra provided additional submissions dealing with the matters raised in Ms Scott's letter.

Telstra submissions have been reviewed by ACMA and to the extent possible issues which were not clear have been the subject of further consultation and discussion between Telstra staff and ACMA staff. While not always ultimately reaching the same view as Telstra, ACMA has nevertheless sought to address or take into account each of the matters raised by Telstra in its submissions. Nevertheless, ACMA recognises that on some issues, because of the tight timeframe within which this report has been prepared, it has been restricted in its ability to gather additional evidence to conduct further consultation with Telstra.

Report Outline

This report details the information used by ACMA in reaching an overall conclusion on whether Telstra has met the coverage standard described in the carrier licence condition.

Chapter Three outlines the legislative basis behind the carrier licence condition and the roles of both the Minister and ACMA. It sets out the obligations and responsibilities under the carrier licence condition and considers the correct interpretation of key concepts. Chapter Three also sets out matters ACMA considers are outside the scope of the report.

Chapter Four deals with methodology. It outlines ACMA approaches to informing itself on coverage equivalence within the statutory framework. It backgrounds ACMA's reliance on drive surveys and analysis of handset sensitivity, external aerial coverage, handheld coverage and coverage maps and explains their relationship to the three criteria ACMA is required to have regard to in reaching conclusions about whether Telstra has achieved equivalent or better coverage.

Chapter Five describes in further detail the methodology employed in the drive surveys. The chapter also discusses factors that may affect the survey results.

Chapter Six provides an analysis of the results for the three major drive surveys and details the relevant summarised data obtained from them. It includes an examination of areas disclosed in the surveys where Next G coverage was found to be deficient relative to CDMA. Finally, ACMA's findings from the survey results are extrapolated to the network as a whole.

Chapter Seven discusses the issue of handset sensitivity and its impact on coverage equivalence. It includes an examination of the range of sensitivities found in both CDMA and Next G™ handsets and draws conclusions about network coverage areas that can be achieved using handsets of various sensitivity. The chapter considers which, if any, NextG handset models are likely to deliver coverage that is less than would be expected using the least sensitive CDMA handsets. Finally, it considers the market share held by various receivers and makes findings about the implications of those figures.

Chapter Eight discusses the extent to which Telstra's coverage maps may be useful in determining equivalence. Comparisons are made between the maps, including a discussion of the uncertainty and limitations encountered. The results of the map comparison are compared to the drive survey results. The chapter also analyses Telstra comments provided in response to an analysis of predicted coverage deficiencies derived from comparison of the maps. It makes findings about a number of areas where Telstra has indicated that Next G™ signals may be deficient relative to CDMA.

Chapter Two lists all of the findings made by ACMA in the report. It sets out ACMA's conclusions about the performance of the CDMA and Next G™ networks and provides the reasons for its conclusions.

CDMA and Wideband CDMA Technology

Telstra's CDMA network was established in August 1999 and is used to provide mobile phone coverage to customers residing in rural and regional areas¹. CDMA is a mobile telephone standard that uses Code Division Multiple Access (CDMA) as its underlying channel access method.

Telstra has deployed a new Wideband CDMA (WCDMA) network, marketed as 'Next G™', to replace their CDMA network. This builds upon the previous CDMA technology, maintaining the high amount of users accessing the network, but offering significantly higher data transfer². It is integrated as High-Speed Downlink Packet Access (HSDPA), a 3G technology chosen to also operate in the 850 MHz frequency band. Next G™ differs from other WCDMA networks operating in the 2100 MHz or 1900 MHz bands, with the 850 MHz band providing a larger area of coverage for a given transmitter.

Telstra announced it intends to switch off its CDMA network on the 28 January 2008, stating their existing Next G™ had achieved same or better coverage to that of CDMA on 15 October 2007³.

¹ <http://www.mobilecomms-technology.com/projects/cdma2000/>

² http://www.telstra.com.au/abouttelstra/media/announcements_article.cfm?ObjectID=40858

³ <http://www.telstra.com.au/cdmaupgrade/index.htm>

Chapter Two. ACMA's Findings, Conclusion and Reasons

Findings

ACMA has made the following findings. The chapter references refer to where the information and other material relating to each finding is found within the Report.

CHAPTER SIX

Finding 6.1: Measured coverage using an external aerial for the Next GTM network totalled across the drive route exceeded CDMA coverage by 202 km or 1.36%.

The Next GTM network provided external aerial coverage for 79.09% or 11832 km of the drive route.

The CDMA network provided external aerial coverage for 77.73% or 11630 km of the drive route.

The total drive route was close to 15,000 km.

Finding 6.2: Combined, the drive routes indicate a slightly larger area of coverage, when using an external aerial, in Next GTM as compared with CDMA.

Finding 6.3: The dual technology drive surveys provide a reasonably accurate guide to the coverage, when using an external aerial, of the CDMA network as at 1 June 2007.

Finding 6.4: Any Next GTM coverage discrepancy in the drive survey under three kilometres is unlikely to be the result of deficient coverage. In any event, given the small number and size of discrepancies under 3 km, ACMA considers them to be immaterial.

Finding 6.5: ACMA has identified four areas from the drive surveys where coverage of CDMA exceeds actual coverage of Next GTM. The discrepancies in coverage are most likely caused by antenna occlusion.

Antenna occlusions in mobile phone networks will result in very small areas where there is CDMA coverage but no Next GTM coverage. However, they are only in one direction and will not exist around the entire cell.

The drive survey found a total of approximately 17 km of coverage discrepancy in favour of CDMA, most probably resulting from antenna occlusion, in a total drive survey of approximately 15,000 km. This amounts to approximately 0.1%.

Finding 6.6: The results of the drive survey indicate that the actual coverage of the networks is very similar or identical in respect to the area that a signal emitted from a base station covers as it is propagated around the base station when a handset is used in connection with an external aerial.

Coverage of handsets used in conjunction with an external antenna is likely to be very similar or identical as between Next G™ coverage and CDMA coverage as at 1 June 2007.

There are likely to be very small areas (typically at the margins of coverage) where either Next G™ is available where CDMA was not (at 1 June 2007) or where CDMA was available (at 1 June 2007) but Next G™ is not. The areas in which Next G™ is available where CDMA was not are likely to be significantly greater overall than areas where CDMA coverage was present but Next G™ is not.

CHAPTER SEVEN

Finding 7.1: There are variations in sensitivity between handset models in both the Next G™ and CDMA handsets that can be used on Telstra's networks.

There is evidence which suggests there is greater variability in the sensitivity of Next G™ handsets than CDMA handsets.

Finding 7.2: The choice of mobile phone handset will not affect equivalence of coverage conclusions when having regard to subclause 15(7)(iii) "appropriate mobile phone used in connection with an external aerial".

Finding 7.3: After examining the evidence available, ACMA considers that handsets with an operational sensitivity relative performance of 5% or less of the benchmark handset (as outlined in table 7.1 from Telstra's sensitivity testing) are likely to provide less coverage than the predicted coverage of the least sensitive CDMA handset. This list includes but may not be limited to the following handsets:

██████████
██████████
██████████
██████████
██████████
██████████

Finding 7.4: A minimum of ██████ of Next G™ phones in use on the Next G™ network as at 30 November 2007 have sensitivity levels that the available evidence suggest may result in coverage that is significantly smaller than ACMA's predicted coverage for the least sensitive CDMA phone when operated in handheld mode.

This percentage figure is unlikely to correspond to the number of customers actually experiencing problems with Next G™ coverage. Mitigating factors such as differential

uptake of 'Telstra's Blue Tick' handsets in regional and remote areas suggest that this percentage overstates the proportion of customers who would experience difficulties in making and holding handheld calls in areas where they were ordinarily able to make and hold such calls using the CDMA network. However, many Next G™ customers in remote and regional areas will be using less sensitive Next G™ handsets to make handheld calls. There are also likely to be Next G™ customers with less sensitive handsets who live in cities who also travel into remoter areas and make calls on a very regular basis. There will be areas in which such people who ordinarily made and received handheld calls on the CDMA network will not be able to do so using their less sensitive Next G™ handsets.

Finding 7.5: If ACMA were to accept that ONLY Blue Tick handsets were considered 'appropriate' Next G™ handsets and they were compared with the CDMA handsets that Telstra define as 'appropriate' CDMA handsets, namely the [REDACTED], ACMA would conclude that the available evidence would suggest that there are no Blue Tick Next G™ handsets that are less sensitive than the Telstra defined 'appropriate' CDMA handsets. This means that Blue Tick Next G™ handsets operating in the same radiated field strength would offer equivalent or better coverage.

CHAPTER EIGHT

Finding 8.1: While conclusions can be drawn from the general shape of the coverage predictions of the networks, small differences in coverage predictions are more likely attributable to the prediction and mapping software than to actual differences in expected coverage. As such, ACMA considers small differences in expected coverage between the two services are not material.

Finding 8.2: Larger predicted discrepancies may, in most instances, be attributed to the implementation process when producing CDMA coverage maps for comparison to Next G™ coverage maps.

Telstra has acknowledged data errors were introduced during production of the coverage maps.

Finding 8.3: In some areas a mapped Next G™ coverage deficiency may represent some degree of actual coverage deficiency. ACMA considers the comparison of coverage maps to be useful for identifying potential areas of coverage deficiency for closer examination.

Finding 8.4: The areas of engineered coverage deficiency due to network configuration differences are not material, as the areas:

- are small in number (11 nationally);
- are small in size;
- with the exception of the [REDACTED], would appear at first inspection to be areas that are remote or inaccessible, and sparsely inhabited areas where Next G™ consumers would be unlikely to visit;
- in the specific case of the [REDACTED], the deficiencies appear to be in several very small localised spots within the general area which are more likely to give rise to problems with handheld coverage than with an external aerial; and

- as the map comparison was conducted on a whole of network basis, the deficient areas are likely to be limited to the eleven identified areas.

On this basis, the presence of these areas of engineered Next G™ coverage deficiency would not change ACMA's finding on actual coverage with an external aerial.

Finding 8.5: In three areas a mapped Next G™ coverage deficiency has corresponded to an actual coverage deficiency caused by an engineering error. ACMA accepts Telstra's assurance that these errors have been corrected in two areas. In the other, ACMA notes that Telstra is still investigating it and has committed to resolving it.

ACMA therefore does not believe these (mostly corrected) very small areas of coverage deficiencies are material in ACMA's consideration of coverage equivalence.

Finding 8.6: Where the drive survey route passes through areas in which the coverage maps have predicted a deficiency in Next G™ external aerial coverage, analysis of the drive survey results does not find a corresponding deficiency in actual external aerial coverage. In fact, the comparison shows that actual external aerial coverage of the Next G™ network is slightly larger than CDMA in those areas.

ACMA considers that a discrepancy in mapped coverage does not necessarily mean a deficiency in actual coverage.

Finding 8.7: The Atoll predictive coverage maps are a conservative prediction of coverage. In general, actual coverage as measured in the drive survey exceeds mapped coverage for both CDMA and Next G™ networks. The extent to which Next G™ actual coverage exceeds mapped coverage varies across the network.

Finding 8.8: Coverage maps are not sufficiently reliable as a guide to coverage (as defined in the carrier licence condition) for use in drawing conclusions about the size and location of specific discrepancies in actual coverage of Next G™ and CDMA.

ACMA considers that coverage maps are useful in providing a gross indication of coverage of the networks on an overall national basis.

Conclusion and reasons

ACMA concludes, subject to the reservations herein expressed, that the Next G™ network does not meet the standard referred to in subclause 15(1)(a) of the carrier licence condition.

ACMA must consider whether Telstra's Next G™ network provides coverage 'equivalent to or better than' the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007.

Coverage using an external aerial

Having had regard to the matters in clause 15 (7)(a)(i) and (iii) of the carrier licence condition, ACMA has found that overall the Next G™ coverage for consumers using an external aerial is virtually the same as CDMA coverage (at the relevant date) with an external aerial. However, actual coverage of Next G™ is not identical or better than CDMA coverage in all areas from all base stations. Rather, it is likely to be inferior to CDMA coverage in some places from some base stations. The total area of inferior coverage is expected to be only a very small fraction of the total area where coverage of the two networks is co-extensive.

Taking 'equivalent' coverage to mean coverage that is 'virtually the same,' ACMA has considered the extent to which the inferior actual coverage found is significant or material in making an overall assessment of coverage on each network as required under the carrier licence condition. On balance, it has concluded that it is not significant or material when using a Next G™ handset with an external aerial.

Accordingly, ACMA has formed the view that the Next G™ network provides coverage 'equivalent to or better than' the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007, when Next G™ handsets are used in connection with an external aerial.

This conclusion is subject to two important reservations:

- In the relevant chapters, ACMA has noted that reasonable minds may differ in determining whether a given area of inferior actual coverage is significant or material. That being said, the proper construction of the condition suggests that coverage need only be virtually the same in order to be 'equivalent'. It does not need to be absolutely identical.
- There is also a degree of uncertainty in the evidence before ACMA relevant to this issue. Thus, in Finding 6.6 the Authority finds there are likely to be other very small areas, typically at the margins of coverage, where CDMA was available (at 1 June 2007) but Next G™ is not. While these are likely to be minor (similar to the discrepancies ACMA detected in its drive surveys) ACMA has no other evidence about them. Similarly, in its consideration of a small number of areas of engineered coverage deficiency due to network configuration differences between CDMA and Next G™, ACMA was not able to draw confident conclusions about the existence and precise location of any deficiencies in actual Next G™ coverage in the time available and having regard to the available evidence.

Coverage in handheld mode

Turning to the matters in clause 15(7)(a)(ii), and taking account that the Next G™ network provides signal levels that are at least equivalent to the CDMA network as it was at 1 June 2007 [cl.15(7)(a)(i)], ACMA has considered whether there are any differences in sensitivity between Next G™ handsets and CDMA handsets that might affect whether the two networks provide 'equivalent coverage' when handsets are used in handheld mode.

While ACMA has conflicting evidence before it, it is likely that some Next G™ models do not provide the same coverage as the worst performing CDMA handset when used in handheld mode. While these models are few in number, they represent a significant proportion of total Next G™ handsets in use. This is notwithstanding that the majority of Next G™ handsets in handheld mode provide similar or better coverage to CDMA handsets.

Although there is evidence that since July 2007 customers dwelling in remote or regional areas are more likely to have acquired handsets with a Blue Tick label, many Next G™ customers in remote and regional areas will be using less sensitive Next G™ handsets to make handheld calls. There are also likely to be Next G™ customers with less sensitive handsets who live in cities who also travel into remoter areas and make calls on a very regular basis. There will be areas in which such people, who ordinarily made and received handheld calls on the CDMA network, will not be able to do so using their less sensitive Next G™ handsets.

Having regard to these findings, ACMA has found that the Next GTM network does not provide coverage 'equivalent to or better than' the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007, when handsets are used in handheld mode.

To the extent that the evidence underlying this conclusion might be regarded as equivocal, ACMA notes that the Minister is required to be 'satisfied' that equivalence has been achieved. Given the state of the evidence on this issue, it would be difficult to be satisfied that equivalence has been achieved.

In summary and turning to whether the Next GTM network meets the standards in subclause 15(1)(a) of the carrier licence condition, although there is strong evidence of equivalence of coverage for users of Next GTM handsets when used in connection with an external aerial, because equivalent handheld coverage has not been achieved for customers using the least sensitive Next GTM mobile phones, ACMA considers overall that the Next GTM and CDMA networks are not equivalent within the meaning of clause 15(1)(a) of the carrier licence condition.

Alternative conclusion in the event Telstra's construction of 'appropriate handset' is the correct one

In Chapter Three of this Report ACMA canvasses an alternative construction of the words 'appropriate handset' in the carrier licence condition that is supported by Telstra.

Adoption of the alternative construction would not affect ACMA's conclusion that the Next GTM network provides coverage 'equivalent to or better than' the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007, when Next GTM handsets are used in connection with an external aerial.

Having regard to Finding 7.5, however, ACMA would also have found Next GTM network does provide coverage 'equivalent to or better than' the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007, when handsets are used in handheld mode.

This is subject to the following proviso. Finding 7.5 is based on an opinion from Telstra as to which Next GTM and CDMA handsets would be 'appropriate' under the alternative construction. ACMA has not had the opportunity to consider properly whether these would be the only, or the correct, 'appropriate' handsets under the alternative construction. However, it is highly likely that ACMA would still find that the Next GTM network provided coverage 'equivalent to or better than' the CDMA network even if a somewhat different list of the more sensitive CDMA and Next GTM handset models were adopted.

In light of the above, if the alternative construction of 'appropriate handset' were adopted, it is highly likely ACMA would consider overall that the Next GTM and CDMA networks are equivalent within the meaning of clause 15(1)(a) of the carrier licence condition. In ACMA's view such a finding would be open to the Minister if he preferred the alternative construction of 'appropriate handset'.

Chapter Three. Legal Framework

Legislative basis

TELSTRA'S CARRIER LICENCE CONDITIONS

Section 56 of the *Telecommunications Act 1997* (the Act) provides for the grant of telecommunications carrier licences. Subsection 63(3) enables the Minister to impose conditions on a particular carrier licence issued under section 56 of the Act prior to the grant of the licence, and to come into force upon that grant of the licence.

The *Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997* (Original Declaration) was made on 24 June 1997 under this provision and came into force on 1 July 1997 with the grant of Telstra's carrier licence. The Original Declaration sets out the details of the licence conditions as they relate to Telstra.

Subsection 63(5) enables the Minister to vary, by written instrument, conditions imposed on a carrier licence under section 63.

ACMA'S ROLE IN RELATION TO CARRIER LICENCE CONDITIONS

ACMA has the statutory responsibility of ensuring compliance with carrier licence conditions.

Section 68 provides that a carrier must not contravene a condition of its carrier licence. A breach of section 68 is a civil penalty provision.⁴

Section 69 enables ACMA to give a carrier a written direction requiring a carrier to take specified action if a carrier has contravened, or is contravening a carrier licence condition. A carrier must not contravene a remedial direction.

Section 70 enables ACMA to issue a formal warning if a carrier contravenes a carrier licence condition.

Part 31 of the Act empowers ACMA (and the Minister) to institute proceedings in the Federal Court for the recovery of a pecuniary penalty of up to \$10 million for each contravention of section 68.

The CDMA – Next G™ carrier licence condition

On 15 September 2007, the Attorney-General, on behalf of the Minister for Communications, Information Technology and the Arts made the *Carrier Licence*

⁴ Section 68(3) Telecommunications Act 1997

Conditions (Telstra Corporation Limited) Declaration 1997 (Amendment No. 1 of 2007) (the Amending Declaration). The Amending Declaration varies the Original Declaration to the extent that it, inter alia, imposes a number of licence conditions relating to the closure and maintenance of the CDMA network. In this report, the Original Declaration as amended, is referred to as the carrier licence condition.

The Explanatory Statement to the Amending Declaration states:

The purpose of the Amending Declaration is to require Telstra to maintain its CDMA network until the Minister is satisfied that the Alternative Network provides coverage and retail services that are equivalent to or better than the coverage and retail services which are currently provided on or, in connection with, Telstra's CDMA network.⁵

The relevant condition is reproduced fully at Attachment 1. For the purpose of this report, the relevant clause of the carrier licence condition is the clause 15.

The carrier licence condition requires Telstra to maintain the operation of its entire CDMA Network until the Minister notifies the licensee that the Minister is satisfied that:

- (a) the Alternative Network provides coverage equivalent to or better than the coverage provided by Telstra's CDMA network that was in place as at 1 June 2007.
- (b) The Alternative Network provides retail services equivalent to or better than those provided on or in connection with Telstra's CDMA network as at 1 June 2007.⁶

The Alternative Network is defined in the Amending Declaration as:

The mobile telecommunications network, or combination of networks, used to provide the mobile carriage services marketed by the licensee as Next GTM services.

The CDMA Network is defined in the Amending Declaration as:

The mobile telecommunications network, or combination of networks, used to provide the mobile carriage services marketed by the licensee as CDMA services.

Minister's decision

Subclause 15(2) provides that the standards in subclause (1) do not apply where the Minister has not made a determination as to equivalence within the time frame and in the manner provided by the statute.

The trigger for the making of a decision by the Minister is provided by subclause 15(2)(a) in which Telstra was able, on or after 15 October 2007, to give the Minister written notification that, in the opinion of Telstra, the Next GTM network met the standards in subclauses 15(1)(a) and (b).

On 15 October 2007, Telstra provided the Minister with written notification of equivalence. A copy of the notice to the Minister is at Attachment 2.

⁵ Explanatory Statement to the *Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997 (Amendment No 1 of 2007)* at page 2

⁶ Subclauses 15(1)(a) and (b)

As a result of the notification, the Minister has the earlier of 14 weeks from the date of notification or three weeks from the date on which the Minister receives a report from ACMA to:

- notify Telstra that he is satisfied of the matters mentioned in subclauses 15(1)(a) and (b); or
- notify Telstra that he is not satisfied and giving reasons for such determination.

Failing such notice by the Minister under either subclause 15(2)(a) or (b), Telstra is not bound by the requirement to provide equivalent or better coverage and retail services.

In light of the Telstra notification, the latest date the Minister may make a determination under subclause 15(2)(b)(iii) or (iv) is **21 January 2007**.

ACMA's reporting obligation

Subclause 15(2)(b)(ii) of the carrier licence condition requires that ACMA provide a report to the Minister on whether the Next G™ network meets the standards referred to in subclause 15(1)(a). This report is provided to the Minister in satisfaction of its reporting obligation under the carrier licence condition.

The Explanatory Statement envisages that the Minister will consider the ACMA findings and other relevant material in order to make a decision on whether the Next G™ network has attained the equivalence standards.⁷

Key Concepts

In providing a report to the Minister on the standard referred to in subclause 15(1)(a), ACMA is required to consider and give meaning to several key concepts used in the carrier licence condition.

COVERAGE

Coverage is defined in the Original Declaration⁸ and explained in the Explanatory Statement⁹ as:

coverage means an area in which customers of a carrier or carriage service provider which supplies a mobile telecommunications service are ordinarily able to make or receive calls by means of that carrier's or provider's network.

A note to the definition of 'coverage' in the Original Declaration provides:

Note It is intended that the coverage of a carrier's or carriage service provider's public mobile telecommunications service includes areas in which customers of that service are ordinarily able to make or receive calls by means of the carrier's or provider's network but, for reasons such as system or network failure or network congestion, are unable to do so from time to time.

⁷ Explanatory Statement to the Amending Declaration at page 5

⁸ The definition of coverage and its accompanying note are reproduced from clause 3 of the consolidated *Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997*. This definition is not contained in the amending declaration attached to this report. The full consolidation can be accessed through FRLI: [http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/0/A1F50FFBA4159CF6CA25735B001C6623/\\$file/CarrLicConditions.pdf](http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrumentCompilation1.nsf/0/A1F50FFBA4159CF6CA25735B001C6623/$file/CarrLicConditions.pdf)

⁹ Explanatory Statement to the Amending Declaration at page 4

The key matters to arise from this definition is that coverage is determined by mobile phone users that are ordinarily able to make or receive calls using the network, leaving aside such issues as network failure or network congestion.

“ ... EQUIVALENT TO OR BETTER ... ”

The carrier licence condition refers to the standard of the Next GTM network providing coverage *equivalent to or better* than the coverage provided by Telstra’s CDMA network.

The term ‘equivalent’ is not given meaning in the carrier licence condition. ACMA notes, however, that the Explanatory Statement provides as follows:

The 'equivalence' standard is intended to apply to ensure that coverage continues to be provided at locations where coverage could ordinarily be used to make and hold phone calls, including coverage regardless of whether or not that 'coverage' is reflected in Telstra's own coverage maps. However, the standard is not intended to apply in areas of sporadic coverage, and is therefore not intended to require 'identical' coverage.¹⁰

Based on the explanation of equivalence in the Explanatory Statement, it is clear that equivalence of coverage is not to be based simply on Telstra’s mapped coverage. Further, equivalence of coverage is not intended to be assessed on the basis of areas of sporadic coverage.

ACMA understands the term ‘equivalence of coverage’ is intended to be assessed on the areas in which a mobile phone user could ordinarily make or receive calls, leaving aside network failure or network congestion that may affect calls from time to time. This does not include areas of sporadic coverage and is not to be determined based simply on Telstra’s mapped coverage, but rather, *actual* coverage.

In terms of the actual meaning of equivalence, ACMA takes the view that the term, when used in the context of the carrier licence condition, does not require identical coverage between the networks, but instead requires coverage by the Next GTM network that is *virtually the same* as that provided by the CDMA network. This means that the networks must be substantially co-extensive so that the respective areas of coverage associated with base stations within each of the networks can be regarded as ‘virtually the same’. A very high level of correspondence is required between the areas covered by signals emitted from base stations associated with each of the networks. The test does not require identical coverage. On an overall assessment of equivalence, equivalence may be found even though there could be very small areas which had CDMA coverage on 1 June 2007, but for which Next GTM coverage does not exist.

The application of the concept of equivalent or virtually the same coverage is discussed in more detail in Chapter Four.

Although ACMA did not need to specifically consider this point, the concept of ‘better’ coverage would entail a standard that is better than identical coverage between the networks.

FORTUITOUS COVERAGE

A common occurrence in radiocommunications is the concept of ‘fortuitous coverage’. In a telecommunications context, this refers to the situation where end users are able to make and

¹⁰ Explanatory Statement to the Amending Declaration at page 4

receive calls in areas that are outside the planned or intended coverage area. This is simply a phenomenon of radiofrequency propagation

The carrier licence condition and the Explanatory Statement make no mention of ‘fortuitous coverage’. Rather, the explanation of ‘equivalence’ in the Explanatory Statement distinguishes between ‘sporadic coverage’ and coverage that can ordinarily be used to make and hold phone calls. This is different from the distinction between planned or intended coverage and fortuitous coverage. Sporadic coverage can occur within an area intended to be covered by a network but for a range of reasons such as terrain or building clutter, that coverage is patchy and may not be available ordinarily. Conversely, there may be areas outside of the area of planned or intended coverage where it is nevertheless ordinarily possible to make and hold telephone calls.

ACMA’s report is concerned with whether coverage of the Next GTM and CDMA networks is equivalent or better, irrespective of whether that coverage is planned or intended or is merely fortuitous. As such, ACMA is concerned with actual rather than intended coverage, and with coverage that is ordinarily available rather than merely sporadic.

MATTERS ACMA “MUST HAVE REGARD TO”

The Explanatory Statement states that:

The Minister has asked the ACMA to carry out assessments of the equivalence of the coverage of the Alternative Network with coverage of Telstra’s CDMA network, by reference to the matters provided in paragraph 15(7).¹¹

Subclause 15(7) of the carrier licence condition provides that:

- (7) For the purposes of this clause:
- (a) the existence of equivalent or better coverage is to be determined having regard to:
 - (i) the area that a signal emitted from a base station covers as it is propagated around the base station; and
 - (ii) the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of voice calls using only an appropriate handheld mobile phone handset; and
 - (iii) the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of voice calls using an appropriate mobile phone used in connection with an external aerial; ...

Criterion (a)(i) - “the area that a signal emitted from a base station covers as it is propagated around the base station”

The ACMA understands this criterion is relevant to coverage equivalence based on signal strength. In order for a CDMA or Next GTM mobile phone handset to make or receive calls, it must be in an area that is covered by signals emitted from a base station.

In practice, the mere presence of a signal is insufficient to give coverage. The received signal must be of sufficient strength for the CDMA or Next GTM mobile phone handset to be able to make or receive calls. The area of coverage will be the area within which signals of sufficient strength are available.

The area in which the CDMA or Next GTM networks can enable the connection and maintenance of voice calls will be determined by the ability of the mobile phone handsets in the respective networks to receive the signals. The boundary of coverage will occur at the

¹¹ Explanatory Statement to the Amending Declaration at page 5

minimum received signal strength required for a given CDMA or Next GTM mobile phone handset to make and receive calls. This characteristic is known as the sensitivity of the mobile phone handset. Put simply, the more sensitive the mobile phone handset, the weaker the signal from a base station that is required to make and receive calls. All other parameters being equal, a more sensitive mobile phone handset will give greater ‘coverage’ in terms of the distance from the base station at which voice calls can be received or maintained.

In short, in order to consider coverage of a network it is necessary to consider both components of the network: the base station and the mobile receiver.

Criterion (a)(ii) - the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of voice calls using only an appropriate handheld mobile phone handset;

Criterion (a)(iii) - the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of voice calls using an appropriate mobile phone used in connection with an external aerial.

The difference between criteria (a)(ii) and (a)(iii) is that the former relates to coverage measured in terms of handheld mobile phone handsets whereas the latter relates to the use of a mobile phone used in connection with an external aerial, such as mobile phone used in the form of a car kit. As such, ACMA has been required to assess coverage in the context of these two modes of mobile communications.

Overall, these criteria relate to the consideration of equivalent or better coverage because the area in which the CDMA or Next GTM networks can enable the connection and maintenance of voice calls will be limited by the ability of the mobile phone handsets in the respective networks to receive the signals.

ACMA interpretation of the clause 15(7)(a) criteria

ACMA has concluded, reading clause 15(7)(a) as a whole, that it must assess coverage equivalence taking into account both the area of the signal emitted from base stations in each of the CDMA and Next GTM networks and the extent to which sufficiently strong signals are emitted from those base stations to enable the connection and maintenance of voice calls:

- using only an appropriate handheld mobile phone; and
- using an appropriate mobile phone used in connection with an external aerial (for example a directly coupled car kit).

APPROPRIATE HANDSETS

One of the key terms to arise in the criteria relevant to determining equivalence is the concept of an ‘*appropriate*’ handset.

ACMA draft view

ACMA expressed the view in a draft report provided to Telstra for comment that an appropriate handset is any handset sold or offered for use by Telstra in connection with the respective networks.

In reaching this view, ACMA noted the part of the explanatory statement to the amendment to the carrier licence condition which deals with clause 15(7)(a) contains the words ‘using a handheld mobile phone’ and ‘using a mobile phone in connection with an external aerial’.

These words, it was said, suggest that there was no particular limitation on the class (or type) of mobile phones intended for the purposes of the carrier licence condition.

On the other hand, the draft report noted that the Regulation Impact Statement for the carrier licence condition, which is attached to the Explanatory Statement, notes that one of the matters that gave rise to the need for the CDMA licence condition was that:

“... Telstra has stated that many coverage issues currently being experienced are due to customers not using the most appropriate handset and equipment.” [emphasis added]¹²

Despite this reference to ‘the most appropriate handset’, ACMA’s draft report noted that the carrier licence condition uses the expression ‘an appropriate handset’ not ‘the most appropriate handset’. This was said by ACMA to be consistent with a broad construction of the phrase when used in the carrier licence condition. ACMA therefore concluded in its draft report that an appropriate handset was any handset sold or offered for use by Telstra in connection with the respective networks.

Telstra’s view

Telstra takes a narrower view of what is an appropriate handset. In its view, *“the use of the word “appropriate” in the carrier licence condition confirms the intention by the Minister that the standard is to be judged using handsets that are suitable or fit for purpose. That is, when measuring equivalence in rural or fringe areas, the Next G™ handsets that should be compared with the CDMA handsets are those that are represented as suitable or fit for use in rural or fringe coverage areas – that is, Blue Tick handsets.”*

Telstra argues that the word “appropriate” is a word that *“limits by reference to whether the relevant characteristics are aligned (i.e. suitable) – it says nothing about availability, ubiquity or frequency within a population – indeed, there may be a small number that are “appropriate” in a context or there may be a wide number – “appropriate” does not measure this.”*

In Telstra’s view *“had the Minister intended for the test to be one of “any” handheld mobile phone, or a review of population spread of Next G™ handsets, the Minister could have inserted the word “any” in place of “appropriate” or made clear that a market survey of the locations of use of phones of different models of phones was to be conducted.”*

Telstra also submitted that, *“the CDMA network is a network primarily designed for rural and regional areas, whereas the Next G™ network has been designed (and marketed) as a national network – now available to 98.9 percent of the population. By definition, this means that handheld mobile phones that were marketed and sold for the CDMA network were primarily designed for rural and regional use - whereas (due to the national nature of the Next G™ network), phones that are marketed and sold for the Next G™ network cover a broader spectrum of users and a wider variety of user locations.”*

Telstra also noted that it has been *“reinforcing the message that only certain mobile phones are appropriate for rural or fringe coverage use – i.e., outside Telstra’s mapped coverage areas – initially through point of sale consultation with customers and follow-up communications, and then more formally from mid 2007 through its Blue Tick stickers and point of sale material that marks handsets that Telstra has “Recommended for Rural Handheld Use”.*

¹² Regulation Impact Statement, Amending Declaration Explanatory Statement at page 3

In conclusion, Telstra strongly submitted that it would be “*nonsensical that all mobile phones (including those which Telstra is clearly advocating as not appropriate for rural use) should be considered in any testing of equivalent coverage in rural areas outside mapped coverage areas.*”

Telstra obtained an opinion from Charles Scerri QC which supported its interpretation on this issue. A copy of that opinion is at Attachment 16.

Telstra’s Blue Tick and the Next G™ network

Telstra’s Blue Tick is a label given by Telstra to handsets which it recommends for ‘handheld use in rural and regional areas’. It introduced this label in mid 2007, which is nearly nine months after the Next G™ network was launched on 6 October 2006 and phones were first sold.

When Telstra launched its Next G™ network it had four mobile handsets available for purchase, the Samsung A701 and A 501, Telstra ZTE 850/51 and the LGTU500. None of these devices had the Blue Tick when they were first sold though Telstra now designates the LG TU500 as a Blue Tick device.

On 21 May 2007 Telstra launched Next G™ on pre-paid mobiles – the LG TU500 and the Telstra 256. At that time neither was labelled with the Telstra Blue Tick.

Telstra first announced a mobile handset ‘tailored for rural and regional customers’ on 12 June 2007 – that was the LG TU550. Telstra subsequently labelled this handset with a Blue Tick.

By the end of November 2007 Telstra’s Next G™ network had more than two million customers. By 27 December 2007 Telstra had ‘nearly 30 devices on the Next G™ network’ but only seven with the Blue Tick. Market share information from Telstra indicates that Blue Tick phones made up only ██████ of handsets in use on the Next G™ network on 30 November 2007 (see Attachment 9).

Telstra signed up many regional and rural customers to the Next G™ service in the period between 6 October 2006 and the introduction of the Blue Tick label in mid 2007. Even after mid 2007 handsets which do not have a Blue Tick label have continued to be sold to consumers in rural and regional areas. In these circumstances it is reasonable to assume that there are many consumers in rural and regional areas who now use handheld handsets which are not Blue Tick handsets¹³.

¹³ In addition, Telstra made the following comments which indicate that there is a lower proportion of non-blue tick phones in non-metro areas than metro areas, which suggests nevertheless there are a significant number of non-blue ticks handsets used in non-metro areas:

“Telstra has analysed the distribution of where the devices are being used across regional and rural Australia, which shows “blue tick” devices have a higher penetration in non-metro areas. (Note Metro / Country is not the ACMA definition). For example the ██████ accounts for ██████ metro devices, but ██████ country. This ratio is similar for other “blue tick” devices.

In contrast the A-rated devices have an inverse ratio, having a higher penetration in metro compared to non-metro.” (see page 9 of Attachment 16).

ACMA’s approach on ‘appropriate handset’

Telstra noted in submissions to ACMA that ACMA’s assessment of equivalence is to be done in relation to ‘coverage’. As noted above, coverage is defined in the carrier licence condition as:

“an area in which customers of a carrier or carriage service provider which supplies a mobile telecommunications service are ordinarily able to make or receive calls by means of that carrier’s or provider’s network.”¹⁴

Under clause 15(7)(a) of the carrier licence condition the existence of equivalent or better coverage (that is, equivalence between the areas in which customers are ordinarily able to make or receive calls on the respective networks) is to be determined having regard to each of the matters set out in subclauses (i), (ii) and (iii). Subclause (ii) requires ACMA to have regard to:

“the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of voice calls using only an appropriate handheld mobile phone handset.”

ACMA must therefore, in assessing equivalence, have regard to appropriate handheld mobile phone handsets ordinarily used by Telstra customers to make or receive calls by means of each of the respective Telstra networks.

Telstra’s position is that the most sensitive handsets, that is those recommended by Telstra for use in rural and regional areas, labelled by them as Blue Tick handsets, are the only handsets that are appropriate handheld mobile phone handsets. Telstra therefore argues that these are the only handsets to which ACMA can have regard.

If ACMA’s assessment of equivalence were limited to use of Blue Tick handsets only, a proportion (and perhaps a minority) of the handsets ordinarily used by Telstra Next GTM customers could be considered by ACMA and be the subject of the report to the Minister. Any report would thus be heavily qualified by virtue of that fact.

Policy objective of the amendment to the carrier licence condition

The explanatory statement to the amendment to the carrier licence condition explains the policy basis for the amendment and can give some guidance on how the word ‘appropriate’ should be interpreted. According to the explanatory statement, one of the policy objectives of the amendment of the carrier licence condition was to ensure that:

“...consumers in regional areas who can currently receive services from the CDMA network will be able to access equivalent services from the Alternative Network” (ie the Next GTM network).”

To the extent that a phrase in the carrier licence condition is open to more than one interpretation, ACMA considers it should be interpreted in a way that best enables the policy objectives to be met. Protection of the interests of consumers who ordinarily use handsets which are not Blue Tick handsets in regional areas and areas of fringe coverage has to be given weight when deciding on the scope of what is meant by ‘appropriate handset’. After all it is the handset that enables the consumer to access the network.

¹⁴ Clause 3 of the Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997

Use of ‘appropriate’ in the BSA

ACMA has also considered the use of ‘appropriate’ in other legislative contexts. In section 6 of the Broadcasting Services Act 1992 (BSA), the definition of ‘broadcasting service’ uses the phrase ‘...*having equipment appropriate for receiving that service...*’. The explanatory memorandum to that provision notes in relation to this aspect of the definition that “*that the receiver is by virtue of its design and technical characteristics capable of receiving the service, or the service provider has the technical capacity, by remote operation, to enable the receiver to receive the service; whether the delivery uses the radiofrequency spectrum, cable, optical fibre, satellite or any other means, or a combination of those means.*”

This use of *appropriate* in the context of ‘broadcast service’ is consistent with the notion that equipment must be ‘suitable for use in receiving a service’ to be regarded as *appropriate* equipment for the service.

Since October 2006 Telstra has sold handsets which by virtue of their design and technical characteristics are suitable for use on the Next GTM network. Consistent with this approach to “appropriate” (which indeed is ACMA’s approach), all handsets sold would be regarded as within the scope of what is regarded as an appropriate handset.

Representations to consumers

The Next GTM network is a national network that covers a range of areas from metropolitan and major regional centres to rural and regional areas. All Next GTM handsets are axiomatically capable of being used on the Next GTM network and have been sold on this basis and offered for sale for this purpose. From July 2007 Telstra began to recommend a limited number of handsets as Blue Tick devices. ACMA understands that there was no such recommendation expressed before July 2007. Any customers who purchased handsets before then may well have understood that their devices were suitable for use on the whole of the Next GTM network, including parts of the network in rural and regional areas.

As noted above, Telstra has sold and continues to sell non-Blue Tick Next GTM handsets in rural or regional areas for use on its Next GTM network. Telstra customers also continue to use non-Blue Tick Next GTM handsets in rural or regional areas. Telstra however argues on pages 8 to 9 of its response to the ACMA draft report, that the proportion of rural customers with lower sensitivity Next GTM handsets (ie lower sensitivity non-Blue Tick Next GTM handsets) is low. Even accepting Telstra’s view on this, it still means that there are Next GTM customers who use lower sensitivity Next GTM phones in rural or regional areas.

Disregarding customers without Blue Tick Handsets or with less sensitive handsets from ACMA’s consideration would exclude a substantial number of customers from the protection of the amended carrier licence condition.

ACMA’s conclusion

Whilst ACMA understands the proposed Telstra construction of ‘appropriate mobile phone handset’ and considers that it is clearly arguable, ACMA considers that the better view is that an appropriate handset means any handset that is suitable for use on the respective networks that has been sold or offered by Telstra for sale in connection with the respective networks to customers. This includes all of those customers using handsets in rural and regional areas since the Next GTM network was launched in October 2006. It therefore covers at least 6 Telstra Blue Tick devices and at least 26 other handsets which do not have the Blue Tick label.

ACMA considers that its interpretation is more likely to promote the policy objective of the carrier licence condition described above. ACMA notes that all Next G™ handsets by virtue of their design and technical characteristics are capable of being used on the Next G™ network. There are customers who have obtained non-Blue Tick Next G™ handsets and who ordinarily use those handsets in rural and regional areas including those areas with fringe coverage. Among other things, ACMA's understanding of the purpose of the licence condition was to take account of experiences of such customers when measuring equivalence and protect them in the transition from the CDMA network to the Next G™ network.

In assessing the equivalence of the CDMA and Next G™ networks in successfully enabling the connection and maintenance of voice calls, ACMA has considered the evidence available about the capacity of the range of mobile phone handsets suitable for use on the Next G™ network and currently used on that network and sought to compare this with the available evidence of the range of sensitivities of mobile phone handsets suitable for use of the CDMA network and in use on 1 June 2007. Handset performance (and specifically its sensitivity) is a determinant of coverage and is extensively discussed at Chapter Seven.

ACMA recognises that it is open for the Minister to take the view that he prefers Telstra's construction of 'appropriate handheld mobile phone handset'. For the assistance of the Minister, ACMA therefore sets out in this report the conclusions that would be reached if such an interpretation was adopted (see Chapter Seven).

Chapter Four sets out the methodology ACMA has used to assess the criteria under subclause 15(7)(a) of the carrier licence condition in order to determine whether the Next G™ network meets the standard mandated by subclause 15(1)(a) of the carrier licence condition.

1 JUNE ASSESSMENT DATE

The carrier licence condition requires Telstra to provide equivalent or better coverage than that provided by Telstra's CDMA network that was in place on 1 June 2007.

The Explanatory Statement explains that this date was chosen because:

The final CDMA tower supported by Commonwealth funding was brought into operation by 1 June 2007. Furthermore, at that time the ACMA had conducted a wide range of testing of the CDMA network throughout Australia.¹⁵

In reporting to the Minister, ACMA is mindful that the equivalence or better standard of the Next G™ network is required under the licence conditions to be measured against the coverage provided by the CDMA network as at 1 June 2007.

The primary task of ACMA is to determine, as best as it is able, with the best available evidence, the coverage of the CDMA network based on ACMA's understanding of the areas in which customers of the CDMA network could ordinarily make or receive mobile phones calls, as at 1 June 2007. The evidence referred to in this report, represents the ACMA's best understanding of the coverage of the CDMA network as at the relevant licence condition date.

¹⁵ Explanatory Statement to the Amending Declaration at page 4.

MATTERS OUTSIDE THE SCOPE OF ACMA'S REPORT

The carrier licence condition make it clear that certain matters fall outside the scope of ACMA's report to the Minister on equivalence of coverage. Accordingly, these matters have not been discussed in the report. For example, ACMA does not deal with data services and retail services.

Significantly, this report is on whether the Next GTM meets the standard referred to in paragraph 15(1)(a) of the carrier licence condition. It does **not** make any recommendations on what could be done if this standard is not met.

Data Services

This report does not examine the equivalence of the networks in respect of data services. Subclause 15(7)(a) of the carrier licence condition requires ACMA to have regard to the extent to which a signal emitted from a base station is of sufficient strength to enable the connection and maintenance of *voice calls* only. Therefore coverage in respect of data services and bandwidth is outside the scope of this report.

Retail Services

Subclause 15(1)(b) relates to the equivalence of retail services. Under subclause 15(2)(b)(iii), ACMA is required to report to the Minister on whether the Next GTM network meets the standard referred to in subclause 15(1)(a). Subclause 15(1)(b) relates to retail services. As such, retail services are not discussed in this report.

Chapter Four. Methodology for Determining Equivalence

Assessing coverage equivalence

The legal framework delineated in the previous chapter makes it clear that ACMA, in coming to a concluded view on coverage equivalence, must have regard to the matters in subclause 15(7)(a) of the carrier licence condition. In forming an overall view on whether the Next GTM network meets the standard in subclause 15(1)(a) of the carrier licence condition, ACMA has adopted the position that coverage equivalence requires the coverage of the networks to be *virtually the same*.

This chapter outlines the approaches ACMA has taken to informing its decision on coverage equivalence within the statutory framework.

As discussed in Chapter Three, the carrier licence condition require ACMA to have regard to coverage equivalence taking into account the area in which the CDMA and Next GTM networks can successfully enable the connection and maintenance of voice calls based on:

- using an appropriate handheld mobile phone handset; and
- using an appropriate mobile phone used in connection with an external aerial (for example, a directly coupled car kit).

In addition to technical information on the operation of the networks, ACMA has used the following information to inform its consideration of the issues:

- **Results of drive surveys of coverage (Chapters Five and Six)**
- **Results of mobile phone handset sensitivity tests (Chapter Seven)**
- **Results of a comparison of coverage maps (Chapter Eight)**

This chapter briefly discusses the approach taken and how this information has assisted ACMA in taking into account the matters it must have regard to in forming a conclusion on whether the Next GTM network meets the standard in subclause 15(1)(a) of the carrier licence condition.

ACTUAL COVERAGE

Considering the legal framework discussed in the previous chapter, ACMA concluded that coverage equivalence required a comparison of the *actual* coverage of the CDMA and Next GTM networks, rather than planned or predicted coverage.

Accordingly, ACMA considers that it cannot solely rely on Telstra's coverage maps in order to undertake the necessary comparison. Notwithstanding their limitations, however, mapped coverage comparisons have the potential to provide useful ancillary information, particularly in respect of areas not covered by the drive survey (see Attachment 4, Prediction Mapping Methodologies).

ACMA considered the range of options available for collecting the information it needed in order to draw conclusions on the actual coverage of the networks.

Drive Surveys

It was not feasible to perform a detailed field measurement census of the coverage around the entire area of each CDMA and Next GTM base station in Australia. However, ACMA judged that reliable evidence of coverage could be obtained from a drive survey using a reasonably large sample of base station cells across Australia. ACMA believed that it was possible to make confident inferences about coverage equivalence of the networks from this sample without conducting an exhaustive survey of the entire networks.

ACMA examined the drive survey methodology developed for the original map verification task that ACMA had been conducting for the Department¹⁶ prior to the amendment of the carrier licence condition. ACMA concluded that the survey process collected a large sample of data on actual coverage and therefore could be used to inform its determination on coverage equivalence under the carrier licence condition. The drive survey generally took a route that cut through a cell so that the edges of coverage could be determined on the way in and out of the coverage area. ACMA also examined in depth certain cells along the route. ACMA used these results, together with predictive software, to validate that coverage measured along the drive route through a cell provides an accurate representation of coverage around the cell (see Attachment 4).

The drive survey was undertaken using mobile phone handsets with directly coupled car kit antennas. Survey equipment logged the CDMA and Next GTM received signal and call parameters for each network along the survey route, with each network measured almost simultaneously. The results are presented in terms of kilometres of coverage of each network compared to the total kilometres of the drive route. The results were compared to determine the extent of coverage overlap between networks along the drive route.

The drive survey methodology and the survey route are discussed in Chapter Five.

RELATIONSHIP OF DRIVE SURVEYS TO THE LICENCE CONDITION

Coverage in particular areas

ACMA's view of the legal framework requires that, in assessing whether equivalent or better coverage exists, that equivalence must be determined by consideration of the two networks as a whole. Within that assessment, however, there is also a need to examine areas of coverage deficiency that may arise in particular locations.

As a consequence, the results of sub-routes driven along the drive survey routes have been analysed to ensure that the overall assessment does not mask significant Next GTM coverage

¹⁶ Prior to the amendment of the CLC, ACMA had been providing technical advice to the Department on Telstra's proposed closure of the CDMA network. The then Minister for Communications, Information Technology and the Arts had requested ACMA to undertake an audit of the CDMA and Next GTM networks in order to verify the accuracy of Telstra's published coverage maps.

shortfalls in particular locations. This aspect of the assessment is examined in detail in Chapter Six.

CDMA network on 1 June 2007

The carrier licence condition require ACMA, after Telstra's equivalence notification, to compare the coverage of the Next G™ network, to Telstra's CDMA network that was in place at 1 June 2007. Conducting all the drive surveys on this date was not practical and, in any event, the Declaration was made after this date.

In forming a view on the results of the drive survey tests ACMA needs to consider to what extent the CDMA coverage measured during the drive surveys between October and December 2007 is a fair representation of the CDMA network in place at 1 June 2007. ACMA has therefore compared the CDMA coverage measured on the drive surveys with CDMA measurements taken during earlier benchmarking surveys of CDMA. The aim of the comparison was to draw conclusions or inferences from the survey findings about the extent of CDMA coverage as at 1 June 2007.

More detail on this comparison is located in Chapter Six and Attachment 3.

Handset sensitivity testing

The drive survey results provided direct evidence of the area in which each network can successfully enable the connection and maintenance of voice calls using an *appropriate mobile phone used in connection with an external aerial*. This coverage will depend upon not only the propagation of the signal from the base station, but also on the ability of the handset, when used in conjunction with an external aerial, to receive the signal from the base station.

The relevance to this Report of the sensitivity of mobile phone handsets and its relationship to network coverage has already been explained in the legal framework.

The sensitivity of the mobile phone handset will depend upon matters such as:

- the performance of the radiofrequency (RF) amplifier in the phone; and
- for a mobile phone used in connection with a car kit, the gain of the external aerial used;
- for a mobile phone handset used in handheld mode:
 - the performance of the internal aerial; and
 - the manner in which the handset is gripped and the position of the handset in relation to the user's head.

The following equipment was used to assist in ensuring that ACMA's drive surveys provide a valid comparison of network coverage when handsets are used in conjunction with a car-kit:

- identical, commonly-available car-kits with roof-mounted antennas for both networks
- CDMA and Next G™ handsets that were judged to perform well in the network in handheld mode as well as in connection to a car kit antenna.

As the internal antenna of a mobile phone handset is bypassed with the directly coupled external car kit antenna, this removes most of the sensitivity variability between handset models, meaning that ACMA is comparing ‘like with like’ (see Chapter Seven).

However, the limits of the ACMA drive surveys are that they did not collect direct evidence of the respective coverage of CDMA and Next GTM networks using only an appropriate *handheld* mobile phone handset. That is, the drive surveys were conducted with a handset used in connection with an external aerial rather than a handset on its own.

Determining handheld coverage

The carrier licence condition requires ACMA to have regard to coverage of the networks using an appropriate *handheld mobile phone handset*. For practical reasons it was not possible for ACMA to determine coverage equivalence in handheld mode by conducting a field survey similar to the drive survey that established external aerial coverage.

As a general rule one would expect the area in which calls can be connected and maintained using a good external aerial to be larger than for a mobile phone handset used in handheld mode with an internal antenna. Telstra, for example, in producing published coverage maps, derives handheld coverage by assuming a fixed reduction equivalent to 10 dB of signal strength for coverage for handheld mode.

In reality, however, different models of CDMA or Next GTM handset will have different levels of sensitivity and ‘appropriate’ Next GTM handsets overall may be more or less sensitive than ‘appropriate’ CDMA handsets.

Even if the drive survey establishes equivalent or better Next GTM coverage for telephones used in car kit mode, handheld coverage may not be equivalent if ‘appropriate’ Next GTM phones do not achieve the same level of coverage as the least sensitive ‘appropriate’ CDMA phone.

For this report, ACMA has used information from its own field and laboratory trials of mobile phone handsets, as well as examining the results of similar trials conducted by Telstra. It has combined this information with the drive survey results to draw conclusions about the comparative coverage of Next GTM and CDMA mobile phones used in handheld mode. Handset testing is discussed in Chapter Seven.

Telstra’s Coverage Maps

The carrier licence condition requires ACMA to compare the *actual* coverage of CDMA and Next GTM networks. Therefore, mapped coverage alone cannot be used to determine whether or not coverage is equivalent. ACMA understands that mapped coverage is often a conservative prediction of actual coverage. Therefore the extent to which mapped coverage of CDMA and Next GTM is co-extensive may not necessarily be a reliable indication of the overlap of actual coverage (except perhaps over perfectly flat terrain).

While the drive survey covered a substantial number of cells throughout Australia, a survey cannot be expected to provide information on actual coverage at every location in Australia. Notwithstanding the limitations of using maps for direct inference of network equivalence, the maps may be a useful ancillary source of information for examining areas not covered by the drive survey. For example, if the maps indicate a significant area in which CDMA coverage exceeds Next GTM coverage, then this may warrant further investigation.

Chapter Five. Approach to Drive Surveys of Coverage

This chapter provides background information on the drive surveys as well as describing the methodology for the surveys in detail. The chapter also discusses factors that may affect the survey results. The results of the drive surveys are discussed in Chapter Six.

The results from the drive surveys form the main basis on which ACMA has drawn its conclusions on the coverage equivalence of Telstra's CDMA and Next GTM networks for handsets used in connection with an external antenna. The survey routes covered close to 15,000 km across all of Australia's states as well as the Northern Territory. Field measurements of the voice coverage provided by both networks were taken while driving along the pre-determined routes using a vehicle mounted logging system. The surveys of both networks were conducted concurrently throughout October and November 2007. Benchmarking surveys of the CDMA network were conducted in February and June 2007. The surveys were conducted under contract by Zamro International Pty Limited (Zamro). An ACMA engineer was present to accompany and observe all of the drive surveys.

Background to drive surveys

In 2006, before the carrier licence condition was contemplated, the then Minister, through the Department, established a working group to examine key issues relating to the closure of the CDMA network by Telstra. The Working Group was comprised of representatives from ACMA, Telstra and the Department.

As part of the Working Group process, the Minister asked ACMA in 2006 to undertake audits of the existing coverage of Telstra's CDMA and Next GTM network. The audit methodology was discussed in detail by a coverage subgroup of the Working Group, which was convened by officers from the Department and included ACMA and Telstra engineers and senior managers. The original purpose of the audits was to verify Telstra's coverage maps of the CDMA and Next GTM networks for comparison. ACMA's role in preparing the audits was as technical advisor to the Department.

The effect of the September 2007 licence condition was to establish a new process and change the role of ACMA and its responsibilities. Previously, ACMA's role, as requested by the former Minister, was to conduct a survey intended to investigate the veracity of the *mapped* voice coverage of the CDMA and Next GTM networks. ACMA is now responsible for reporting on whether the actual voice coverage of Next GTM network is equivalent to or better than the actual voice coverage of the CDMA network.

ACMA engaged Zamro in December 2006 to conduct the survey of the CDMA and Next GTM networks. Zamro was selected to assist ACMA in the coverage surveys after an open tender process which was conducted in accordance with ACMA's tender guidelines.

The drive survey methodology was discussed at length during Working Group meetings between Telstra, ACMA and the Department. The methodology has also been provided to Telstra for comment. Telstra has advised that it considers the methodology to be "a mostly robust technique"¹⁷.

Overview of the survey process

In order to inform its view on whether the Next GTM network has equivalent or better coverage than the CDMA network, ACMA has undertaken drive surveys to measure the parameters of the two networks.

Drive surveys of CDMA coverage were conducted in February and June 2007 in order to benchmark the coverage provided at those times along selected survey routes. Dual technology surveys of both CDMA and Next GTM coverage began on 15 October 2007 and concluded on 1 December 2007.

The surveys involved measuring coverage along the selected drive routes using an external roof mounted antenna connected to commercially available handsets in a car kit configuration. Logging software was used to record coverage parameters. The Zamro survey team was accompanied by an ACMA engineer, who observed the survey procedure and monitored the results.

Drive Survey Route

The Zamro field survey measurements were made while driving along routes which were set by ACMA.

The drive survey routes were:

- South Eastern Australia: Melbourne – Mildura – Adelaide – Broken Hill – Bourke – Charleville – St George – Parkes – Wagga Wagga – Albury – Melbourne (approximately 5000 km)
- Tasmania (approximately 1800 km)
- Perth – Geraldton – Carnarvan – Dampier – Broome – Halls Creek – Katherine – Tennant Creek – Mt Isa – Longreach – Rockhampton – Mackay (approximately 7850 km).

More details on the exact drive routes are provided in the report from Zamro at Attachment 11 including detailed maps. The total length of routes surveyed was close to 15,000 km. The routes went through approximately 230 cells across the country¹⁸. Telstra estimates that it has nearly 3500 CDMA base stations and over 6000 Next GTM base stations¹⁹.

¹⁷ Email 14 December 2007 from Telstra's Director of Government Relations.

¹⁸ This cell count under-estimates the actual number of cells that the drive route came into contact with, especially in metropolitan and high density areas where there is a large amount of overlap between cell coverage and where cells adjacent to the route were monitored for a short time.

¹⁹ Letters from Telstra to ACMA dated 29 and 30 October 2007 with the subject: *Planned CDMA Network Closure*.

The drive survey routes were chosen because of the diversity of conditions that would be encountered throughout the surveys. The drive survey routes included city and regional areas, but mainly focused on rural, regional and remote areas where Next G™ coverage is likely to be the only mobile network available to consumers. The drive survey routes included a selection of sites in all states and the Northern Territory.

The surveys took into account a range of factors affecting radiowave propagation. The chosen routes covered a range of terrain and vegetation as well as urban, suburban and rural environments. It covered a wide variety of roads, from major and minor highways and connecting roads to isolated dirt tracks. Given both networks operate on adjacent frequencies, ACMA expects that they would have the similar propagation patterns in varying environments.

ACMA's surveys measure coverage in approximately seven percent of the cells in Telstra's CDMA network. In ACMA's view, the sample measured is sufficiently broad and robust to support findings on the network as a whole. The more critical element of the surveys is whether the method chosen stands up to engineering scrutiny. Extreme results in the sample are likely to be as a result of conditions at the particular base station. Factors that will affect the margin of error are discussed at the end of this chapter.

The surveys did not measure in-building coverage as this was beyond the scope of the project.

Details on the drive survey method

Vehicle Set Up

The method used to measure both CDMA and Next G™ coverage was to connect commercially available handsets to identical car kits which utilise roof mounted antennas. The Zamro survey vehicle used an arrangement which allowed two antennae to be roof mounted so that both antennas were in the same radiofrequency environment with similar shadowing, fading and ground plane effects. Zamro used commercially available enclosed coil type whip antennas with a gain of 5 dBi²⁰. The test equipment specifications are included in Attachment 13.

Handsets used in the survey vehicle were set to engineering test mode to exclude acquisition of a GSM signal, allowing only CDMA and Next G™ signals to be monitored by the respective handsets.

Checking and configuration

The handset, antenna and patch lead combination, all of which are commercially available, were tested for integrity and comparability as follows:

²⁰ The gain variation of commercially available antennas normally used for this purpose is approximately 2 dB to 10 dB.

- Basic antenna integrity was tested by making Voltage Standing Wave Ratio measurements and plots in an open, unobstructed area. This test ensured the antennas had no major faults, were tuned to the frequency band of operation and that there was similar performance between the two antennas.
- Three units of each handset model were tested to determine whether the handsets of the same model performed consistently. This was done by combining two phones onto a single antenna and performing drive tests. Phone performance parameters such as received signal level, transmit power and other parameters were tested for equivalence. Once this test was complete, the three phones were known to perform consistently for each technology. This stage of testing ensured the phones had no manufacturing defects or differences in RF performance due to manufacturing tolerances or wear and tear.
- The antenna configuration was tested by performing a drive test with two CDMA (or two Next G™) handsets were each connected to an antenna. As the handsets had been previously tested for consistency, this test ensured that there were no variations in the antenna paths.

These calibration procedures were performed at the start of each survey route and periodically through the survey route to ensure that no equipment degradation had occurred in the field.

In the case of phone or software lockup during survey activities, the test vehicle was immediately stopped and the survey equipment turned off and re-started. Such incidents occurred infrequently during the drive surveys and were mostly attributed to software lockup related to windows-based software.

Handsets

The handsets were connected to a laptop computer running commercially available logging software. The phones that were used were the Kyocera KX5 for the CDMA network and the LG TU500 for the Next G™ network. The Kyocera KX5 is a mid-to-high end phone and is considered to perform well in rural environments. The LG TU500 has a Blue Tick and is recommended by Telstra for rural use.

As it was impractical to test numerous phones on the drive test, ACMA selected phones which:

- were or are popular selling models;
- had an external antenna connector with readily available patch cords;
- were considered to perform well when used in conjunction with a car kit antenna; and
- were compatible with the Invex3G software.

ACMA believes that the choice of handsets used in the drive survey did not impact on the final results of the drive surveys. The antenna used by a handset is the major source of variation in performance. In this instance, both the Kyocera KX5 and the LG TU500 were connected to identical antennas. The variation in receive sensitivity between the handsets chosen, when connected to an external aerial, is small and would not materially affect the result. This was confirmed by the coupled laboratory tests which ACMA conducted. These tests are detailed in Chapter Seven and Attachment 7.

Software

The software used to log and analyse the measurements was the Invex 3G suite, produced by Andrew Corporation. This software allowed off-the-shelf handsets to be connected to car kit antennas and linked to a PC which was running the software.

Recorded Parameters

The software was capable of recording all parameters required for the logging and post analysis of calls while the handsets were in communication with a mobile base station. These parameters included, but were not limited to:

- Received Signal Strength;
- call set-up and hold successes and failures during repeated 90 second call establishment time-frames with 12 second intervals;
- time stamping; and
- geographical location from a GPS.

The Invex 3G software also allowed the CDMA and Next GTM frequency bands to be monitored while the survey vehicle was out of range and in motion. Calls were made automatically while driving along the specified route. Upon call connection, calls were made for 90 seconds and forcibly dropped for 12 seconds, on a continuous basis. Log files were kept of the measured parameters and backed-up each day. The logs were emailed to the Zamro offices in Melbourne each evening for processing and backed-up on a storage device. These logs could be run through the Invex system to simulate a recreation of logged drive testing, or examined in detail to retrieve specific parameters recorded at given times and locations.

Records were kept relating to vegetation cover, terrain and prevailing weather conditions during the drive survey.

Data processing

After the completion of each survey route, Zamro processed the log files and produced a report for ACMA detailing the results of coverage measurements along with statistical information. This information includes:

- measured kilometres of the driven survey route;
- measured kilometres of Next GTM coverage on the driven survey route;
- measured kilometres of CDMA coverage on the driven survey route;
- coverage of each network as a percentage of driven kilometres; and
- the difference in kilometres of coverage along the driven route between the networks.

Zamro provided ACMA with detailed maps of the drive route, showing diagrammatically the level of CDMA and Next GTM coverage along the driven survey route.

In addition to the consultants report, ACMA engineering staff have analysed some of the raw data obtained in the drive surveys. This approach provides transparency and an additional level of confidence in the results outlined in the reports provided by Zamro by comparing actual coverage levels and Telstra's published coverage in selected areas. Attachment 4 contains this analysis.

Factors Potentially Affecting Survey Results

There are several factors that may potentially impact on coverage which have been taken into account in analysing the data from the drive surveys. These factors can be categorised as those that are common to radiofrequency propagation in mobile phone networks and factors that arise due to the drive survey methodology.

FACTORS ATTRIBUTED TO PROPAGATION

Coverage from a mobile phone network is variable and dynamic in time and space. Radio signal propagation is affected by terrain and vegetation cover in the surrounding area, as well as by prevailing weather conditions.

Cell Breathing

The area in which customers can make and receive mobile phone calls depends on reception of a pilot signal from a base station at a sufficiently high level. Other subscribers using the network nearby can affect a caller's ability to connect to the network. The ability to connect relies on an adequate signal-to-noise ratio. Nearby users increase radio noise levels and therefore reduce this ratio. If the noise level causes the signal-to-noise ratio to fall below the minimum required level at the location of a mobile handset user then that user will be unable to establish a call on the network. This effect is known as cell breathing.

An IEEE article²¹ describes cell breathing as follows:

An increase in the number of active users in the cell causes the total interference seen at the receiver to increase. This causes an increase in the required received power for each user, due to the fact that each user has to maintain a certain signal-to-interference ratio at the receiver for satisfactory performance. For a maximum allowable transmit power, an increase in the required received power will result in a decrease in the maximum distance a mobile can be from the base station thereby reducing coverage.

In areas of higher population density where cell coverage areas overlap, calls are normally transferred seamlessly from one base station to another as mobile devices move between coverage areas. If cell breathing or congestion were to occur in such locations it would normally be catered for by overlapping coverage from an adjacent cell. Therefore cell breathing effects are more likely to be apparent to users at the margins of isolated cells.

The effect of cell breathing is **not** linearly related to usage rates. When cell loading varies between low (around 10%) and average or medium levels (between 25% and 75%), cell breathing will cause little variation in the area in which calls can be made. When the cell undergoes higher loading, the area in which calls can be made can reduce more dramatically. Cell breathing would normally be significant only when a cell with only one available voice channel was loaded above 80% of its capacity.

Figure 5.1 shows this non-linear relationship by depicting cell loading as a percentage on the x-axis against maximum path degradation due to cell loading in decibels (dB) on the y-axis.²² It is apparent in Figure 5.1 that path degradation is not significant until the cell is heavily loaded, after which a dramatic increase in path degradation occurs.

²¹ IEEE Transactions on Vehicular Technology, Vol. 48, No. 5, September 1999, The Coverage–Capacity Tradeoff in Cellular CDMA Systems, Venugopal V. Veeravalli, Senior Member, IEEE and Andrew Sendonaris, Member IEEE

²² CDMA Systems Engineering Handbook. Lee, Miller. Artech House Publishers 1998

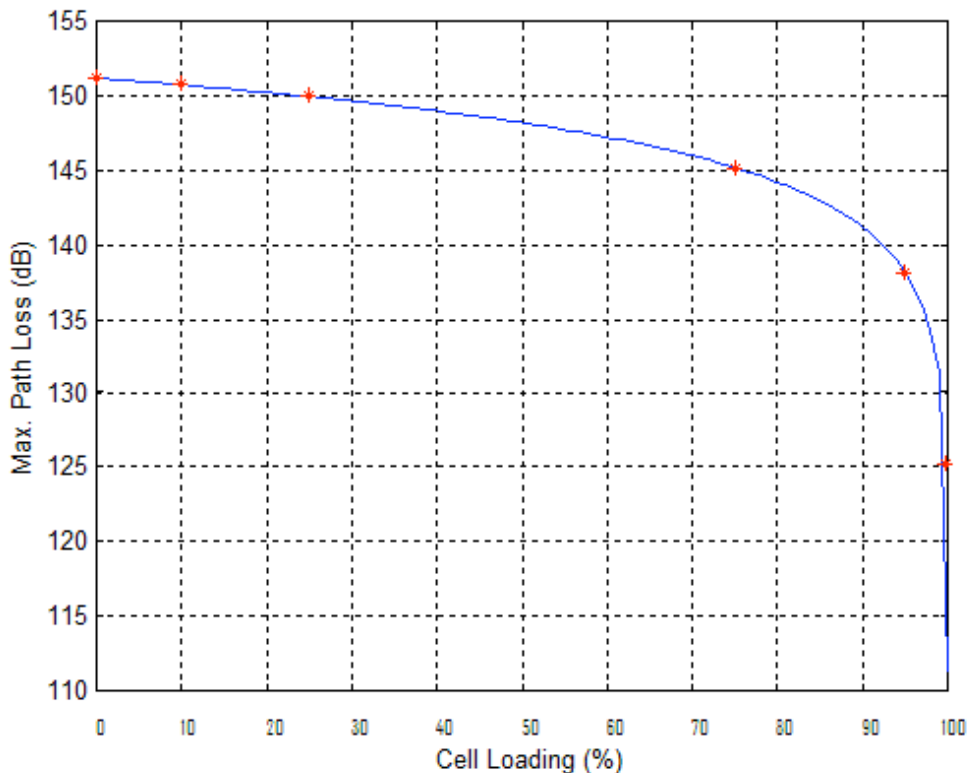


Figure 5.1: Maximum path degradation due to cell loading

To illustrate user experience during cell breathing, selected sample points on the path degradation curve (red crosses in Figure 5.1) have been converted to approximate maximum operational distances from an average cell for a mobile phone user (Figure 5.2).

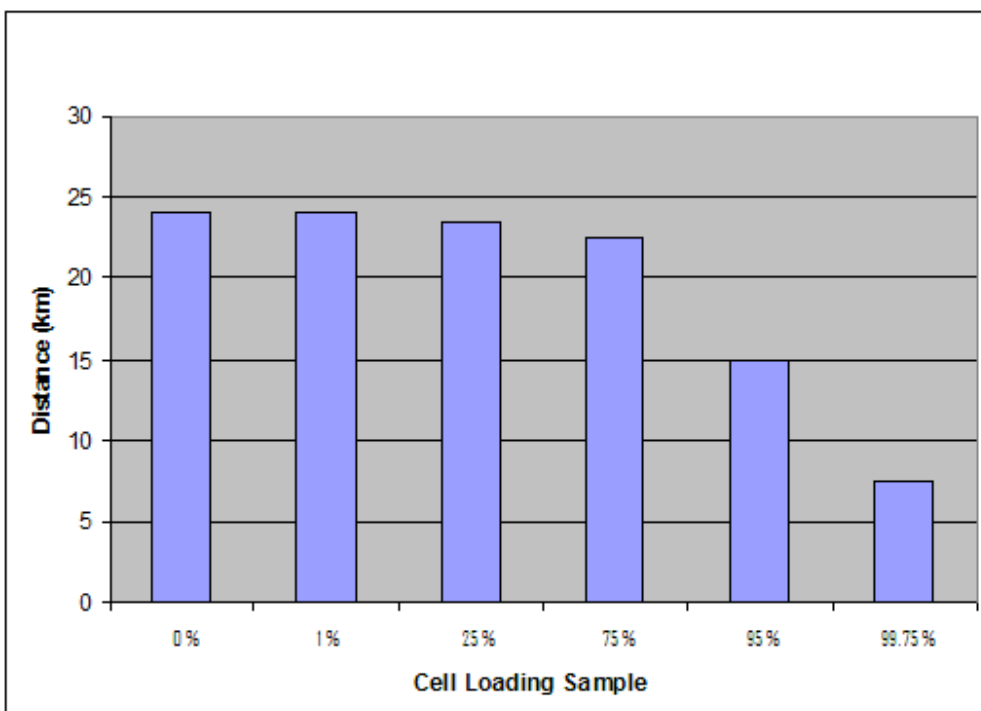


Figure 5.2: Example of operational distance due to cell loading for CDMA

It is apparent from Figure 5.2 that the first four sample points representing cell loading up to 75% make little difference to the distance from the CDMA base station inside which a call can be successfully made. At sample points five, at 95% loading, and six, at 99.75% loading, a dramatic decrease in the maximum operational distance is apparent. This indicates that in a fully loaded and isolated typical CDMA cell at 99.75% capacity with one available channel (which can support many voice calls), the effective operational distance to successfully make phone calls would theoretically be reduced from 24 km to 7.5 km.

Usually cells would not be loaded to the extent where cell breathing is significant, particularly in areas where isolated cells are located and the effects of cell breathing would be apparent.

. If cells have consistently high loading, Telstra has advised that they are upgraded before any capacity limits are reached. However, temporary high cell loading can occur during events such as emergencies or popular sporting events such as a major grand final.

Data use is likely to be more widespread on the Next GTM network than it was on the CDMA network because the CDMA network was only configured for high speed data access at certain locations (capital cities and major regional centres). In contrast, customers using the Next GTM network can potentially access high speed data in every Next GTM cell. However, Telstra has advised ACMA that data use does not affect the likelihood of cell breathing and the instantaneous area around a base station in which calls can be made. This is due to network management techniques such as voice call prioritisation and the cutting of download speeds for data connections when cells become congested.

As detailed in Chapter Three, the definition of coverage in the licence conditions excludes outages due to network congestion. Cell breathing can result only from extreme network congestion. Therefore, any difference between the networks in the areas where customers are able to make calls resulting from cell breathing would not affect ACMA's conclusion on equivalence under the licence condition.

ACMA understands that cell breathing would only be a significant issue under very extreme loading conditions. Telstra has detailed to ACMA its network management techniques which include admission control and congestion control. The result of these techniques is that cell breathing is very unlikely to occur except under very extreme loading conditions.

ACMA's drive surveys measure actual coverage at the time they are conducted. If there were significant cell breathing effects, then they would be incorporated in ACMA's drive survey results and would have become apparent in the analysis of these results. For example, if the Next GTM network did suffer greater cell breathing effects than the CDMA network (at the times and locations of measurement) then it would have become apparent from the results of the drive survey.

Telstra made the following comments on cell breathing in their response to ACMA's draft report (see Attachment 16):

Telstra disagrees with ACMA's assessment of coverage propagation with respect to cell breathing (Chapter 5). Telstra does not accept that "cell breathing" is an issue that will arise to affect coverage in the future. Telstra believes that the 80% loading mentioned on page 22 of the draft report can never be exceeded in a modern WCDMA system. Using a recent article from Qualcomm ("Air Interface Cell Capacity of WCDMA Systems") Telstra concludes that a WCDMA cell will meet other capacity limitations well before

the 80% loading mentioned in the ACMA draft report. Specifically a hard limit exists in the number of spreading codes which occurs at this 80% loading limit.

ACMA does not believe that cell breathing will significantly affect the coverage of the CDMA or Next GTM network, taking into account Telstra's current network management techniques. However, ACMA is not in a position to assess the future loading pattern of Telstra's network. In addition, this is outside the scope of ACMA's report under the carrier licence condition. However the carrier licence condition places an ongoing obligation on Telstra to maintain the Next GTM network at a level that provides coverage equivalence (see subclause 15(4)).

Network congestion and cell outages

Congestion of network cells would be identified through the observation and logging of unsuccessful call attempts. In addition, Telstra keeps records of network congestion, and it is possible to check these records in cases where it is believed congestion may be an issue affecting network coverage.

Vegetation and Terrain

Attenuation of radio signals caused by vegetation can vary according to the type of vegetation as well as its distribution. For instance, reception using a mobile phone can be affected by a single tree depending on the user's position.

Terrain type is not a significant factor in network coverage differences as in the vast majority of cases both CDMA and Next GTM transmitters are co-located, resulting in identical terrain shielding for each network at a given location. While notes on vegetation characteristics were taken by the ACMA engineer on the drive surveys, ACMA expects that vegetation and terrain affects the two networks in the same way as the technologies use adjacent frequency bands.

Weather conditions

Prevailing weather conditions can affect the reception of radio signals. However, under normal weather conditions and for the majority of time, the effect on radio signals in the frequency band of interest is negligible.

Under some weather conditions, such as the presence of low cloud and temperatures of around 25°C, anomalous ducting of radio waves can extend the range of a mobile phone cell by several kilometres over a period of several hours, presenting conditions conducive to sporadic reception. At other times and locations, such as in Northern Australia during the wet season, violent localised storms can attenuate radio signals such that mobile phone reception and microwave radio links used for backhaul are temporarily rendered inoperative.

Given the measurements for CDMA and Next GTM coverage were taken concurrently, the weather conditions would have a similar affect on the networks and therefore allow direct and reliable comparisons.

Effect of diplexers, antenna occlusion and antenna coupling

When installing Next GTM at a base station, the installer may either install new antennas or use existing antennas through the use of low loss diplexers to split and combine the signals from the original CDMA antennas.

In the case of diplexers, once the CDMA system is decommissioned the diplexers should be removed. This would result in a slight increase in the coverage on the Next GTM network.

Where another set of antennas has been installed for Next GTM there may be instances where the new antennas affect the radiation patterns of the older antennas, and vice versa. This can occur through coupling or occlusion. Coupling is where the proximity of an object affects the 'Antenna Q Factor' or radiation pattern of the nearby antenna.

Occlusion is where an object physically blocks the radiation power in a direction which is a straight line from the transmitting antenna to the object and beyond. Telstra has advised that multiple antennas are in place on a significant number of towers and that occlusion effects have been mitigated at many locations by the re-arrangement of antennas. The possibility remains that occlusion effects may still be manifested at some locations by the presence of one antenna for each of the mobile technologies, or by the presence of disused antennas.

If all related tower hardware is removed upon decommissioning of CDMA, any coupling or occlusion to Next GTM antennas that is caused by CDMA equipment should be removed thus improving the radiation of power from that base station. ACMA does not know if Telstra intends to remove old CDMA hardware when the system is decommissioned. After the shutdown of CDMA, the old CDMA antenna could be used for expansion of the Next GTM network. In such a situation, an enhancement of Next GTM coverage can be expected.

In some cases it may not be CDMA antenna equipment that is causing coupling or occlusion. For example, it could be caused by GSM antennas, Telstra's 3G network at 2.1 GHz or another system on the tower. If the equipment that is causing occlusion is still in use then the problem may be difficult to resolve without rearranging antennas on the tower. In some instances this may not be possible due to limited space on the tower.

Interference

At this stage, external RF interference has not been identified during the majority of drive surveys. Examination of the survey logs by Zamro indicate that at one location RF interference from a mobile device may have played a part in anomalous survey results.

ACMA's engineers consider it unlikely that RF interference would affect one network and not the other in the same location due to adjacent frequency bands being utilised by the networks. Therefore ACMA does not expect RF interference to impact on the validity of its result when comparing the CDMA and Next GTM network.

However ACMA is aware that devices such as malfunctioning private television masthead amplifiers and studio transmitter links can cause such problems. If ACMA had discovered RF interference during its coverage survey which was suspected of causing a network coverage problem, ACMA's agreed procedure was to wait at the interference location to see if the interference persisted. ACMA has examined records of interference complaints lodged with ACMA. No interference reports for CDMA or Next GTM were co-extant with the times and locations of the drive surveys in those locations where Next GTM coverage anomalies were recorded. Therefore, there is no evidence that apparent coverage deficiencies were caused by interference to the networks.

Frequency Selective Fading

Frequency selective radio fading is possible, however, this has not been a noticeable problem during the drive surveys. If frequency selective fading is present it would likely affect both the CDMA and Next GTM networks as they operate on adjacent frequency bands.

ANALYSIS OF MEASUREMENT UNCERTAINTIES

Measurement of Radio Frequency (RF) field strengths in the field is subject to numerous uncertainties. RF propagation is dependant on frequency, terrain, weather, buildings and vegetation. As a wave front propagates it bends around and is reflected and diffracted from all of these objects. It also diffracts over the curve of the Earth. These effects are temporal and can result in rapid large changes in the received signal strength. Since the effects are frequency dependant it can be expected that signals from both the Next GTM and CDMA networks would behave in an identical manner averaged over time. Frequency is therefore not a source of uncertainty in this case.

Vegetation changes over time and the affects of vegetation on radio propagation therefore vary. For example, there will be greater signal loss in summer when vegetation is fully developed compared with early spring. In the Northern parts of Australia the same cycle is observed in the wet/dry season cycle. Depending on the position and height of vegetation, losses can vary by up to 15 dB. Even changes in crops such as sugarcane over the year can cause large seasonal differences. A difference of about 5 dB (which equates to about 5% in cell radius) would not be unexpected. Therefore, vegetation is not a source of uncertainty in this case.

Finally other uncertainties, such as Rayleigh Fading and GPS errors, would average over a statistically large sample and as such can be ignored²³. Rounding errors in software would result in anomalous areas of coverage (or no coverage) when the shape of the overall plot was similar or identical. These errors may also be ignored.

Given that ACMA measurements were made over a number of months, and that Next GTM was taking up customers from CDMA during this period, a slight expansion in the coverage of CDMA since the initial survey could be expected. This change is not an indication that CDMA is outperforming Next GTM or that it is improving with time. It is simply indicative of changes in vegetation and the change in loading of CDMA and can therefore be ignored.

UNCERTAINTY FACTORS ATTRIBUTED TO THE SURVEY METHOD

Idle Mode Acquisition time

An issue in measuring Next GTM coverage is the issue of latency or hysteresis in acquiring signals while travelling toward an isolated Next GTM cell from a location which has no coverage. The latency issue arises from the operation of the handset, which scans through

²³ Rayleigh Fading distribution is commonly used to describe the statistical time varying nature of the received envelope of a flat fading signal. A variation over time in received signal level can be expected in a mobile radio channel. (*ref.* Wireless Communications, Rappaport, Prentice Hall. 1999). GPS errors in specifying precise locations along drive routes have been defined by Zamro as up to 30 metres. These errors are related to the degree of conformance between the estimated or measured position, time, and/or velocity of a GPS receiver as compared with a constant standard. ACMA discounts errors in position of up to 1 km due to Idle Mode Acquisition. An error of 30 metres falls within this range.

the available channels looking for a connection when out of range, which takes a certain amount of time. Next GTM handsets automatically revert to ‘sleep mode’ in isolated areas outside coverage range in order to conserve battery power. CDMA phones can also take some time to acquire a signal, however, usually not as much time as Next GTM phones.

When in sleep mode, the Next GTM handset that was used for the coverage survey could take up to 30 seconds longer to acquire an available signal than the CDMA phone that was used. If the vehicle is travelling toward the isolated cell at 100 km per hour, this will result in a difference of up to approximately 800 metres in the location between acquisition of signals by CDMA and Next GTM handsets.

As a further check of the idle mode network acquisition mechanism, ACMA has observed that when the test vehicle was stopped at the location where CDMA coverage was acquired at the edge of an isolated cell, after waiting for up to 30 seconds a Next GTM signal was normally acquired at that location, unless a network problem exists such as antenna shadowing at the local base station. The effect of this mechanism is that a person who lives in an area outside of cell coverage may have noticed a location where a CDMA call can be initiated while travelling toward the local Telstra base station, and now observes that a Next GTM call cannot be initiated until a further distance has been travelled.

The difference in idle mode acquisition time between the two networks may cause Next GTM measured coverage to be under-stated. To take into account idle mode acquisition, the estimated 800 metre margin needs to be considered for Next GTM coverage when driving **into** a cell coverage area. This is consistent with the definition of coverage in the carrier licence condition as customers are “ordinarily able to make and receive calls” in these areas. ACMA has not adjusted the drive survey figures to take this into account and so it needs to be factored into interpretations of the results.

Non-Synchronisation of calls during the survey

During the drive surveys, call duration was set to 90 seconds, with downtime between calls of 12 seconds. As the calls made on each network are not synchronised (that is the CDMA phone and Next GTM phones do not attempt to make a call at the same time), the maximum call drop uncertainty when leaving an isolated coverage area over the total 12 seconds downtime with a vehicle travelling at 100 km per hour is around 300 metres. The locations where the calls are initiated and dropped at the beginning and end of a 90 second call duration period could be identified by examination of the log files created by the Invex 3G software. In addition the maximum call drop uncertainty could be factored into any determination of individual cell equivalence. It is expected that over a statistical sample of a large number of cells, this call drop uncertainty would be significantly reduced.

To take into account non-synchronisation, a 300 metre margin needs to be considered for the figures for coverage when driving **out of** a cell coverage area. This allows for the maximum of a 12 second difference between CDMA and Next GTM call attempts. Synchronisation would affect measurement figures for both networks so in affect it creates a margin of error of approximately ± 300 metres when driving out of a cell.

CDMA uplink limited

In a radio link, the downlink is the radio path between the base station and mobile phone handset, while the uplink is the radio path between the mobile and base station.

It has been observed that the CDMA network may be ‘uplink limited’ to the extent that a successful call can be made and the network connection held, however the uplink voice quality at the extreme margin of coverage can be substandard or non-existent. The result is acceptable voice reception only in the downlink at these marginal locations, which may shift over time. This outcome has been observed during ACMA’s handset testing activities where the mobile phone caller can hear the other caller but could not be heard themselves. Next G™ technology is currently balanced and so “one sided conversations” currently should not occur.

During ACMA’s drive surveys, calls were initiated and held, while being connected to a fixed line answering machine. Consequently, a measure of voice quality could not be ascertained during drive surveys. For this reason, the CDMA coverage figures from the drive surveys may include areas where one side of the conversation could not be heard. [REDACTED]

The implication of uplink limited CDMA phones is that the drive survey results may slightly overestimate CDMA coverage. This would only occur on the edges of coverage and for isolated cells. ACMA has not adjusted the drive survey figures to take this into account and so it needs to be factored into results which showed that CDMA coverage is greater than Next G™ coverage.

Chapter Six. Analysis of Drive Survey Results

This chapter provides the results and analysis of ACMA's drive surveys. The findings arising from the drive survey, together with the findings on handset sensitivity, to be discussed in Chapter Seven, will form the main basis for ACMA's conclusions on equivalence of coverage. The drive survey methodology was described in detail in the previous chapter. Details of the engineering analysis related to survey results can be found in Attachment 4.

As discussed in Chapter Three, ACMA must have regard to both handheld mobile phones and mobile phones used in connection with an external aerial when considering whether coverage is equivalent. The results in this chapter relate to mobile phones used with an external aerial. Chapter Seven discusses the survey results in relation to handheld mobile phones.

The overall results from the survey are described in the following box.

Finding 6.1:

Measured coverage using an external aerial for the Next GTM network totalled across the drive route exceeded CDMA coverage by 202 km or 1.36%.

The Next GTM network provided external aerial coverage for 79.09% or 11832 km of the drive route.

The CDMA network provided external aerial coverage for 77.73% or 11630 km of the drive route.

The total drive route was close to 15,000 km.

These overall figures have been broken down into the three drive routes. The drive survey routes are set out in Chapter Five.

The recorded coverage figures for the three drive routes are shown in the following table.

Table 6.1: CDMA and Next GTM coverage comparisons for drive survey routes

	Total route	Difference	Next G TM coverage	CDMA coverage
South Eastern	5261 km	1 km (0.02%)	4896 km (93.07%)	4895 km (93.05%)
Tasmania	1919 km	33 km (1.73%)	1842 km (96.03%)	1809 km (94.3%)
Perth to Mackay	7780 km	168 km (2.15%)	5093 km (65.47%)	4926 km (63.32%)
Total	14,959 km	202 km (1.36%)	11832 km (79.09%)	11630 (77.73%)

The figures indicate that the area of coverage between the Next GTM and CDMA coverage along the South Eastern route is virtually the same.

The Tasmania and the Perth to Mackay routes showed a larger difference between the total measured Next GTM and CDMA coverage with both these routes having a slightly larger length of Next GTM coverage than CDMA coverage.

Finding 6.2: Combined, the drive routes indicate a slightly larger area of coverage, when using an external aerial, in Next GTM as compared with CDMA.

These results understate Next GTM coverage as they do not take into account effects such as idle mode acquisition, synchronicity or uplink limiting that are discussed at the end of Chapter Five. If these factors were incorporated into these results then the Next GTM coverage figures would be improved compared to CDMA. Another matter that is not considered in the results above is the extent to which CDMA measured during the dual technology drive surveys varies from the CDMA coverage as at 1 June 2007.

CDMA network on 1 June 2007

The carrier licence condition require ACMA to compare the coverage of the Next GTM network to Telstra's CDMA network that was in place at 1 June 2007. Conducting all the drive surveys on this date would clearly have been impractical. Prior to the dual technology drive surveys, ACMA conducted benchmarking drive surveys of the CDMA network in February 2007 across the South Eastern route and in June on the Perth to Mackay route. It did not undertake a benchmarking drive along the Tasmanian route.

ACMA has compared the CDMA coverage in these benchmarking drive surveys with the CDMA coverage from the dual technology drive surveys. These comparisons show that CDMA coverage during the October–November drive surveys was within approximately $\pm 1\%$ of the earlier benchmarking surveys. Particularly as one of the benchmarking surveys was conducted in June, the dual technology drive surveys should provide a reasonably accurate guide to the coverage of the CDMA network as at 1 June 2007.

Detail on the benchmarking is contained in Attachment 3.

Finding 6.3: The dual technology drive surveys provide a reasonably accurate guide to the coverage, when using an external aerial, of the CDMA network as at 1 June 2007.

Sub routes

The figures discussed above present a comparison of overall coverage of the networks across Australia. There may be areas along the drive routes that only have CDMA coverage. These discrepancies would not show up in the total figures if there are also areas where there is only Next GTM coverage. This is likely to be the case given that Telstra has claimed to have rolled out over 6000 Next GTM base stations compared with less than 3500 CDMA base stations²⁴.

As discussed in Chapter Four, in ACMA's view, the carrier licence condition requires coverage of the CDMA and Next GTM networks to be virtually the same in order for ACMA to find equivalence of coverage. Therefore, it is not appropriate to "offset" areas that have Next GTM coverage only against areas that only have CDMA coverage. In other words, areas of Next GTM coverage need to be virtually the same as areas of CDMA coverage.

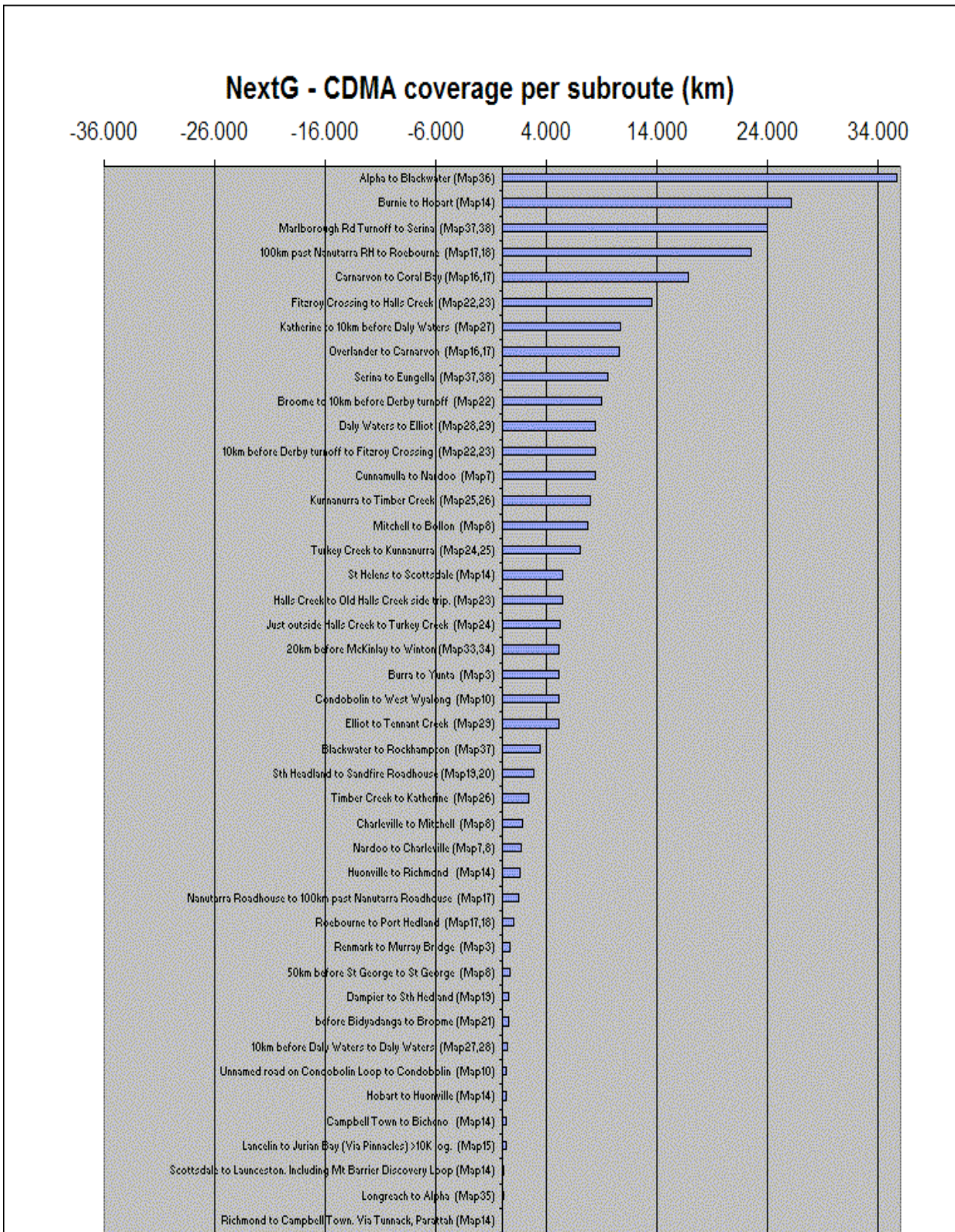
To determine whether the networks are virtually the same, it is essential to examine more disaggregated results to gain an understanding of coverage on a location by location basis. To this end, the three drive routes were divided into sub routes of approximately 150 to 250 km. These sub routes will show any individual areas where measured CDMA coverage exceeds Next GTM coverage.

Of course, it is theoretically possible that any aggregation of the measurements (for example, into sub-routes as small as 150 to 250 km) could conceal significant discrepancies in coverage, such that ACMA was inadvertently 'offsetting' a large area of Next GTM only availability against a similar sized area of CDMA only availability. To ensure that this has not occurred, the maps of the drive survey results have been examined in detail. It was found that all locations where CDMA coverage exceeds Next GTM by more than 3 km have been identified by the sub route examination. Six additional locations were found that exhibited discrepancies that were 1.5 km or smaller. As discussed below, ACMA considers these discrepancies to be immaterial particularly as they are on approach to isolated cells where idle mode acquisition comes into play. No other Next GTM coverage deficiencies were identified from the examination of the drive survey maps. Any further discrepancies that exist would be less than 0.7 km and do not appear on the maps.

Once divided, the complete set of drive routes produced 91 sub routes. The majority of these sub routes recorded coverage that was almost the same for the CDMA and Next GTM networks. These sub routes are shown in figure 6.1 below.

²⁴ Letters from Telstra to customers dated 29 October and 30 October 2007, Subject: Planned CDMA Network Closure.

Figure 6.1: The difference between Next G™ and CDMA coverage per sub route (km)



	Richmond to Campbell Town. Via Tunnack, Paratook (Map14)					
	Yunta to Broken Hill (Map4)					
	Wagga Wagga to Myrtleford (Map11)					
	Melbourne to BP Servo on Western Hwy (Map1)					
	BP Servo on Western Hwy to Trawalla (Map1)					
	Trawalla to Horsham (Map1)					
	Horsham to Lascelles (Map2)					
	Lascelles to Mildura (Map2)					
	Mildura to Renmark (Map2)					
	Murray Bridge to Adelaide (Map3)					
	Adelaide to Eurra (Map3)					
	Broken Hill to Wilcannia (Map5)					
	Wilcannia to Tilpa (Map6)					
	Bollon to Runnymede Rd (Map8)					
	St George to 30km before Moree (Map3)					
	30km before Moree to Moree (Map3)					
	Moree to Coonabarabran (Map3)					
	West Wyalong to 10km past West Wyalong (Map11)					
	10km past West Wyalong to Wagga Wagga (Map11)					
	Myrtleford to Mansfield (Map11,12)					
	Bicheno to St Helens (Map14)					
	Launceston to Devonport via Devonport Airport (Map14)					
	Hobart to Campbell Town (Map14)					
	Campbell Town to Devonport Airport (Map14)					
	Perth to Landelin (Map15)					
	Jurien Bay to Geraldton (Map15)					
	Halls Creek to just outside Halls Creek (Map24)					
	Mt Isa to Cloncurry (Map32)					
	Cloncurry to 20km before McKinlay (Map32,33)					
	Winton to Longreach (Map34)					
	Rockhampton to Marlborough Rd Turnoff (Map37)					
	Eungella to Mackay (Map38)					
	Camoowal to Mt Isa (Map31,32)					
	Tomingley to Parkes (Map10)					
	Bourke to QLD Border (Map7)					
	Runnymede Rd to 50km before St George (Map8)					
	Parkes to 5km past Condobolin (Map10)					
	Geraldton to Kalbarri (Map16)					
	Mansfield to Melbourne (Map12)					
	Devonport to Burnie (Map14)					
	Coonabarabran to Tomingley (Map10)					
	Kalbarri to Overlander (Map16)					
	5km past Condobolin to unnamed road on Condobolin loop (Map11)					
	Barkley Homestead to Camoowal (Map31,32)					
	Tilpa to Bourke (Map6)					
	Coral Bay to Nanutarra Roadhouse (Map14)					
	Sandfire Roadhouse to before Biggsidings (Map21,22)					
	Tennant Creek to Barkley Homestead (Map31)					
	QLD Border to Winnamilla (Map7)					

Source: Zamro, Next G™ vs CDMA Coverage Report (December 2007), Overall report, page 15.

The sub routes are ordered by the difference between measured Next GTM coverage and CDMA coverage. The sub routes starting from the top are where Next GTM coverage is greater than CDMA coverage. These are represented by the positive distances. The sub routes commencing from the bottom are where measured CDMA coverage is greater than Next GTM. These deficiencies in Next GTM coverage are represented by the negative distances.

One third of the sub routes recorded Next GTM coverage that exceeded CDMA coverage by about one kilometre or more. Only nine sub routes recorded CDMA coverage that exceeded Next GTM by about one kilometre or more. These sub routes are discussed below. They have also been analysed by Telstra and their assessment is contained in Attachments 5 and 19.

ACMA considers that Next GTM coverage deficiencies less than three kilometres can be discounted for the following reasons:

- Idle Mode Acquisition (see Chapter Five): during the approach to an isolated Next GTM cell, the idle mode acquisition issue dictates that a distance of around 800 metres could be travelled before network acquisition²⁵. A stationary user would acquire the network within 30 seconds of switching on the handset. ACMA considers this to fall within the definition of coverage.
- As discussed in Chapter Five, non-synchronisation of calls during the survey can result in a discrepancy in coverage of approximately 300 metres.
- Chapter Five also describes how uplink limiting will result in the survey slightly overestimating CDMA coverage.
- A variation in received signal level can be experienced at any time due to atmospheric and other effects, at the extreme margin of a cell coverage area and this could vary the location of successful network acquisition.

Finding 6.4: Any Next GTM coverage discrepancy in the drive survey under three kilometres is unlikely to be the result of deficient coverage. In any event, given the small number and size of discrepancies under 3 km, ACMA considers them to be immaterial.

ANALYSIS OF SUB ROUTES WHERE NEXT GTM COVERAGE DEFICIENCY EXCEEDS THREE KILOMETRES

As discussed above, Figure 6.1 shows that measured CDMA and Next GTM coverage is the same for the majority of sub routes. Of interest for the purposes of this report are the sub routes where CDMA coverage is greater than Next GTM. There are seven in this category. However, ACMA believes that two of these discrepancies are the result of equipment problems during the drive surveys. These problems are described in more detail in Attachment 5.1. That leaves five sub routes with discrepancies that total approximately 43 km. The following table is derived from table 6.1 above. It shows these five sub routes where CDMA coverage is greater than Next GTM. These sub routes are discussed below starting with the Cunnamulla route which recorded the largest discrepancy.

²⁵ At 100 km/h

Table 6.2 Sub routes where measured CDMA coverage exceeds Next GTM coverage by over 3 km

#	Sub route	Next G TM - CDMA Coverage (km) ²⁶
30	5 km past Condobolin to unnamed road on Condobolin loop (map 10)	-3
79	Barkley Homestead to Camooweal (Map30,31)	-5
14	Tilpa to Bourke (Map6)	-5
57	Coral Bay to Nanutarra Roadhouse (Map18)	-10
16	QLD Border to Cunnamulla (Map7)	-20
	Total	-43

Source: Zamro, Next GTM vs CDMA Coverage Report (December 2007), Overall report, page 15.

Sub route 16: Cunnamulla

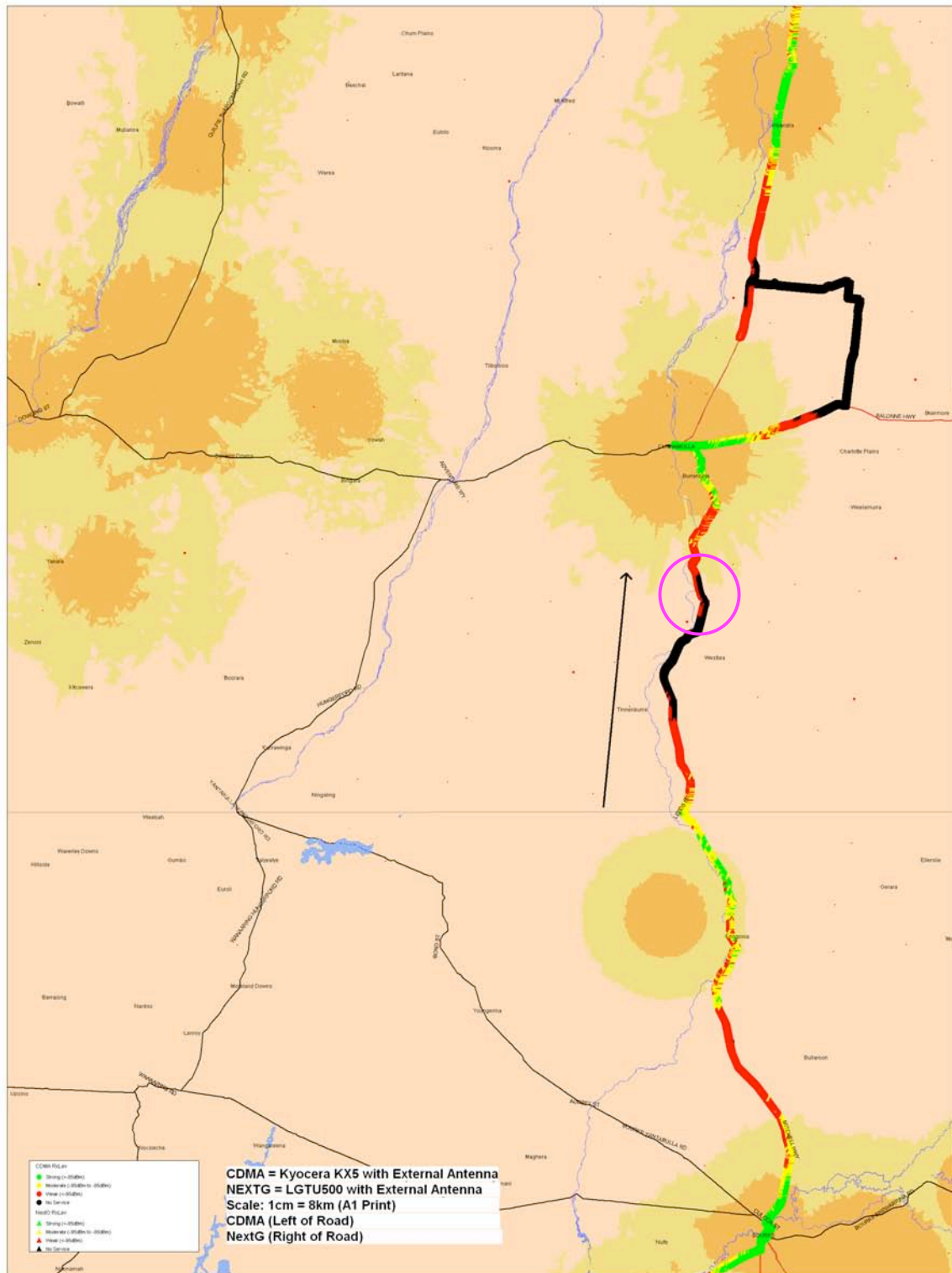
There was a 20 kilometre stretch in this sub route where CDMA coverage was measured but Next GTM coverage was not. This is the largest discrepancy that was found on ACMA's drive surveys. This deficiency is circled in pink on the following map just south of the Cunnamulla base station²⁷ in inland southern Queensland. CDMA is shown on the left hand side of the road, Next GTM on the right. Red, yellow and green show areas where the signal strength from the base station is of sufficient strength to enable voice calls using a mobile phone used in connection with an external aerial. Black shows areas where the signal is not of sufficient strength. The orange and yellow areas on the diagram illustrate Telstra's published prediction maps for CDMA coverage. They assist in determining the location of base stations. The inner, smaller orange areas represent handheld coverage. The outer, larger yellow areas show coverage when using an external antenna.

²⁶ These numbers have been rounded to one significant figure.

²⁷ Driving North and East out of the Cunnamulla cell shows a small amount of the road where Next GTM has greater coverage than CDMA. The log files show that the CDMA coverage driving into the next cell to the north is actually quite patchy and therefore is not "of sufficient strength to enable the connection and maintenance of voice calls" (see section 15(7)(a) of the carrier licence condition).

Figure 6.2:

Map 7: Telstra CDMA vs NEXTG Coverage - Bourke to Wyandra (Oct 2007)



Source: Zamro, Next GTM vs CDMA Coverage Report (December 2007), Overall report, page 25.

Measurements were taken in three locations at the edge of the Cunnamulla cell. The map in Figure 6.2 shows that the coverage discrepancy was only measured to the south of the cell. It was not measured to the north and east. The logged result indicated marginally greater Next GTM coverage than CDMA to the east and north of Cunnamulla, confirming the measurements showing that there was a Next GTM coverage problem to the south of Cunnamulla at the time of measurement. Therefore the potential problem appears to be limited to the southern direction rather than around the entire cell. A similar coverage deficiency on the Next GTM network in relation to CDMA was noted by ACMA during the benchmarking survey of CDMA coverage in February 2007²⁸.

Zamro's consultant engineer suspected that there may have been a problem with the antenna arrangement on the base station tower at Cunnamulla possibly resulting in an occlusion effect. It appears that the problem may not be intermittent as it was measured in February and October of 2007.

In December 2007 Telstra was notified of the measured coverage deficiency and dispatched its own survey vehicle to investigate. As a result Telstra provided ACMA with a report on its findings, an extract of which is included below:

Telstra acknowledges that in February of this year the Cunnamulla site had a problem with an occluded antenna on the Next GTM system. This was discovered during the network equivalence work performed by Telstra in April. At that time changes were done that improved the performance of the site. Further improvement was performed in September and a final drive test showed that network equivalence had been met at that time.

The full report from Telstra can be found in Attachment 5.

This indicated that Telstra was aware of a coverage problem in the Cunnamulla area which existed earlier in 2007, but that it considered the problem resolved prior to October 2007.

Based on the evidence available, ACMA believes that the apparent coverage deficiency to the south of Cunnamulla is due to antenna occlusion. ACMA has analysed the log files for this location and believes that the extent of the coverage deficiency may have been overstated in the drive survey. The files show that for part of the discrepancy area the test calls made using CDMA equipment were dropped prematurely. Therefore the CDMA signal would not appear to be of 'sufficient strength to enable the connection and maintenance of voice calls' (clause 15(7)(a) of the carrier licence condition). If the area in which calls were not maintained on the CDMA network is taken into account, then only 6 km of Next GTM coverage deficiency exists. This is further reduced when the effects of idle mode acquisition and uplink limiting are taken into account.

Nevertheless, Telstra agree that this area should be the subject of further investigation.

Sub route 57 Coral Bay to Nanutarra Roadhouse

Analysis of the log files for this location again reveals that whilst the CDMA phone attempted to place calls, all of these call attempts failed in the majority of the area of the apparent deficiency. Therefore the signal would not appear to be of 'sufficient strength to

²⁸ At that time the Next GTM survey software was concurrently undergoing trials in the Zamro survey vehicle and so Next GTM measurement were taken. However the logged results are not available for detailed comparison due to their trial nature and because they were recorded prior to the 15 October 2007 which was the date that Telstra declared that the coverage of their Next GTM network was equivalent to their CDMA network. See Attachment two.

enable the connection and maintenance of voice calls'. In addition, due to the weather conditions, the coverage of the CDMA network in this area can be considered sporadic at the time of measurement. Once failed call attempts are taken into account the area of apparent deficiency is less than 1 km.

Sub route 14 Tilpa to Bourke

Again an examination of the log files reveal that the CDMA calls were not maintained in the area of apparent coverage discrepancy. Once this is taken into account the area of deficiency is reduced to less than 3 km. However, Telstra believe that a coverage discrepancy does not exist in this location.

Sub route 79 Barkley Homestead to Camooweal and

Sub route 30 5 km past Condobolin to unnamed road on Condobolin loop

The measured Next GTM coverage deficiencies on these sub-routes in relation to CDMA coverage is approximately 5 and 3 km. These measurements would be smaller when the effects of idle mode acquisition and uplink limiting are taken into account.

ACMA considers that they are most likely to have resulted from antenna occlusion effects at the local base stations. Other less likely causes include handset malfunction, external RF interference and selective fading. Maps of these sub routes are contained in Attachment 11.

Telstra is developing solutions for these deficiencies and warrant that they will be implemented before 28 January 2008.

Conclusions on Next GTM coverage discrepancies greater than three kilometres

When dropped calls are taken into account, only the following four areas remain where CDMA coverage is greater than Next GTM coverage:

- Sub route 16 Cunnamulla (6 km)
- Sub route 14 Tilpa to Bourke (3 km)
- Sub route 79 Barkley Homestead to Camooweal (5 km)
- Sub route 30 5km past Condobolin to unnamed road on Condobolin loop (3 km).

ACMA considers that these discrepancies are most likely due to antenna occlusion. Telstra is investigating solutions to most of these discrepancies.

The carrier licence condition requires ACMA to consider whether the Next GTM network is providing coverage that is *equivalent to or better* than the coverage provided by Telstra's CDMA network. As discussed in Chapter Three, ACMA has taken the view that this means that coverage by the Next GTM network is to be *virtually the same* as that provided by the CDMA network. It is relevant to keep in mind that the carrier licence condition does not require coverage to be identical. This implies that network coverage may still be 'virtually the same' despite some very minor Next GTM coverage deficiencies.

ACMA considers the four areas of coverage deficiency revealed by the drive survey to be very small when compared with the enormous areas of coextensive coverage traversed during the drives. They represented isolated exceptions to a general picture of coextensive coverage areas. The effects of uplink limiting and idle mode acquisition mean that ACMA's drive survey methodology has overstated the actual coverage deficiencies in these locations, which will be smaller than the figures suggest. Accordingly, ACMA concludes that network

coverage as sampled during the surveys is ‘virtually the same’ notwithstanding the deficiencies.

Given judgement is required when determining what coverage constitutes ‘virtually the same’, the Authority notes that reasonable minds may differ on the materiality of a given coverage deficiency.

Deficiencies were discovered in four of the 230 cells which ACMA surveyed or approximately 17 kilometres in a 15,000 km survey. As the drive survey was only a sample, the presence of the deficiencies in the drive survey results indicate that there are likely to be similar minor deficiencies in the coverage of other parts of the Next GTM network.

Finding 6.5: ACMA has identified four areas from the drive surveys where coverage of CDMA exceeds actual coverage of Next GTM. The discrepancies in coverage are most likely caused by antenna occlusion.

Antenna occlusions in mobile phone networks will result in very small areas where there is CDMA coverage but no Next GTM coverage. However, they are only in one direction and will not exist around the entire cell.

The drive survey found a total of approximately 17 km of coverage discrepancy in favour of CDMA, most probably resulting from antenna occlusion, in a total drive survey of approximately 15,000 km. This amounts to approximately 0.1%.

Overall conclusion on coverage with an external antenna

Measured coverage with an external aerial for the Next GTM network (totalled across the three survey routes) exceeded CDMA coverage by 202 km or 1.36%. This was across a total drive route of close to 15,000 km.

In ACMA’s view, the results of the drive survey are likely to be representative of the performance of the entire network, that is, coverage will be broadly very similar, though with small areas typically at the margins of coverage where either Next GTM is available where CDMA was not (at the relevant date) or where CDMA was available at the relevant date but Next GTM is not. Moreover, the areas where Next GTM is available where CDMA was not are likely to be greater overall than areas where CDMA coverage was present but Next GTM is not. This is because:

- the technical characteristics of the two networks are similar. In radiofrequency terms, the frequencies that the networks use are effectively identical. The radiofrequency modulation of the networks is nearly identical. In regional areas, the antenna towers and transmitted power levels are as close as practical.
- there is no evidence that there are locations where there are CDMA base stations deployed but no corresponding Next GTM base station. There is however evidence that there are substantially more Next GTM base stations than there are CDMA base stations. Telstra estimates that it has nearly 3500 CDMA base stations and over 6000

Next GTM base stations²⁹. Telstra claim that “Next GTM technology has been added to all CDMA and 2GSM sites, as well as nearly one thousand new sites since launch”³⁰.

- ACMA’s drive survey sample was large. ACMA’s surveys covered approximately 15,000 km and travelled through approximately 7% of the CDMA cells. As discussed in Chapter Five, the survey covered areas with a range of different characteristics which may affect RF propagation. Any systematic lack of equivalence would be expected to become evident on such a large sampling of the cells in the networks.
- Telstra were not aware of ACMA’s drive survey route³¹ and so were not in a position to influence the test results.
- The results for the three drive survey routes are consistent. They range from approximately 0 to 2% difference in CDMA and Next GTM coverage.
- ACMA engineers have used the survey results to predict coverage around selected isolated cells. Within the limitations of the modelling software, this analysis suggests that the survey results are a reasonable indicator of whole of cell coverage.

Finding 6.6: The results of the drive survey indicate that the actual coverage of the networks is very similar or identical in respect to the area that a signal emitted from a base station covers as it is propagated around the base station when a handset is used in connection with an external aerial.

Coverage of handsets used in conjunction with an external antenna is likely to be very similar or identical as between Next GTM coverage and CDMA coverage as at 1 June 2007.

There are likely to be very small areas (typically at the margins of coverage) where either Next GTM is available where CDMA was not (at 1 June 2007) or where CDMA was available (at 1 June 2007) but Next GTM is not. The areas in which Next GTM is available where CDMA was not are likely to be significantly greater overall than areas where CDMA coverage was present but Next GTM is not.

²⁹ Letters from Telstra to ACMA dated 29 and 30 October 2007 with the subject: *Planned CDMA Network Closure*.

³⁰ See page 2 of Attachment 16.

³¹ Telstra is likely to have received some general indications of some of the routes, notably from an indicative map of the proposed South Eastern Australian drive survey that was published as part of ACMA’s RFT (Request for Tender) process. However, details of final routes were confidential and, in any event, were substantially different from the published indicative maps.

Chapter Seven. Mobile phone handsets and their effect on coverage

As discussed in Chapter Three, one of the coverage issues that gave rise to the need for the carrier licence condition was identified by Telstra as arising from the handsets and equipment used by customers.

This chapter considers coverage for mobile phone handsets used in the handheld mode. In order to do this it was necessary to consider the ability of the handset to receive the signal from the base station. This is referred to as handset sensitivity.

In order to form a view on whether Next GTM and CDMA coverage for handheld mobile phones is equivalent, it is necessary to investigate the range of handset sensitivity levels for CDMA and Next GTM handsets. Taking account of the strength of the respective network signals from base stations, it is then possible to draw conclusions about the respective coverage areas of the networks using the various appropriate handsets in handheld mode. If the coverage that is able to be achieved with **any** appropriate Next GTM handset is significantly less than the least sensitive CDMA phone, then having regard to subclause 15(7)(ii) of the carrier licence condition, it is the view of ACMA that this would tend to suggest that the coverage of the Next GTM network is not equivalent to the CDMA network for users of handheld mobile phone handsets.

The draft ACMA Report and Telstra's response

In its draft of this Report, provided to Telstra on 24 December last year, ACMA considered several sources of evidence about the range of sensitivities for CDMA and Next GTM phones, and the effect of these differences in sensitivity in the coverage of the two networks.

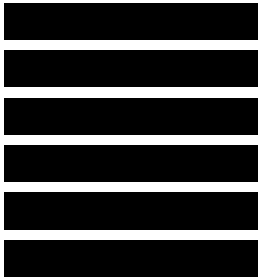
ACMA concluded on the available evidence that among Next GTM handsets there was a larger range of sensitivity than among the range of CDMA handsets. ACMA also found that some Next GTM handsets are below the expected level of sensitivity for CDMA handsets, while others are above that level (Finding 7.1 of the draft Report).

The draft Report went on to consider the impact of this finding on ACMA's assessment of whether there is equivalence of coverage. At Finding 7.2 of its draft report, it was concluded that the choice of handset would not affect equivalence of coverage conclusions when having regard to subclause 15(7)(iii) "appropriate mobile phone used in connection with an external aerial".

Turning to the assessment of equivalence of coverage having regard to handsets in handheld mode, ACMA sought to draw conclusions both about the coverage that would be achieved

using the least sensitive CDMA handset and whether any of the Next GTM handsets in use were or were not able to match this coverage in the field. It concluded:

Finding 7.3: After examining the evidence available, ACMA considers that handsets with an ‘operational sensitivity relative performance’ of -86 dBm or less as outlined in table 7.1 from Telstra’s sensitivity testing will provide less coverage than the predicted coverage of the least sensitive CDMA handset. This list includes but may not be limited to the following handsets:



ACMA then sought to draw conclusions about the percentage of all Next GTM handsets in use constituted by this group of the least sensitive Next GTM handsets. It concluded:

Finding 7.4: A minimum of [redacted] of Next GTM phones in use on the Next GTM network as at 30 November 2007 have sensitivity levels that will result in coverage that is significantly smaller than ACMA’s predicted coverage for the least sensitive CDMA phone when operated in handheld mode. ACMA considers a proportion of [redacted] is significant.

Telstra, in its response to the draft Report, made a number of submissions and also introduced further evidence about the matters dealt with in this chapter. In summary, it submitted:

- The ACMA handset test does not take into account a range of factors and is based on rudimentary data provided by Telstra not suitable for comparative purposes;
- Even if the tests were valid, the threshold ‘arbitrarily set by ACMA’ for which Next GTM devices are considered unsuitable is flawed;
- Even if the threshold is accepted, the proportion of devices falling short of the threshold is significantly overstated;
- Even if the proportion of handsets falling short of the threshold is accepted, ACMA has not provided any evidence of the extent to which these handsets are actually used in fringe coverage areas rather than metropolitan and large regional centres; and
- In reaching its conclusions, ACMA should have regard to evidence arising from new testing of handsets conducted by Telstra.

ACMA has reviewed its draft findings in light of Telstra’s submissions, additional evidence, information and other material and its consideration of Telstra’s arguments are set out below.

Introduction to handset sensitivity

The sensitivity of a handset is a measure of how well a radiofrequency signal can be successfully processed by the handset. The lower the power level that the receiver can successfully process, the better the sensitivity of the handset.

Sensitivity is most significantly determined by the handset's in-built antenna. A small antenna, while delivering a 'stylish' and portable product, may not deliver the best performance. A handset employing an antenna with low gain will not be as sensitive as one with a high gain antenna in the same radiated field strength. This is because the power received by a handset is directly related to the gain of an antenna³². Therefore, all else being equal, if the gain of a handset antenna is larger, the received power is larger.

The sensitivity of a handset will directly affect the coverage experienced by the user. A handset with greater sensitivity can receive and process lower power signals from the base station. As the power level of a signal emitted from the base station decreases as distance from the base station increases, a handset with greater sensitivity will be able to receive and process signals at a greater distance from the base station. Therefore, a handset with greater sensitivity will provide greater coverage to the user than a handset with less sensitivity. This concept is illustrated in figure 7.1.

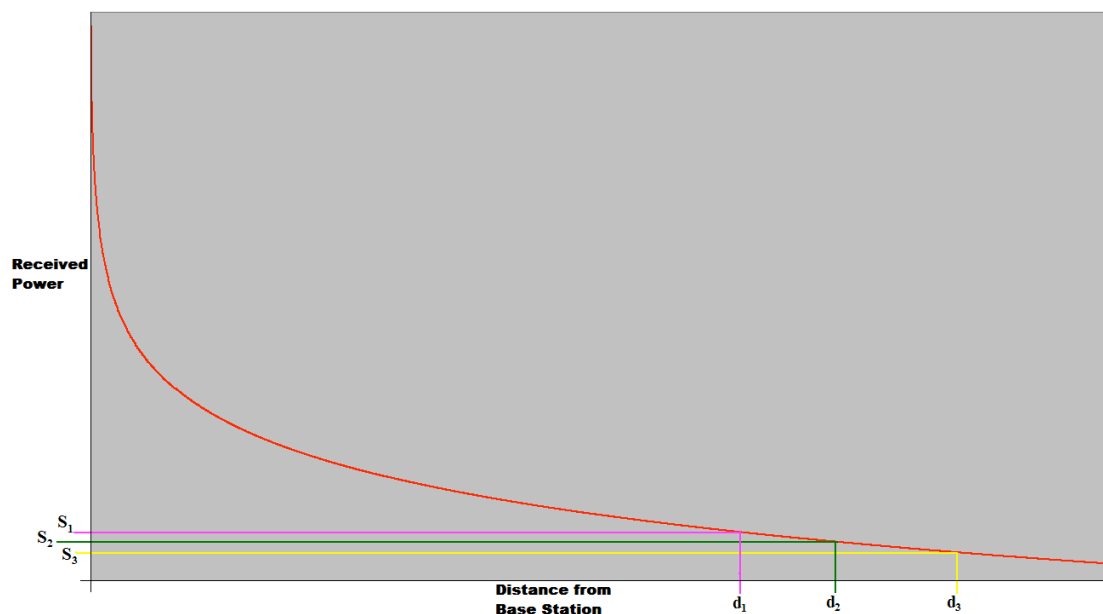


Figure 7.1: Illustration of variation in area in which calls can be connected and maintained using handsets with different sensitivities (not to scale)

The red line in figure 7.1 shows the general relationship between the received power level and distance from the base station. The received power decreases in a logarithmic fashion as the distance from the base station increases until it can no longer be measured or detected. The y-axis represents the received power level. S₁, S₂ and S₃ represent three levels of received power for three hypothetical handsets. Because of the logarithmic relationship a small change in sensitivity can result in a much larger change in distance.

Factors that determine handset sensitivity

The sensitivity of the mobile phone receiver used in handheld mode will depend upon matters such as:

- the performance of the handset's in-built antenna;

³² Doble, J. (eds) (1996) Introduction to Radio Propagation for Fixed and Mobile Communications, USA, Artech House, Inc

- the manner in which the handset is held, including the way the handset is gripped and the position of the handset in relation to the user's head; and
- the performance of the radiofrequency amplifier within the phone.

The in-built antenna and the manner in which the handset is held are the most significant factors.

Internal antenna

As previously mentioned, the sensitivity of a handset is significantly affected by its internal antenna. With the miniaturisation of handsets has come the miniaturisation of handset antennas. In current mobile handsets, the antenna is often simply a strip of metal.

Devices with extendable antennas will typically perform better and have greater sensitivity than devices with internal antennas. Many CDMA handsets have extendable antennas, whereas only a small number of Next G™ handsets currently on the market or used by Telstra customers have extendable antennas.

Human Interaction with the Handset

The sensitivity and performance of a handset can vary significantly depending on the proximity of obstructions. A person's grip on the handset and positioning of the handset in relation to the user's head and the base station can cause significant differences in received field strength and sensitivity. For example, by holding a handset close to one's head, both the received signal strength and the sensitivity can be altered by up to 20 dB (100 times) or more. These effects are most prevalent toward and beyond the edge of coverage due to the weakness in signal strength.

Another effect that can occur through human interaction with handsets is coupling. By simply touching certain handsets, coupling can occur which reduces receiver sensitivity. This occurs because the human in contact with the handset essentially becomes part of the unit from a radiofrequency perspective. This changes the resonant frequency of the handset and therefore decreases its sensitivity.

External Antennae

It follows from these observations and antenna theory that the connection of an external antenna, such as that in a good quality car kit, will remove the dependence on the internal antenna and thus reduce the range of sensitivities, improve signal reception and remove the effect of human interaction with the system. This is reflected in finding 7.2 below. Telstra has not indicated any difficulties with this finding.

ACMA's information on handset sensitivity levels and their effect on coverage

ACMA'S POSITION IN THE DRAFT REPORT.

In the draft report sent to Telstra, ACMA used the following evidence to draw conclusions about the handset sensitivity levels:

- A. Results from Telstra's own handset sensitivity testing. These tests were conducted within an anechoic chamber in both ideal "free-space" conditions, as well as held in the hand (see Attachment 6).

- B. Results from ACMA's own tests on handset sensitivity:
- a. Laboratory coupled tests (which disregard the effects of a handset's internal antenna)
 - b. Laboratory free-space tests within an anechoic chamber
 - c. Field testing conducted by ACMA at Condobolin

The tests mentioned above are outlined in Attachment 20.

Handsets are an element of the network and thus handset sensitivity is an important element in determining equivalence of coverage for CDMA and Next GTM when handsets are used in handheld mode. ACMA compared the performance of handsets from both systems and from this drew conclusions about equivalence of coverage.

In the draft report, ACMA used the [REDACTED] CDMA handset as a benchmark because Telstra rated it as a '100%' handset. In their initial measurements, it was the best performing CDMA handset.

In the draft report, using the first set of measurements provided by Telstra and in the absence of any other evidence about the performance of CDMA handsets comprising the remainder of the market, ACMA took the sensitivity spread for CDMA handsets as [REDACTED]. The [REDACTED] spread of sensitivities is based on a sample of CDMA handsets that represents [REDACTED] of the market. At that time these were the only handsets about which ACMA had any information.

When comparing sensitivities ACMA understood that there may be other CDMA handsets in the market with lower sensitivity than captured in the [REDACTED] sample. ACMA therefore allowed an additional [REDACTED] sensitivity margin to accommodate any handset in the remaining [REDACTED] of the market that may be less sensitive. [REDACTED] is an estimate of the possible range for the remaining [REDACTED] based on an extrapolation of the known range for the [REDACTED]. This may not necessarily capture all CDMA handsets used by Telstra customers.

ACMA also received information from Telstra that there is approximately a [REDACTED] statistical variation in RSSI and RSCP measurements. Therefore, ACMA has allowed an additional 1 dB to compensate for this. This method is verified by Telstra on page 3 of Attachment 15.

Adding these figures, **ACMA considered that a total relative sensitivity spread of [REDACTED] was an appropriate figure to use when comparing the performance of Next GTM and CDMA handsets** as a part of the network for the purposes of defining coverage. This gives some leeway for the possibility that still less sensitive CDMA phones than those in the information provided by Telstra comprise a significant share of the market.

Basing this on the [REDACTED] benchmark, [REDACTED] below 100% is 5% and so Next GTM handsets with a relative sensitivity below 5% of the benchmark CDMA performance would be below the sensitivity of the worst CDMA handset.

ACMA used three methods to make the comparison: these are outlined in Attachment 20. The results from all methods are generally consistent to the extent that they allow ACMA to rank handsets according to sensitivity based on the benchmark CDMA handset [REDACTED] and from this determine whether a particular Next GTM handset will achieve significantly less coverage than the coverage for the least sensitive CDMA handset.

In its draft report ACMA compared the Next GTM results from ACMA's tests and Telstra's information to CDMA relative sensitivities to determine coverage equivalence. The purpose of this comparison was to determine whether the coverage for any of the Next GTM handsets

is significantly less than the predictions for the least sensitive CDMA handset. ACMA used a combination of information to derive coverage for the least sensitive CDMA handset used in handheld mode. This evidence included:

- a CDMA handset sensitivity benchmark derived from Telstra reports: the [REDACTED] which is rated at 100%
- derived coverage from ACMA's measured CDMA drive survey results; and
- an estimate of the range of distances in which CDMA phones would operate from a base station for direct comparison to the Next G™ field test results derived by using the field tested sensitivity level of CDMA handsets in combination with Telstra's CDMA sensitivity results.

Analysis of these tests in the draft report found that, due to their relative sensitivity performance based on the benchmark [REDACTED] CDMA handset, the following handsets would when operating as network elements appear to provide less coverage than the assumed least sensitive CDMA handset:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

TELSTRA'S RESPONSE AND ADDITIONAL EVIDENCE

Following receipt of Telstra's response to the draft report, ACMA has considered new results from Telstra's additional sensitivity testing. This material was provided to ACMA on 4 January 2008. Telstra's response is found at Attachment 16.

Telstra made a number of points in their response and this section deals with those relating to handset sensitivity issues. The full analysis of Telstra's response on sensitivity issues is contained in Attachment 21 and described briefly below.

Telstra's response contained a new range of CDMA handset sensitivities which were on average 6 dB lower than the previous measurements and had differences between Telstra's earlier testing of the same handset which were as large as 20 dB. All of these measurements were based on a different handset grip than used in the first set of Telstra's measurements. This grip is described as 'a lightly closed grip, with the device held firmer, but with finger up the back of the device' in Telstra's response.

³³ [REDACTED] was also tested by the Kondinin group in their field trials and was the worst performing in terms of sensitivity.

³⁴ [REDACTED] suffer from considerable effects due to coupling of the handset when in contact with a human hand. AMCA was unable to confirm these results as it did not conduct tests involving human interaction with the handsets.

³⁵ [REDACTED] suffer from considerable effects due to coupling of the handset when in contact with a human hand. AMCA was unable to confirm these results as it did not conduct tests involving human interaction with the handsets.

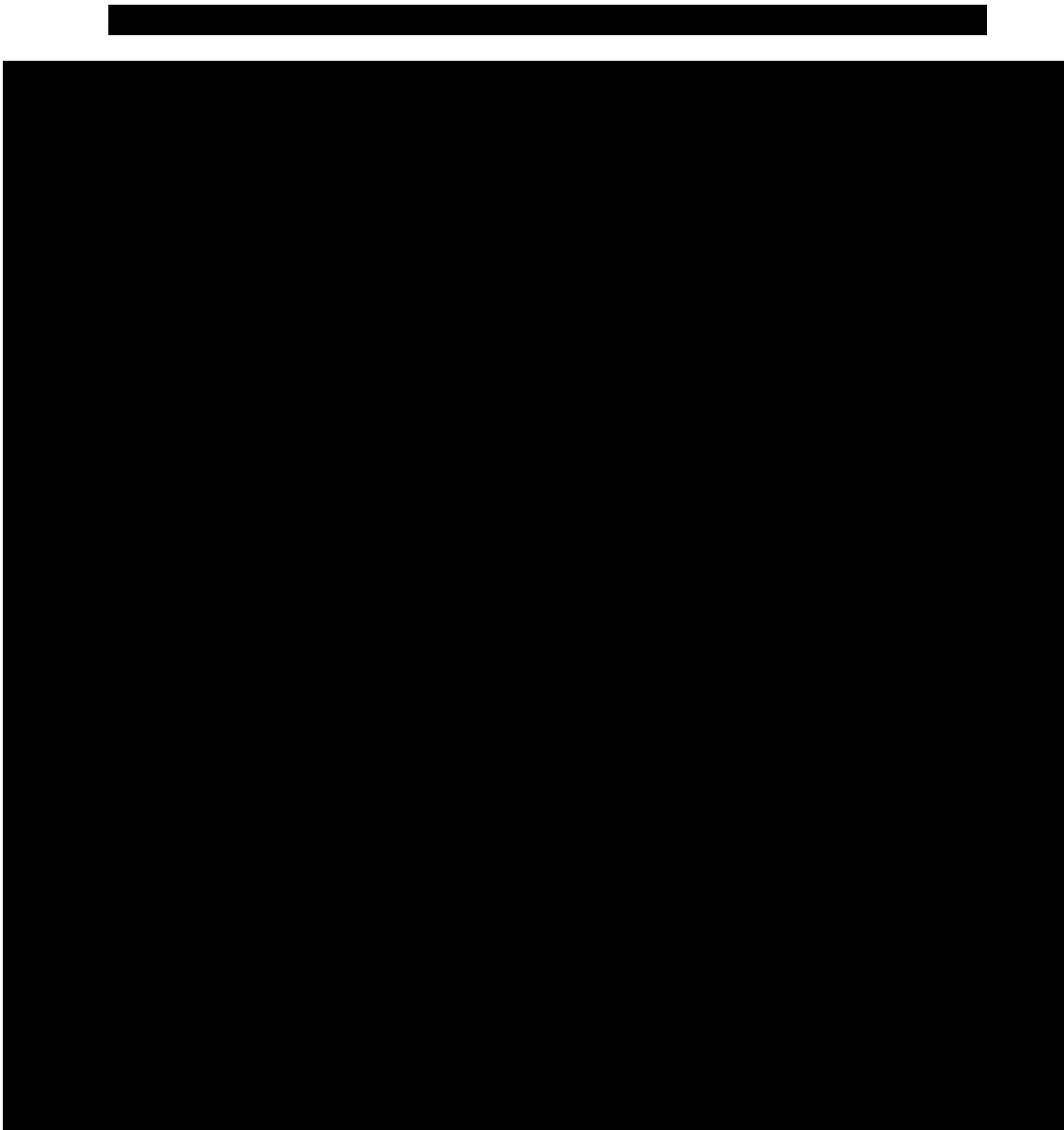
[Redacted]

[Redacted]

[Redacted]

[Redacted]

ACMA staff attended testing with Telstra staff at Parramatta telephone exchange on 2 January 2008 where differences in handset sensitivity were tested with differing grips. The tests are outlined in Attachment 21 and shown in Table 7.1 below. The grip described in Telstra's response above and used in figure 7.2 was not used or demonstrated in the presence of ACMA staff.



The figures in Table 7.1 demonstrate a wide range of sensitivities for both types of handset but also that the Next G™ handsets have as great a range of sensitivity change as the newly measured CDMA handsets.

Comments on Telstra's arguments can be found below.

DISCUSSION

In their response Telstra argue that:

- The range of CDMA handset sensitivities was understated in their original measurements which were used by ACMA to benchmark Next G™ handsets. A revised set of figures was provided, showing a greater sensitivity range for CDMA handsets using a different grip and a larger number of CDMA handsets.

ACMA agree that the grip used will affect the sensitivity range of a handset and affect different handsets in different ways. ACMA however do not accept that Telstra's revised figures provide a sufficient basis for comparing CDMA handsets with Next G™ handsets. They also fail to provide a satisfactory basis on which to conclude that the earlier test measurements should be disregarded or discounted. ACMA's concerns about Telstra's revised measurements arise because of the following matters:

- The original figures test both CDMA and Next G™ handsets using free space measurements and measurements made with the handsets held in an identical grip (and can therefore be the subject of a valid comparison).
- The new figures use a different grip to that used in the original test and so cannot be validly compared with the earlier handset measurements.
- The new set of figures contains no free space measurements for the new range of CDMA handsets and thus cannot be validly compared with earlier Next G™ or CDMA handset measurements.
- The new measurements are only of CDMA handsets and thus cannot be validly compared with earlier Next G™ handset measurements.
- The relative handset rankings from the original measurements are consistent with the findings of other ACMA tests, such as the field trials and ACMA laboratory free space measurements.
- The new set of measurements is not consistent with the findings of other ACMA tests, such as the field trials and ACMA laboratory free space measurements.
- The original figures provide a helpful benchmark because they also use free space measurements which are unaffected by grip style.
- During their visit to Parramatta exchange handset testing facility in January 2008, ACMA staff witnessed a wider range of sensitivities under varying grips for three Next G™ handsets [REDACTED] than seen in the November 2007 Telstra measurements.
- In tests at ACMA offices, ACMA staff were able to cause by varying the grip a much wider range of sensitivity variation than outlined in Telstra's second measurements in two [REDACTED] Next G™ handsets ([REDACTED]).

Two new handsets with very low sensitivity using the new grip style were also presented in the new measurements. These were [REDACTED] series handsets.

Telstra has stressed that there are more CDMA handsets on the market than have been tested. ACMA concedes that there is [REDACTED] of market share of CDMA handsets about which ACMA has no sensitivity data and that it is possible some of these may perform more poorly than 5% of the benchmark. However:

- ACMA was unable to verify the sensitivity performance, in free space or using the original grip, of the two [REDACTED] series CDMA handsets tested by Telstra.

- ACMA were not satisfied that these two handsets have lower sensitivity than other CDMA handsets measured in the original tests.
- More comprehensive testing would be required before ACMA could determine the relative sensitivities of the [REDACTED] series CDMA handsets or any other CDMA handsets which have been sold by Telstra.
- According to Telstra, the market share in December 2007 was [REDACTED] or less for each [REDACTED] series handset.
- ACMA has allowed a [REDACTED] range in sensitivity to allow for unknown CDMA handsets. Despite Telstra's new measurements, this allowance remains a reasonable estimate of the likely variation from the original measurements done on the same basis as the original measurements.

In its draft report, ACMA also compared its results to the Kondinin report³⁶. This report is a well publicised field test of Next G™ handsets. The report also compares the performance of a sample of Next G™ handsets to CDMA handsets. Kondinin released an updated version of this report³⁷ in January 2008. ACMA also compared the results of ACMA tests with the findings in this update. While ACMA have compared its results to the Kondinin reports, they were not used in the final analysis of handset sensitivities.

Finding 7.1: There are variations in sensitivity between handset models in both the Next G™ and CDMA handsets that can be used on Telstra's networks. There is evidence and information which suggests there is greater variability in the sensitivity of Next G™ handsets than CDMA handsets.

Finding 7.2: The choice of mobile phone handset will not affect equivalence of coverage conclusions when having regard to subclause 15(7)(iii) "appropriate mobile phone used in connection with an external aerial".

Conclusion on handset sensitivity

ACMA accepts that the evidence used to reach conclusions on handset sensitivities is incomplete. Given more time, an independent controlled experimental measurement of all available CDMA and Next G™ handsets could be undertaken in laboratory conditions using models of the human head and hand and exploring each handset in each grip iteration.

ACMA has not had, in the circumstances, the time nor resources to undertake such a comparison but instead has made findings based on the evidence at hand including Telstra submissions.

Based on the information available, ACMA used three methods to analyse the data collected and these are described in Attachment 20. ACMA also undertook an analysis of the new

³⁶ Kondinin Group, "Farmers short-changed with poor handsets", Farming Ahead, August 2007, Page 24.

³⁷ Kondinin Group, "Next G Phones Show Improvement", Farming Ahead January 2008 No. 192.

relative sensitivity measurements for CDMA handsets provided by Telstra in January 2008, which can be found in Attachment 21.

The results from ACMA's analysis are consistent with the finding that the range of both CDMA and Next G™ handsets that can be used with Telstra's networks exhibit variability in sensitivity. The ACMA tests and the measurements provided by Telstra has provided evidence which suggests there is more variability in the sensitivity of Next G™ handsets than there is for CDMA handsets.

Telstra has argued that using a different grip will result in a wider range of CDMA sensitivities within which Next G™ handset sensitivities will lay. ACMA accepts that varying the way a handset is held will affect the sensitivity of the handset. However, evidence suggests this is equally true for Next G™ handsets and CDMA handsets. Relative sensitivity may change with grip type but ACMA considers that the relative sensitivity will remain the same if a worst case grip is used for each handset type. As such the available evidence suggests that the relative sensitivities used, benchmarked against the CDMA '100%' handset as outlined in the first group of Telstra Next G™ figures, remain valid.

From the results of Telstra's Next G™ sensitivity tests, based on the benchmark [REDACTED] CDMA handset, the following handsets would appear to provide less coverage than the assumed least sensitive CDMA handset based on the benchmark:

- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]
- [REDACTED]

The result for the [REDACTED] is consistent with the results of handset sensitivity testing conducted by ACMA.

In addition to these handsets, the coverage provided by the [REDACTED] in the Condoblin field test is considered to be marginal and may provide less coverage than the predicted coverage of the least sensitive CDMA handset.

In the ACMA handset testing, the sensitivity of the Samsung Blackjack was significantly less than that of any other handset tested. Telstra has advised ACMA that this handset is faulty, ACMA accept this and have tested a replacement Blackjack which returned results in accordance with Telstra's initial ranking.

In identifying Next G™ handsets that are less sensitive than its predictions of the least sensitive CDMA handset, ACMA included some leeway for the possibility that there exists

³⁸ [REDACTED] was also tested by the Kondinin group in their field trials and was the worst performing in terms of sensitivity.

³⁹ The [REDACTED] suffer from considerable effects due to coupling of the handset when in contact with a human hand. AMCA was unable to confirm these results as it did not conduct tests involving human interaction with the handsets.

⁴⁰ The [REDACTED] suffer from considerable effects due to coupling of the handset when in contact with a human hand. AMCA was unable to confirm these results as it did not conduct tests involving human interaction with the handsets.



Although Telstra has withdrawn the [redacted] from sale, it accounts for approximately [redacted] of Next G™ devices in use. This is a significant proportion and would therefore account for a considerable number of customers.

The [redacted] are currently for sale for use on the Next G™ network and currently account for [redacted] respectively of handsets in use. ACMA considers this to amount to be material and additionally the market share of these handsets is likely to increase in the future.

The [redacted] represents [redacted] of all Next G™ handsets currently in use on the network. While this handset is no longer for sale, it accounts for a material amount of the market share of Next G™ devices.

The [redacted] is currently for sale on the Next G™ network but currently only accounts for [redacted] of devices in use. ACMA does not consider this market share material, however the proportion of these handsets could increase in the future.

Telstra argues that the ACMA representation that [redacted] of network usage may be affected by less sensitive Next G™ devices (Table 7.2) is misleading. They point out that this conclusion is reached without any data or analysis of where customers are using the so-called low sensitivity handsets, particularly whether and the extent to which they are being used in fringe coverage areas where their lower sensitivity may have an impact (if these handsets are overwhelmingly being used in metropolitan areas and large regional centres, their lower sensitivity will have little or no impact on received coverage).

ACMA agree that where these handsets are used in metropolitan areas the user may experience no coverage difficulties because of overlapping cells. ACMA do not however have any evidence that these users remain in good coverage areas or indeed if they journey to fringe areas where choice of handset is a factor. ACMA notes that some of the lower sensitivity handsets are no longer on the market and that their market share could be expected to decrease with time.

In June 2007 Telstra commenced advertising a range of high sensitivity handsets known as Blue Tick handsets. ACMA would expect that point of sale advice by Telstra would mean the uptake of these handsets in regional areas where coverage would be an issue would be high. However, based on the evidence available to ACMA, [REDACTED] of the handsets in the system have lower sensitivities such that the users may experience coverage problems and while not all of this 30% may ever operate in regional areas. ACMA does not believe the possibility of this can be discounted.

Finding 7.4: A minimum of [REDACTED] of Next G™ phones in use on the Next G™ network as at 30 November 2007 have sensitivity levels that the available evidence or information suggest may result in coverage that is significantly smaller than ACMA’s predicted coverage for the least sensitive CDMA phone when operated in handheld mode.

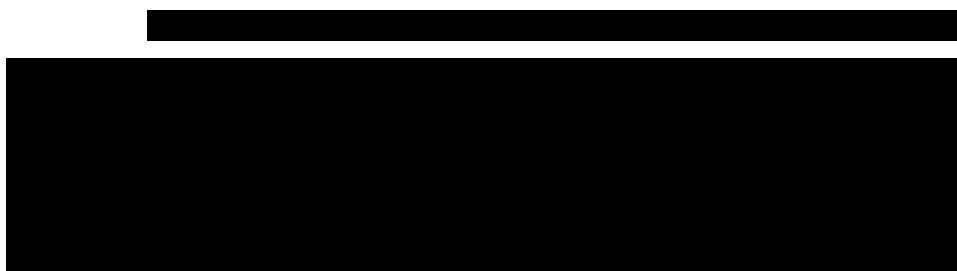
This percentage figure is unlikely to correspond to the number of customers actually experiencing problems with Next G™ coverage. Mitigating factors such as differential uptake of Blue Tick handsets in regional and remote areas suggest that this percentage overstates the proportion of customers who would experience difficulties in making and holding handheld calls in areas where they were ordinarily able to make and hold such calls using the CDMA network. However, many Next G™ customers in remote and regional areas will be using less sensitive Next G™ handsets to make handheld calls. There are also likely to be Next G™ customers with less sensitive handsets who live in cities who also travel into remoter areas and make calls on a very regular basis. There will be areas in which such people who ordinarily made and received handheld calls on the CDMA network will not be able to do so using their less sensitive Next G™ handsets.

Blue Tick Handsets

ACMA have based the findings above on the interpretation that an ‘appropriate’ Next G™ handset is any handset available to connect to the Next G™ network. As discussed in Chapter Three, Telstra argue that a different approach to the definition should be taken. This section considers what the results and findings would be if one were minded to accept Telstra’s definition of appropriate handset.

One page 11 of their submission Telstra state that “...it would be sensible to compare Telstra’s Blue Tick range with the following CDMA handsets: Nokia 2280, Nokia 6385, Nokia 6255...” (see Attachment 16).

Table 7.3 shows the results for the three CDMA handsets named by Telstra from the first Telstra response shown in Attachment 6.



This shows that the three handsets suggested by Telstra to be used in a comparison to Next GTM Blue Tick handsets have a range in sensitivities of [REDACTED]

The first round of CDMA handset testing conducted by Telstra and presented to ACMA as shown in Attachment 6 was performed using the same grip as that used in the Next GTM handset testing presented in the same document. Table 7.4 shows the results for the Next GTM Blue Tick handsets from the first Telstra response shown in Attachment 6.



The results in table 7.4 show that Next GTM Blue Tick handsets have a range in sensitivities of [REDACTED].

The results of ACMA's field testing at Condobolin and Crookwell are shown in Attachments 8 and 17, respectively. Both tests showed that the most sensitive Next GTM handsets tested have equal or greater sensitivity than the most sensitive CDMA handsets tested.

To compare the range of sensitivities of CDMA and Next GTM handsets from the results of the first round of Telstra tests outlined above, it is assumed that the most sensitive Next GTM handset has equal sensitivity to the most sensitive CDMA handset. This is the worst case for Next GTM handsets as it is likely that the most sensitive Next GTM handset has greater sensitivity than the most sensitive CDMA handset.

Using this benchmark and comparing the range in sensitivities of the CDMA and Next GTM handsets shows that the least sensitive CDMA handset is less sensitive than the least sensitive Blue Tick handset. This result is further supported if it is assumed that the two 100% handsets in the CDMA and Next GTM results have equal sensitivities.

Finding 7.5: If ACMA were to accept that ONLY Blue Tick handsets were considered ‘appropriate’ Next G™ handsets and they were compared with the CDMA handsets that Telstra define as ‘appropriate’ CDMA handsets (namely the [REDACTED]), ACMA would conclude that the available evidence would suggest that there are no Blue Tick Next G™ handsets that are less sensitive than the Telstra defined ‘appropriate’ CDMA handsets. This means that Blue Tick Next G™ handsets operating in the same radiated field strength would offer equivalent or better coverage.

Chapter Eight. Comparison of Coverage Maps

Introduction

This chapter examines the results of a comparison of Telstra's predictive coverage maps. The map comparison exercise, conducted by the Department's mapping section on ACMA's behalf, is detailed in Attachment 10.

The Carrier Licence Condition requires ACMA to compare the *actual* coverage of the CDMA and Next G™ networks. Predicted coverage—as represented in coverage maps—is an estimate, subject to limitations and errors inherent to the prediction process and does not, for example, take into account the behaviour of various different models of handsets operating as part of the network. As a consequence of the presence of such shortcomings, predictive coverage maps should generally be used with caution in making overall comparisons of network coverage as a whole.

This chapter examines the extent to which the comparison of coverage maps can provide a useful guide to actual coverage. The chapter discusses the limitations of coverage predictions, categorises the coverage differences apparent from the comparison, and compares the coverage predicted by the maps to the results of the drive survey.

Limitations of coverage predictions

GENERAL LIMITATIONS

Coverage predictions are a method for estimating the coverage which can normally be expected in an area. While they are a useful tool in estimating likely coverage, they cannot be used to determine conclusively where coverage is and is not available for the purposes of the licence condition⁴¹. For example, ACMA understands that Telstra's published coverage maps are based on predictions of where services will be available in at least 90% of locations for at least 90% of the time. This is not the same definition of service availability as ACMA is required to address under the carrier licence condition.

⁴¹ Detailed information on the limitations of predicting coverage is addressed in Attachment 4 – Predictive Mapping Methodologies.

TELSTRA'S COVERAGE PREDICTIONS

Both CDMA and Next G™ coverage prediction maps used in the comparison exercise were produced by Telstra using the Atoll coverage prediction software tool. Telstra and ACMA agree that this tool provides accurate coverage predictions when correctly applied.

Telstra produced the maps for each network using the same coverage prediction tool, as Telstra was concerned about the comparison of maps produced using different tools with different capabilities. Note that the predictive maps published by Telstra on its website for CDMA coverage areas were produced with a different coverage prediction tool.

Categories of mapped coverage deficiency

A comparison of the coverage prediction maps for CDMA and Next G™ identified 63 areas where mapped coverage of CDMA exceeded Next G™ coverage. The details were sent to Telstra for comment. The identified areas and Telstra's response are detailed in Attachment 12.1 and updated in table two of Telstra's supplementary response to the draft report (see Attachment 19).

Table 8.1 below summarises the categories of mapped coverage differences that were used by Telstra in its response.

Table 8.1: Telstra categorisation of apparent mapped Next G™ coverage deficiencies

Category	Number of areas	Percentage
Forecasting anomaly	8	12.7%
Data error	41	65%
Configuration Difference	11	17.5%
Engineering error	3	4.8%
Total	63	100%

ACMA agrees that Telstra's taxonomy provides a useful framework for considering the apparent coverage deficiencies.

Forecasting anomalies

There are numerous small areas at the fringes of coverage where one service or the other (but not both) have been predicted.

The majority of these locations identified as having CDMA coverage and no Next G™ coverage appear to be less than 1 km across.

Telstra, in a submission to ACMA, has provided the following notes on the accuracy of the data that was used to compare predicted coverage of the two services:

There is a speckle or random type pattern visible across both map types. This effect is an artefact of the prediction process which uses simulated radio propagation models. These

speckles are generally single pixel uncertainties that are generated by the simulation calculations and data processing that turns the mathematical output of the simulation tool into a picture. The simulation tool performs millions of calculations on decimal numbers (not integers) that are necessarily truncated within the computer. Although the calculation precision is high, truncation errors will be introduced given the large number of calculations in the simulation. These truncation errors will be different for CDMA and Next GTM predictions. Another source of errors arises from the graphing of the final mathematical output. This requires the decimal numbers to be “binned”. Numbers near the edge of a bin can be tipped into one bin or another by the truncation error ...⁴²

ACMA agrees with Telstra’s assessment of the limited accuracy of both CDMA and Next GTM coverage predictions, and the inherent problems in making a direct, highly detailed comparison between the two. Artefacts such as those discussed by Telstra can be seen in the maps showing potential difference in the coverage of the two services⁴³. Therefore areas of predicted CDMA coverage outside Next GTM coverage identified in the comparison exercise must be considered in the context of the likelihood of both mapping implementation errors and errors introduced by the comparison process.

Finding 8.1: While conclusions can be drawn from the general shape of the coverage predictions of the networks, small differences in coverage predictions are more likely attributable to the prediction and mapping software than to actual differences in expected coverage. In any event, ACMA considers small differences in mapped coverage between the two networks are not material.

Data Errors

Moderate sized, non-trivial areas of CDMA-only predicted coverage found in the Atoll CDMA coverage maps provided by Telstra, can be categorised into:

- relatively small discrepancies in areas of mountainous terrain
- relatively small discrepancies where the prediction on the Telstra website (using older predictive software) do not agree with the Atoll predictions
- several large discrepancies where a CDMA base station is indicated, however no corresponding Next GTM base station is indicated. This situation could result from missing data or alternatively from missing Next GTM base stations.

Telstra has advised that the Atoll maps representing CDMA coverage were produced expressly for comparison of network coverage in a short time span, and that consequently these CDMA coverage maps have been produced without the required rigour, resulting in an erroneous outcome for some CDMA coverage predictions. Recent clarification from Telstra indicates that a large number of input data errors have been identified which explain many of the anomalies noted. ACMA accepts Telstra’s advice.

⁴² Attachment 10.1 Telstra, Letter to James Shaw, 16 November 2007 “Re: Supply of Coverage Map Data”.

⁴³ See Attachment 10

Finding 8.2: Larger predicted discrepancies may, in most instances, be attributed to the implementation process when producing CDMA coverage maps for comparison to Next GTM coverage maps.

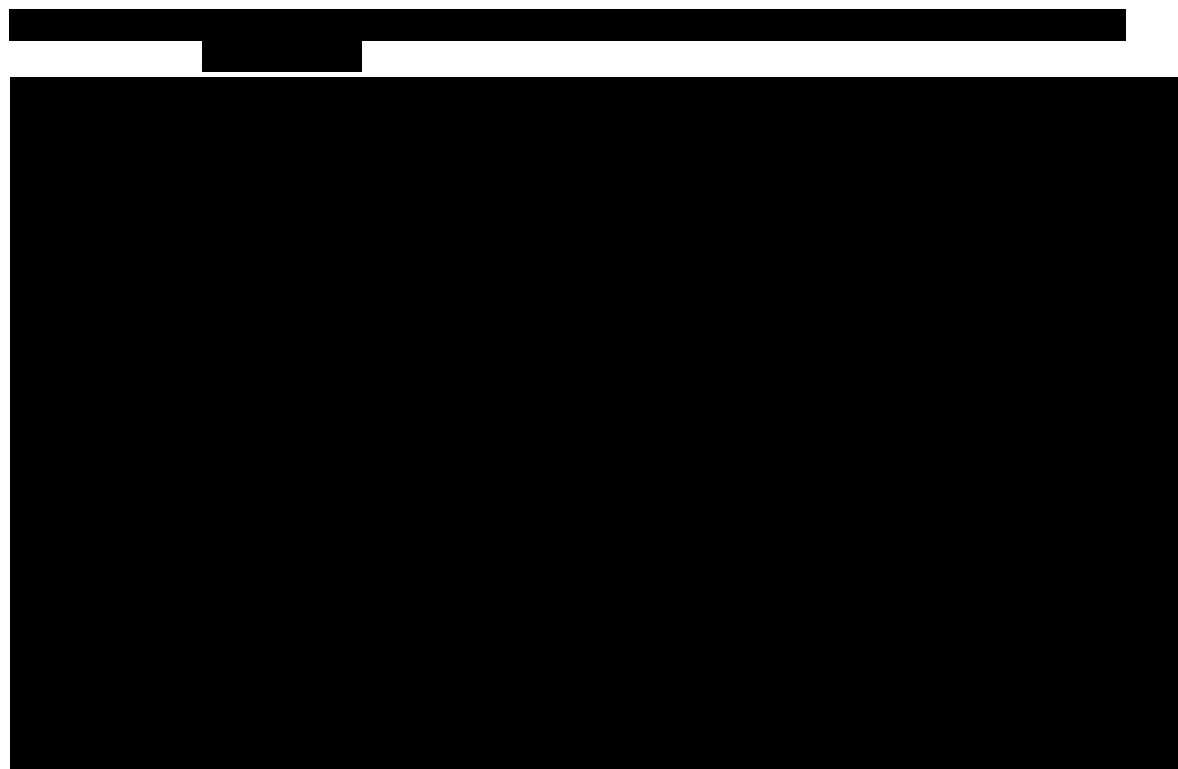
Telstra has acknowledged data errors were introduced during production of the coverage maps.

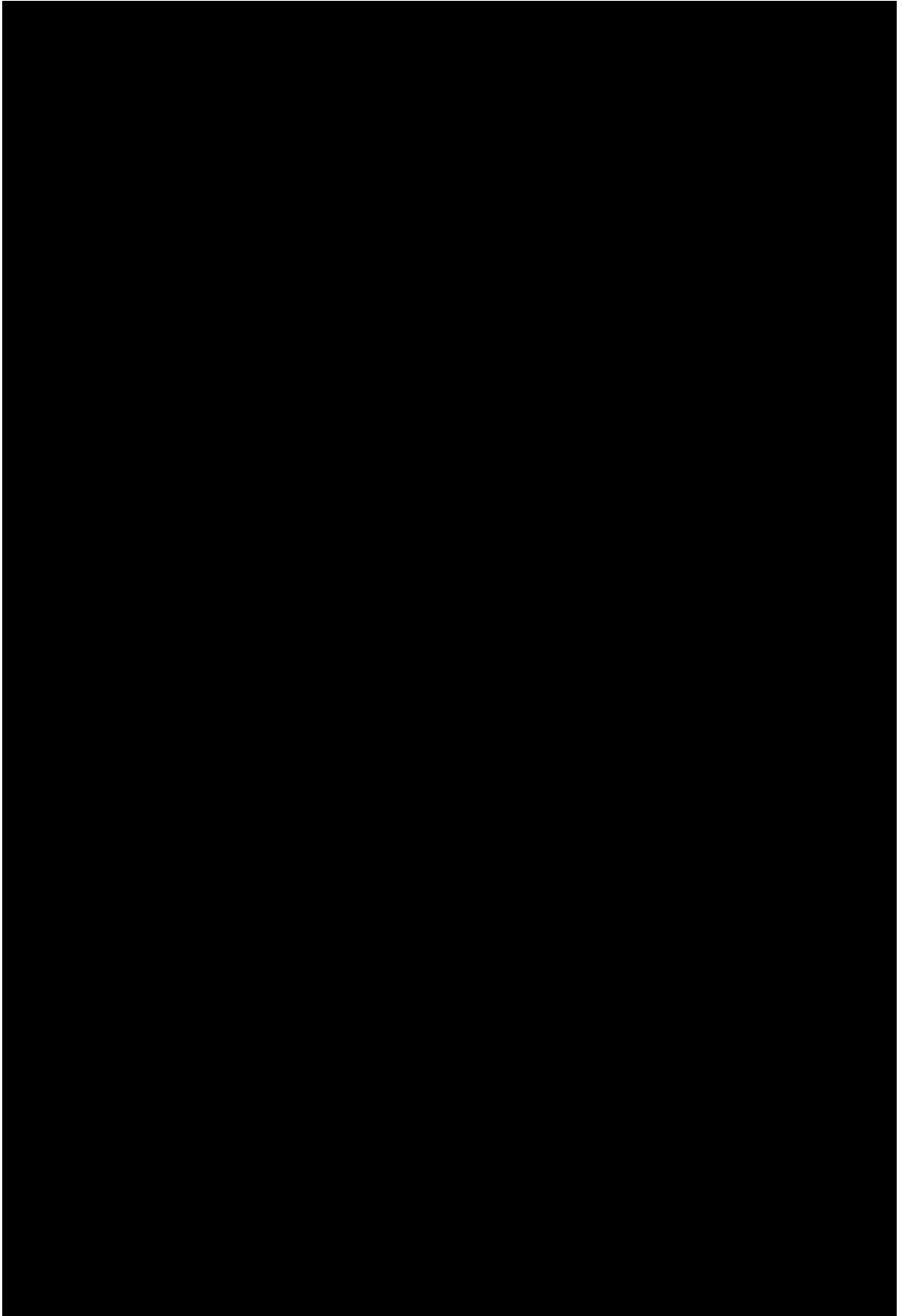
Configuration Differences

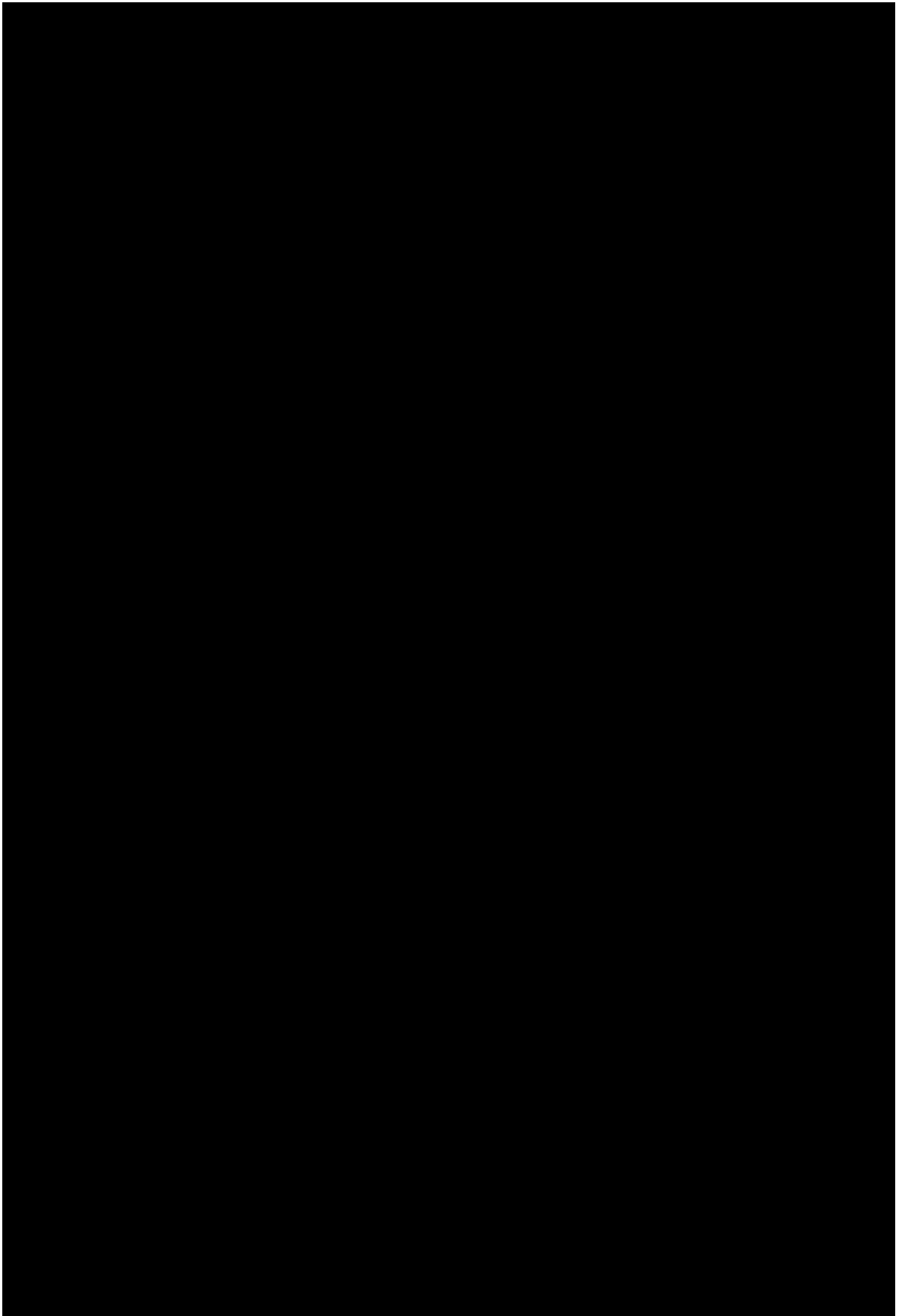
As a result of its consideration of anomalies identified in the map comparison exercise (see Chapter Eight). Telstra has acknowledged that actual signal reductions exist in eleven areas.

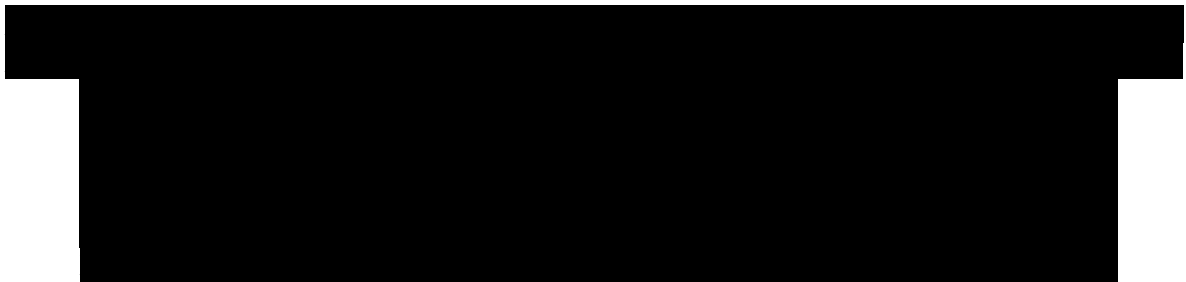
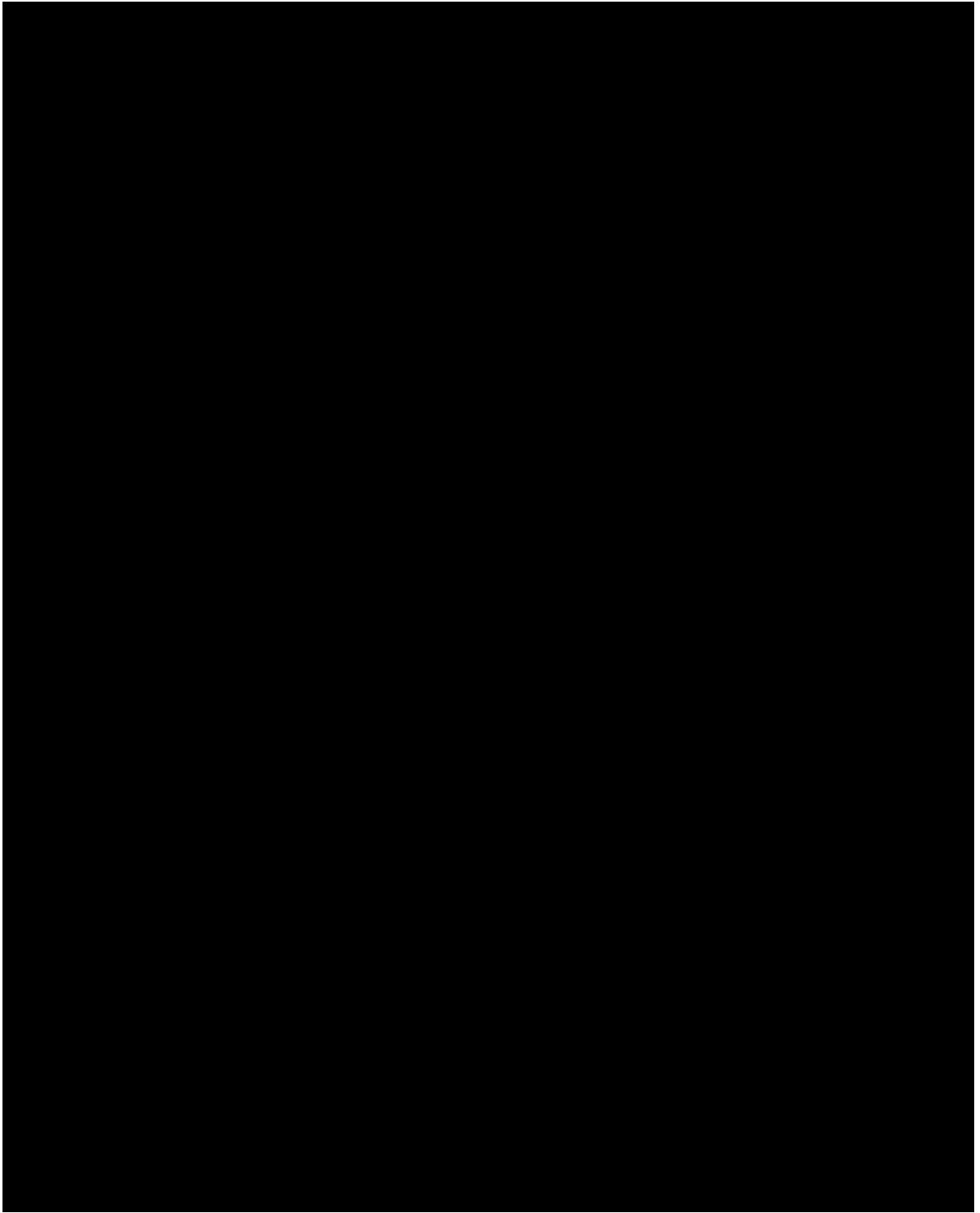
Finding 8.3: In some areas a mapped Next GTM coverage deficiency may represent some degree of actual coverage deficiency. ACMA considers the comparison of coverage maps to be useful for identifying potential areas of coverage deficiency for closer examination.

The configuration differences acknowledged by Telstra are summarised in the table below, which has been derived from Attachment 12.1, Telstra's supplementary response to the draft report (Attachment 19) and preliminary analysis by ACMA. Maps showing the coverage deficiencies are at Attachment 23.









Although Telstra has indicated in its supplementary response that they are generally committed to rectifying any coverage differential identified “no matter how minor”, prior to 28 January 2008, Telstra also has indicated that in these cases they do not propose any action (except that they propose a new base station for [REDACTED], and that further enhancement is planned for [REDACTED]).

ACMA must consider the extent to which these potential actual coverage deficiencies will affect ACMA’s consideration of whether coverage equivalence has been achieved.

Unlike the unintentional coverage discrepancies revealed in the drive survey (see Chapter Six), or the unintentional engineering errors discussed later in this chapter, these potential coverage deficiencies result from conscious network configuration decisions taken by Telstra. Therefore ACMA has given these deficiencies specific consideration.

Drawing confident conclusions about the exact location and extent of actual coverage deficiencies in the terms of the condition is difficult without further information for the general reasons canvassed elsewhere in this chapter, which means that mapped predictions will often understate or otherwise misrepresent actual coverage. Nor can it be inferred necessarily that just because there is a discrepancy in predicted coverage shown on a map, that there will also be a discrepancy in actual coverage in the terms of the condition. This will depend on factors such as terrain and it is possible that there will be no corresponding deficiency in actual coverage.

In the present cases, ACMA believes it is quite likely that there will be some deficiencies in actual coverage resulting from these network configuration decisions.

From an inspection of the topographic maps and a rudimentary comparison with aerial photography in some areas, ACMA agrees that Telstra has attempted to engineer the coverage deficiencies to be within remote or uninhabited areas. However, further investigation would be required to determine for certain the extent to which the areas were inhabited or likely to be used by potential Next G™ network consumers.

ACMA noted in Chapter Three that equivalence does not require identical coverage, but rather coverage that is virtually the same. ACMA considered that a very high level of correspondence is required between the areas of coverage associated with the base stations of each network for the coverage to be regarded as ‘virtually the same’. It considered that an overall assessment of equivalence could be found even though there are very small areas of Next G™ coverage deficiency. It has found as follows:

Finding 8.4: The areas of engineered coverage deficiency due to network configuration differences are not material, as the areas:

- are small in number (11 nationally);
- are small in size;
- with the exception of the [REDACTED] would appear at first inspection to be areas that are remote or inaccessible, and sparsely inhabited areas where Next G™ consumers would be unlikely to visit;

- in the specific case of the [REDACTED], the deficiencies appear to be in several very small localised spots within the general area which are more likely to give rise to problems with handheld coverage than with an external aerial; and
- as the map comparison was conducted on a whole of network basis, the deficient areas are likely to be limited to the eleven identified areas.

On this basis, the presence of these areas of engineered Next G™ coverage deficiency would not change ACMA’s finding on actual coverage with an external aerial.

In arriving at this finding, however, ACMA is conscious of the fact that in the end only very general guidance is given by the requirement for the networks to be ‘virtually the same’. Reasonable minds could differ on whether a given discrepancy is significant enough that coverage of Next G™ network is no longer ‘virtually the same’ as CDMA coverage at the relevant date. ACMA is also not in a position, based on its current knowledge of the coverage areas, to determine conclusively the extent of habitation, or more importantly the extent to which these are areas in which mobile phone users would ordinarily make and receive calls. ACMA is also not in a position to identify precisely any offsetting benefit of the changed configuration in terms of additional coverage of Next G™ in areas that currently do not enjoy CDMA coverage.

Engineering Errors

At three locations [REDACTED] [REDACTED]. Telstra has conceded that engineering issues had resulted in actual coverage deficiencies. Telstra claims that the first two areas have now been rectified, and the [REDACTED] matter is under investigation. Telstra has committed, in its supplementary response to the draft report, to rectify all actual coverage deficiencies prior to 28 January 2008.

Finding 8.5: In three areas a mapped Next G™ coverage deficiency has corresponded to an actual coverage deficiency caused by an engineering error. ACMA accepts Telstra’s assurance that these errors have been corrected in two areas. In the other, ACMA notes that Telstra is still investigating it and has committed to resolving it.

ACMA therefore does not believe these (mostly corrected) very small areas of coverage deficiencies are material in ACMA’s consideration of coverage equivalence.

Comparison of coverage maps with drive survey results

In order to test whether coverage maps provide a useful proxy for actual coverage, ACMA compared areas of identified mapped coverage deficiency with the results of actual coverage on the drive survey. There were four cases where the drive survey crossed a mapped coverage deficiency. The comparison is detailed in Attachment 10.

Finding 8.6: Where the drive survey route passes through areas in which the coverage maps have predicted a deficiency in Next GTM external aerial coverage, analysis of the drive survey results does not find a corresponding deficiency in actual external aerial coverage. In fact, the comparison shows that actual external aerial coverage of the Next GTM network is slightly larger than CDMA in those areas.

ACMA considers that a discrepancy in mapped coverage does not necessarily mean a deficiency in actual coverage.

In the vast majority of locations surveyed by ACMA, it has been found that both CDMA and Next GTM coverage extends beyond the indicated areas on predictive coverage maps, with measured Next GTM coverage in general being greater in extent than measured CDMA coverage. Observations made by ACMA during the drive survey showed that the extent to which Next GTM coverage was greater varied across the network.

Finding 8.7: The Atoll predictive coverage maps are a conservative prediction of coverage. In general, actual coverage as measured in the drive survey exceeds mapped coverage for both CDMA and Next GTM networks. The extent to which Next GTM actual coverage exceeds mapped coverage varies across the network.

Notwithstanding the inaccuracies in the mapping process, the results of the map comparison are still useful on a gross basis. On a national level, for instance, the maps show that areas of mapped Next GTM coverage exceed CDMA, which is not inconsistent with the drive survey results.

Finding 8.8: Coverage maps are not sufficiently reliable as a guide to coverage (as defined in the carrier licence condition) for use in drawing conclusions about the size and location of specific discrepancies in actual coverage of Next GTM and CDMA.

ACMA considers that coverage maps are useful in providing a gross indication of coverage of the networks on an overall national basis.

Glossary

3G	3G refers to the third generation of wireless communications characterised by data rates between 384Kbps and 2 Mbps. It is also standardised under the International Mobile Telecommunications IMT-2000 standard.
ACMA	Australian Communications and Media Authority is Australia's regulator for broadcasting, the internet, radiocommunications and telecommunications.
Anechoic chamber	An RF screened room lined with material that absorbs radio waves. Such chambers are used to test transmitters and receivers. The absorbing material ensures that radio waves are unable to reflect from metallic chamber walls and cause multipath propagation that may interfere with test results. RF screening prevents signals external to the test environment from interfering with the tests.
Base Station	The location of transmitting, receiving and antenna equipment responsible for handling traffic and signaling between a mobile phone and the Network
BER	Bit Error Rate. Bit Error Rate is a means of measurement comparing the total number of bits incorrectly received to the total number of bits sent during a time interval for a digital signal.
Blue Tick	A standard introduced by Telstra recommending a handset for rural handheld coverage.
Carrier licence condition	<i>Carrier Licence Conditions (Telstra Corporation Limited) Declaration 1997, as amended.</i> See Chapter Three.
CDMA	Code Division Multiple Access is a wireless communication scheme specified according to Interim Standard 95 (IS-95).
Cell	Cell generally refers to the physical equipment installed at a base station. In a broader context a Cell refers to the expected coverage area generated by the transmitted signal from this base station.
CLC	See carrier licence condition
CPICH	A Common Pilot Channel is a signal integral in the transmitted bandwidth from a CDMA or WCDMA base station, used to control the connection of user equipment to the network.

dB	Decibel. A decibel is a logarithmic unit of measure used to describe a ratio. For the purposes of this report dB refers to a ratio of signal power.
dBm	A decibel milliwatt. A logarithmic measurement of power. 0dBm is equal to one milliwatt of power. -10dBm is 0.1 mW, -20dBm is 0.01mW and so on. Receiver sensitivity is often measured in dBm.
Department	The Department of Broadband, Communications and the Digital Economy. (Prior to 3 December 2007 the Department of Communications, Information Technology and the Arts).
ETSI	European Telecommunications Standards Institute produces globally-applicable standards for the telecommunications industry.
Evidence	Evidence, data or other information that was before the Authority.
GSM	Global System for Mobile communication is a wireless standard applicable to mobile phone services and is categorised as a 2G system.
IEEE	Institute of Electrical and Electronics Engineers is a non-profit organisation and the world's leading professional association for the advancement of technology.
Kbps	Kilo bits per second. a measure of bandwidth (the total information flow over a given time) on a telecommunications medium. One Kbps is a data or oscillation rate of one thousand bits per second.
Mbps	Mega bits per second. One Mbps is a data or oscillation rate of one million bits per second.
Minister	Minister for Broadband, Communications and the Digital Economy.
Next G™	Name given to Telstra's WCDMA 3G Network operating in 850MHz band. A trademark of Telstra Corporation Limited.
RAKE receiver	A RAKE receiver is a radio receiver which is designed to counter the effects of multipath fading. Multipath fading is where the quality of the received signal is reduced due to the effects of the multiple delayed propagation paths taken by the transmitted signal.
RSCP	Received Signal Code Power is the received power of the Common Pilot Channel transmitted by a CDMA or WCDMA base station transmitter, as measured by the User Equipment
RSSI	Received Signal Strength Indication is a measurement of power in a received signal within a wireless environment.
Sensitivity	The degree to which a mobile device is responsive to an incoming radio signal such that it is able to maintain a call.
Shielded Laboratory	A room designed to prevent radiofrequency signals from entering or leaving the room.
UE	User Equipment, in studies of Received Power, the handset
WCDMA	See Wideband CDMA.
Wideband CDMA	Wideband Code Division Multiple Access is a wireless standard which

	extends CDMA implementation to generate higher data rates. It is categorised as a 3G system.
WRAP	Software for modelling transmitter base stations at a geographical location along with their generated signals, and for conducting radiofrequency interference analyses.
Zamro	Zamro International Pty Ltd. An independent Telecommunications Infrastructure and Professional Services Company, contracted by ACMA to perform the drive surveys for this report.

List of Attachments

1. The Carrier Licence Condition with explanatory statement
2. Telstra – 15 October 2007 Notification of Equivalence
3. ACMA – Comparison of measured CDMA coverage
4. ACMA – Predictive mapping methodologies
5. Telstra – Investigation of coverage around Cunnamulla (Confidential)
 - 5.1 ACMA – Areas where CDMA coverage exceeds Next GTM coverage
 - 5.2 Telstra – Preliminary response to coverage anomalies (Confidential)
 - 5.3 Telstra – Preliminary coverage anomalies analysis (Part 2) (Confidential)
6. Telstra – Report on handset sensitivity (ACMA response document) (Confidential)
7. ACMA – Laboratory Handset Testing – lab & anechoic
8. ACMA – Field testing of handsets at Condobolin
9. Telstra – Market share of Next GTM devices (Confidential)
10. ACMA – Coverage map comparisons
11. Zamro – Next GTM vs. CDMA Coverage report (V2-1)

12. Telstra – Comments on map comparisons (response document) (Confidential)
 - 12.1 Telstra – Map comparisons analysis (response document) (Confidential)
13. Zamro – Survey Equipment Specifications
14. Telstra – Link budgets for CDMA coverage map production (Confidential)
15. Telstra – Next GTM Handheld vs. External Antenna Measurements (Confidential)
16. Telstra – response to the ACMA CDMA – Next GTM Coverage Equivalence draft report (Confidential)
 - 16.1 Telstra – Legal advice from Charles Scerri in the Matter of Telstra Corporation Ltd and Draft Report by ACMA (Confidential)
17. ACMA – Field Testing of Handsets at Crookwell
18. Letter dated 3 January 2008 from the Secretary of the Department to ACMA on the Draft Report on CDMA – Next GTM Coverage Equivalence (Confidential)
19. Telstra – Supplementary response to the AMCA CDMA – Next GTM Coverage Equivalence Draft Report (Confidential)
20. ACMA – Comparison of CDMA and Next GTM handset sensitivity
21. ACMA – Sensitivity differences due to handset holding technique and new Telstra figures for sensitivity
22. Telstra – CDMA market share information (Confidential)
23. ACMA – Prediction maps of coverage configuration differences