IN THE MATTER OF UNDERTAKINGS 23 DECEMBER 2005 LODGED BY TELSTRA CORPORATION LIMITED WITH THE AUSTRALIAN COMPETITION AND CONSUMER COMMISSION IN RESPECT OF UNCONDITIONED LOCAL LOOP SERVICE ("the Access Undertakings")

STATEMENT OF [c-i-c]

On 3 August 2006, I, **[c-i-c]** of 242 Exhibition Street, Melbourne in the State of Victoria, **[c-i-c]**, state as follows:

1

Background

2 I am the **[c-i-c]** of Telstra. I have been **[c-i-c]** since **[c-i-c]**. I have also managed the Telstra Research Laboratories since **[c-i-c]**.

3 **[c-i-c]**

4 **[c-i-c]**

5 **[c-i-c]**

6 **[c-i-c]**

7 Further information on my employment history, academic expertise, memberships, appointments, conferences, research accomplishments and publications are set out in my Curriculum Vitae which forms Attachment A to this Statement.

8 As a result of the above postings and expertise, I am familiar with most new technologies and developments which are available or becoming available in the communications industry.

This statement

9 I have been asked to comment on the report prepared at the request of the ACCC by Analysys Consulting titled "*Comparative Costing of Wireless Access Technologies in Australia*, *final report for the ACCC"* dated 5 May 2006 (the "**Analysys Report**"), the

associated economic model (the "**Analysys Model**") and documentation explaining the operation of the economic model (together the "**Analysys Materials**"). In particular, the focus of this statement is on the cost of providing wireless technologies to customers in "Band 4".

10 For the purposes of preparing this statement, I discussed the issues with **[c-i-c]**whose curricula vitae are attached as Annexure B, C and D respectively. **[c-i-c]**, **[c-i-c]** and **[c-i-c]** have detailed knowledge in relation to radio technology. I have prepared this statement on the basis of my own knowledge combined with the discussions I have had with **[c-i-c]**. To the extent that I have relied on matters of which I was advised by **[c-i-c]**, I believe those matters to be correct.

Summary

11 The Analysys Materials state that the cost of providing connection to customers in Band 4 using a combination of WiMAX and satellite services is $62 per customer per month on average.

12 For the reasons set out below, I consider that Analysys' cost estimate is unrealistic.

The Network Strategies Report

13 I have also reviewed the report prepared by Network Strategies in relation to the Analysys Materials titled "*An accurate assessment of the comparative costs of wireless access technologies in Australia, a report to ACCC"* dated 7 July 2006 (the "**Network Strategies Report**"). That report is critical of the modelling undertaken and conclusions drawn by Analysys regarding the costs of deployment of WiMAX and 3G Technologies in Australia. These concerns are similar to, and independently corroborate, a number of the concerns raised in this statement Further, I have additional concerns which are outlined below.

Technology and Regulatory Overview

<u>Standard Telephone Services</u>

14 As the Primary Universal Service Provider, Telstra is obligated to supply all end users, in all areas of Australia a Standard Telephone Service ("**STS**") upon reasonable request. As such Telstra is also required, pursuant to the Telecommunications (Emergency Call Service) Determination 2002, to make arrangements for emergency calls which comply

with determinations made by the Australian Communications & Media Authority ("**ACMA**").

15 The STS is defined in the Telecommunications (Consumer Protection and Service Standards) Act 1999 (Cwlth). Other obligations which attach to the STS or to providers of the STS can be found in that Act, the Telecommunications Act, the Australian Communications Industry Forum Code "*End-to-end network performance for the Standard Telephone Service"* (C519:2004) ("**ACIF Code**"), and various determinations of ACMA. These include the obligation to provide:

(a) voice telephony services with the ability to make local, STD and international calls;

(b) access to standard emergency telephone services ("**SETS**") free of charge, with a minimum of delay;

(c) support for non voice services such as teletype, fax and modem;

(d) functionality relating to SETS including the ability for the network provide:

(i) information about the number from which the call is made, at the time the call is made; and

(ii) (where the user is using a public mobile telecommunications service or a satellite service) information about the caller's approximate location.

The service must also meet the requirements for legal interception.

16 Telstra must provide STS services in at or above certain connectivity network performance parameters and transmission network performance parameters as outlined in the ACIF Code relating to STS.

17 Telstra is also subject to the universal service obligation which requires Telstra to ensure that "*standard telephone services are reasonably accessible to all people in Australia on an equitable basis, wherever they reside or carry on business*." This means Telstra is required to provide interconnectivity to local and international networks.

18 Telstra is required, in accordance with Telstra's USO Standard Marketing Plan, to keep its network operational (that is display an ability to originate or terminate calls, as indicated

by the presence of a dial tone) 99 per cent of the time over a continuous 12 calendar month period. In order for Telstra to ensure it meets these required service levels, it is necessary for Telstra to provide power supply to the customers' premises equipment ("**CPE**") (i.e. telephone) in the event of a mains power failure.

19 In addition, Telstra is subject to Customer Service Guarantee Standards ("**CSG Standards**") which set out minimum service standards which Telstra is required to meet. Specifically, these standards relate to the minimum performance in relation to the period taken to connect or rectify a fault or service difficulty, and the keeping of appointments to make such connections and rectifications.

20 Under the CSG Standards a 'fault' includes:

(a) absence of a dial or ring tone;

(b) inability to make or receive calls;

(c) disruption to communications because of excessive noise levels;

(d) repetition of service cut offs;

(e) a condition that makes the service wholly or partly unusable; or

(f) if the service includes an enhanced call handling feature — the feature not being operative.

21 Finally, Telstra is required to comply with declared licence conditions relating to network reliability, the Network Reliability Framework ("**NRF**"). The NRF complements the CSG Standards in relation to faults. Essentially the NRF operates to prevent or reduce the incidence of high fault levels and recurrent multiple faults on Telstra telephone services through a comprehensive monitoring, prevention and remedial scheme. The NRF operates at 3 levels: the individual service, the local exchange and the broad geographical area.

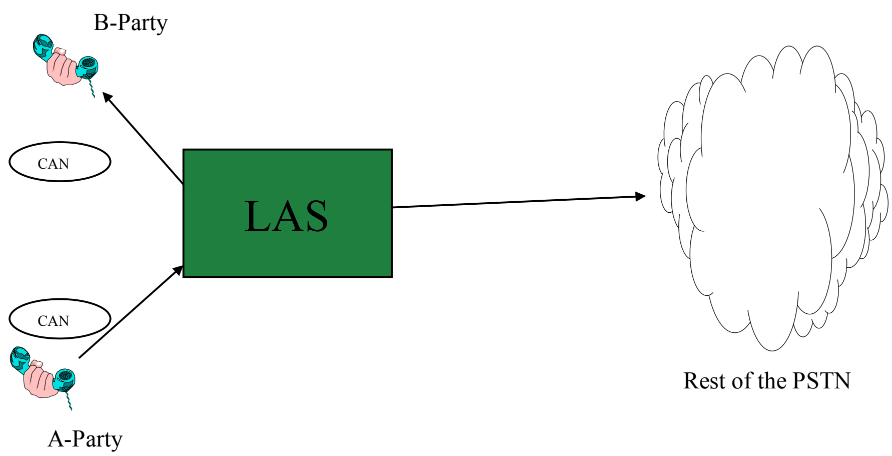
22 For example in relation to individual services, under the NRF Telstra has to take steps to prevent any individual telephone service from experiencing a certain number of faults within a particular period. If a service has 4 or more faults in a rolling 60-day period or 5 or more faults in a 12-month period, Telstra has to notify the ACMA and take remedial

action. The remedial action has to be agreed to by the ACMA and completed to the ACMA's satisfaction.

Making a telephone call on a telecommunications network

23 To make a telephone call from one person's handset (A-party) to another (B-party), the handsets must be linked by a network capable of transmitting the call.

24 The simplest possible call is a call between two customers connected to the same Local Access Switch ("**LAS**"). This call would be a local call. To make a call the A-party lifts the handset. This tells the LAS that the A-party wishes to make a call. The LAS responds by sending a dial tone through the Customer Access Network ("**CAN**") (also known as the '**local loop'**) to the A-party. The A-party then dials the B-number. If the line for the B-number is free, the LAS connects the two lines. This sends a ring tone to the A-party and a ring to the B-party. This may be illustrated as follows:



25 Generally, the same process is used for long distance and international calls but for those sorts of calls, the call is routed through more than one LAS. For the purposes of this statement and without going into unnecessary detail, this would mean the call is routed through the 'rest of the PSTN', meaning the rest of the public switched telephone network.

26 Telecommunications transmission systems use electrical, radio or optical signals. Such communication signals can be sent in either analogue or digital form. Analogue transmission is when the communication signal is sent in the form of a continuous signal. In digital transmission the continuous signal is converted to a series of 0's and 1's, or 'on' and 'off' pulses. This binary information is known as "bits" of data. For a telephone service, the tones in the sound waves are sampled and coded into bits.

27 In the diagram above, the connection between A-party's handset and the LAS is shown as a straight line. In reality, that connection is made by any one of a number of different technologies. The technologies currently deployed to make these telephone connections in Australia include (ordered from most common to least common):

(a) copper cable;

(b) High Frequency radio ("**HF radio**");

(c) Hybrid Fibre Coaxial cable ("**HFC**");

(d) optical fibre;

(e) microwave; and

(f) satellite.

These connection technologies are described below.

Copper cable

28 The technology most predominantly used in the CAN is copper cable. Copper cable is used for both analogue and digital transmission. Typically one pair of twisted copper wires (a "**twisted pair**" or "**copper pair**") is used for each Service In Operation ("**SIO**"). A single SIO is used to connect a single telephone. However, with technical enhancements a single copper pair can be made to carry broadband internet traffic (in the form of DSL described below) and multiple telephone connections.

29 Because the voice transmission over copper cable uses only low frequencies, it is possible to use the high frequencies of the copper cable for other purposes, simultaneously with any voice conversation being transmitted. One such technology which allows a broadband internet service to be provided over the high frequencies is known as Digital Subscriber Line or ("**DSL**"). The benefit of DSL over other types of broadband internet is that usually the customer's premises will already have copper rolled out to the premises, particularly in urban or suburban locations. The limitation of DSL technology is that it can only be offered where the customer's premises are within a certain distance from the local telephone exchange. This distance depends on the type of copper cable, (e.g. its thickness) which is used to connect the customer to the exchange.

HFC

30 HFC is a combination of optical fibre and coaxial cable that provides large capacity and excellent quality enabling high speed data transfers. Optical fibre runs between exchanges and hubs (located in suburban streets), and coaxial cables run between the hubs and customers. Coaxial cable is a cylindrical tube with one central conductor surrounded by an outer conductor, with a shield between the two conductors. HFC can be used to provide cable television, broadband internet and telephony services (although HFC is not used to provide telephony services by Telstra).

Optical fibre

31 Optical fibre cables provide large capacity and excellent quality, and are mainly used for digital transmission. They include a number of fibres and sometimes a thick central wire for strength. Typically, they need repeaters every 100-200 kilometres to regenerate the signal, and a power feed. Each fibre is capable of transmitting data the equivalent of tens of thousands of telephone circuits.

HF radio

32 HF radio transmits at megaHertz ("**MHz**") frequencies. A megaHertz is one million Hertz, which is one million cycles per second. It can cover long distances by refracting ('bouncing') the radio signals off the ionosphere, a naturally occurring layer above the earth. It provides low capacity and only fair quality.

Microwave

33 Microwave is transmitted at gigaHertz ("**GHz**") frequencies. A gigaHertz is one thousand million Hertz, which is one thousand million cycles per second. It uses line of sight between antennas on towers. It covers long distances by using antennas on a series of towers. The signal is received by an antenna on one side of a tower, then amplified, and retransmitted by the antenna on the other side of the tower. It provides large capacity and good quality for all services, including video.

Satellite

34 Satellite transmission is also at gigaHertz frequencies. It uses line-of-sight from an earth station to a communications satellite and then back to another earth station. It covers long distances by using a geostationary satellite above the earth to receive, amplify and

retransmit the signals. These satellites are located approximately 37,000 km above the earth's surface.

35 Satellite provides large capacity and good quality for all services including video. However it has a quarter of a second delay per 'hop'. This delay is referred to as 'latency' which is a measure of the time it takes for data to travel through the network, and is critical for applications that use real-time communications, like voice and video. The latency of satellite services is noticeable to telephone customers and accentuates any echo which may be present. A single satellite hop means transmission using one satellite, and a double satellite hop means transmission using two satellites in a series. A carrier can use echo suppressors or echo cancellers to reduce the echo, but cannot remove the quarter of a second delay per satellite hop.

WiMAX

36 WiMAX is a form of microwave or 'wireless' (radio) technology which provides broadband services based on the Institute of Electrical and Electronic Engineers ("**IEEE**") 802.16 standard or protocol. WiMAX stands for 'Worldwide Interoperability for Microwave Access', which is the name of the forum whose members are made up of communications operators and equipment companies. The WiMAX forum's charter is to promote the IEEE 802.16 standard and to ensure that equipment with the WiMAX stamp conforms to that standard and operates seamlessly with WiMAX equipment from other vendors.

37 There are two variants of WiMAX, namely Fixed WiMAX and Mobile WiMAX. They are at different stages of development. Fixed WiMAX is more advanced in its development than Mobile WiMAX. For example, certified Fixed WiMAX base stations and CPEs began to appear on the market in the first quarter of 2006. Mobile WIMAX is far less developed. The certification process for Mobile WiMAX, (which involves the establishment of a certification laboratory and agreement on test processes) is only due to be completed at the end of 2006. This means that certified Mobile WiMAX equipment will not be available until late 2007. However, even Fixed WiMAX is relatively immature in terms of its deployment. To my knowledge there are no large scale deployments existing today and very little operating data available from real operating experience about its actual performance.

38 As its name suggests, Fixed WiMAX is designed for fixed wireless applications. Mobile WiMAX can support both fixed and mobile terminals. The two variants are not compatible with each other.

39 I understand that the Analysys Report generally refers to Fixed WiMAX, as this would be the more appropriate deployment for Band 4 scenarios.

High Speed Down link Packet Access ("**HSDPA**")

40 HSDPA is another form of wireless (radio) technology which is based on the W-CDMA standard or protocol. HSDPA is an advancement on Wideband Code Division Multiple Access ("**W-CDMA**", also known as third generation or **"3G"**). The base 3G technology enables users to receive data rates at rates up to 384 kilobits per second ("**kbps**"). However, owing to propagation loss issues (described below), and the fact that users are spread out over different distances from the cell's base station, the average data rates are about 200 kbps.

41 For 3G mobile networks using W-CDMA, HSDPA is an improved transmission method for sending data to users in the downlink direction (i.e. from the base station to the user). HSDPA requires new software and some small modifications to be made to W-CDMA base stations. HSDPA is yet to be rolled out in Australia.

42 HSDPA will enable users to receive data rates up to about a maximum 'peak' rate of 14 Mbps or Megabits per second. While peak rates are possible in theory, owing to propagation loss (described below), environmental and other factors, users will receive data at 2.2 Mbps on average, depending on their location.

43 As HSDPA is presently optimised for the transmission of data, it is currently not designed to support voice. However, HSDPA is generally implemented along with W-CDMA which supports circuit switched voice. The 3G Partnership Project, which is a Standards body, is currently working on support of high quality voice over IP technology on HSDPA.

Similarities and differences between HSDPA and WiMAX

44 Both HSDPA and WiMAX use portions of the radio frequency spectrum based on dedicated and exclusive allocation made by the ACMA, a government agency.

45 Both HSDPA and WiMAX transmit digital signals using defined but different protocols. These protocols are initially defined by industry bodies, equipment manufacturers and eventually ratified by relevant International Standards organisations to ensure uniformity and worldwide interoperability. The two technologies themselves are however not interoperable, for example a HSDPA receiver would not be able to communicate with a WiMAX transmitter because they speak different 'protocols' or 'languages'.

46 Both HSDPA and WiMAX transmissions, like all radio technologies, suffer from "propagation loss" which means that as the digital signal travels through the environment it gradually loses signal strength, much as a wave loses its strength as it reaches the shore. This loss of signal energy results in a practical limit on the coverage area of a HSDPA or WiMAX radio transmitter, usually measured as a "cell radius" - being the radial distance from a transmitter. A small cell radius implies less coverage compared to a large cell radius. A radio technology with a larger cell radius will need fewer transmitters to cover a given area.

47 The most important factor governing cell radius is the frequency used. Because of fundamental principles of physics, radio signals with lower frequencies are received with greater strength over a longer distance than radio signals with higher frequencies. Thus it is advantageous to use spectrum in the lower frequency band compared to spectrum in a higher frequency band.

48 Telstra is currently in the process of deploying HSDPA in the 850 MHz band because:

(a) Telstra has already purchased the right to use spectrum in this band through a competitive auction process; and

(b) other (overseas) carriers will have deployed HSDPA equipment which operates at this band and therefore the necessary equipment will be readily available from equipment vendors.

49 **[c-i-c]**

50 Today WiMAX is only standardised to operate in much higher frequency bands, such as the 2.3, 2.5, 3.5 and 5.8 GHz bands. Therefore it will have much smaller cell radii compared to HSDPA systems. Accordingly, WiMAX systems will require a larger number of transmitters to cover the same area as HSDPA systems. **[c-i-c]**

Development of WiMAX equipment and deployment of networks to date

51 Vendors of WiMAX equipment need to submit their equipment for certification testing to demonstrate that it conforms to the standards and is inter-operable with equipment from other vendors. A total of 11 vendors have now successfully passed equipment through the Fixed WiMAX certification program. There are 23 separate pieces of certified equipment split between the Subscriber Station (i.e. CPE) (14) and Base Station (9) categories. However, as stated above, the actual operating experience with WiMAX equipment is limited.

Voice calls on WiMAX

52 A voice service can also be delivered over WiMAX using a technology known as Voice Over Internet Protocol ("**VOIP**").

53 The difference between a VOIP telephone call and a call over the PSTN is that calls across the PSTN are 'circuit switched' - meaning a dedicated circuit is established and retained for the duration of a call. On the other hand, in a VOIP call there is no dedicated path between the two parties. Voice traffic is broken up into small units known as packets which contend (or compete) for passage in a shared channel. Voice packets from different users will contend against each other as well as against data packets emanating from data calls. Packets may have to wait in a queue to get access if channel capacity is fully utilised at any given time.

54 For an end user to make a call using VOIP over WiMAX he or she would require CPE with a VOIP device attached to (or contained within) the handset. The VOIP device samples the speaker's voice, and converts the samples into digital format. Then, a complex algorithm (known as a codec) is applied to the digitized speech to reduce (compress) the amount of information that is sent to the other party. After the information is structured into packets additional encapsulation information is added to the packets. This is akin to a message in an envelope - the message is the information being sent by VOIP. The address on the envelope contain protocols as to the destination of the message and information about the format of the message.

55 The signal would then be transmitted from the customer's CPE, across the WiMAX wireless connection to the base-station. The network behind the base station would require additional equipment to manage the VOIP traffic and interconnect it to the PSTN.

56 Impairments suffered in the transport of VOIP packets will degrade the voice quality perceived by the listener. In particular, VOIP packets can be subject to data corruption or packet loss. Generally speaking the human ear will only tolerate a limited amount of data loss or corruption before the speech quality becomes unacceptable. Sources of packet loss and corruption are delay, delay variation, congestion and signal degradation due to noise.

Delay

57 Because voice conversations can only tolerate a limited amount of 'latency', packets of voice cannot be delayed for too long when transmitted across the network. Packet delay is a problem which arises due to packetisation (which is the time to collect and transmit each packet of information) and due to packets contending within the network for shared resources (such as a shared transmission link) and thus having to queue to gain access to those resources. When packets are delayed for too long, they have to be discarded and this can make a voice conversation sound slow, disjointed or even unintelligible.

Delay Variation

58 Delay variation occurs where packets of data sent over a network are not only delayed, but each packet is delayed for a different amount of time. The effect of delay variation is that the total transmission time for some packets is shorter or longer than other packets. This affects the quality of the voice signal perceived by the listener.

Congestion

59 If a network becomes very busy ('congested'), the queues of packets waiting for shared resources may overflow, in which case packets are lost and thus are missing from the voice stream received by the end user. Like packets that arrive too late, this leads to an impairment of the signal quality.

Data Corruption

60 Packets can also be destroyed due to data corruption which occurs when the transmitted signal in a wireless network is degraded by noise, being any unwanted signal which interferes with the transmission. Various techniques such as packet re-transmission can be applied to minimise such corruption but these in turn increase the delay and delay variation.

61 For its part, WiMAX tries to minimise these delay and packet loss impairments by applying quality of service algorithms on the transmitted packets. For example, WiMAX will give priority to VOIP packets over packets belonging to services with less stringent delay requirements. However these quality of service algorithms are only effective where the network has sufficient capacity. For example, where insufficient capacity means that packets are significantly delayed, quality of service algorithms will be of no effect. I discuss below the necessary capacity.

Fundamental Assumptions of the Analysys Model

62 The Analysys Model makes a number of assumptions as follows:

(a) the model assumes an initial roll-out of 1 WiMAX base station per exchange area;

(b) the model assumes that the WiMAX system can provide service for premises up to 12 km from the base station;

(c) the model assumes customers outside the WiMAX footprint would need to be served by satellite;

(d) values are attributed to the unit radio costs, carrier throughput achieved and spectrum required to provide the level of service;

(e) the model assumes market uptake of services, broadband service speed per customer and a contention ratio for the sharing of the channel capacity.

63 Despite the fact that the Analysys Report states that it is seeking to provide ‘indicative costing’ at a ‘fairly high level’, it could only be said that the pricing is indicative of a theoretical world which bears little resemblance to the Australian marketplace, and which uses network equipment which operates well beyond its widely-known technical limitations.

Spectrum limitations

64 Analysys assumes that there is a wide band of spectrum available in the 3.5GHz range for WiMAX deployment. The estimate used is in excess of what is possible both in theory, and in practice, in Australia.

65 Telstra owns very limited amount of spectrum in the range assumed by the Analysys Model. Telstra's Spectrum licenses in the 3.5 GHz band covers **[c-i-c]** of all addresses within Band 4 ESAs.

66 The Analysys Model assumes 3-sectored base stations. This means the coverage are of the base station is divided into 3 sub areas. Each sub area is served by a different portion of the spectrum (frequency)The Analysys Model also uses 5 MHz carriers. A carrier is a frequency in the spectrum band and it occupies, in conjunction with the information carried on it, a portion of the spectrum band – 5 MHz in the case of Analysys model. Thus it would require 3×5 = 15 MHz spectrum for a 3 sector single carrier system, i.e. 1 carrier per sector. In Australia, the most spectrum any single party owns in any area in the 3.5 GHz band is approximately 65 MHz. This means that the maximum number of carriers which may be used at any single base station is 4 (65÷15). The total spectrum available in the 3.5GHz band is 100 MHz. Analysys, however, assumes that 15 carriers can be deployed per sector. 15 carriers would require 15×15 =225 MHz of spectrum.

67 The Analysys Model also does not take into account any costs for sub-licensing the required spectrum from Telstra's competitors, where this is available.

Using WiMAX to provide STS

68 The Analysys Report states that the Analysys Model provides the cost of Telstra, or a new entrant, providing a service equivalent to ULLS. This is clearly not the case as the Model fails to take into account costs that would be necessarily incurred in providing a STS over WiMAX.

69 The call control infrastructure and technology for enabling a WiMAX network to be STS compliant is yet to be developed. No such carrier grade deployment exists today. Thus to provide STS over WiMAX, new technology would have to be developed, deployed, tested and implemented prior to being rolled out. This would involve considerable costs.

70 This would also involve considerable risk, as there is with any new technology roll out. Given the importance that STS is provided (and the fines which may be imposed for a failure to provide STS), additional network infrastructure would be required to ensure required reliability and availability. The Analysys Report and Analysys Model do not take into account the costs associated with mitigating the risks of providing STS on WiMAX.

71 For Telstra to implement PSTN like services using WiMAX it would need to implement additional network infrastructure because WiMAX does not include specification of how voice services are developed. As set out above, WiMAX would have to utilise VOIP technology, which is currently not implemented in Telstra's core network. The cost for doing this have not been addressed in the Analysys Model.

72 Analysys assumes that the packets to provide voice calls need only be 8 kbps. This does not take into account the 64 kbps required for PSTN quality or to carry fax and modem signals as described in paragraph 15. It also does not take account of the encapsulation described in paragraph 54 above. Once encapsulation is taken into account, the data rate becomes at least 40 kbps when voice is coded at 8 kbps. This is consistent with the WiMAX forum which estimates the data rate for voice calls to be 64 kbps. However, that would only be for calls which are equivalent to mobile calls in terms of quality. To provide calls equivalent to PSTN quality the data rate is 64 kbps and with required encapsulation it becomes close to 128 kbps.

73 An Erlang is measure of voice traffic. Analysys assumed 10 milli Erlangs of voice traffic per customer. The amount of traffic in Australia is a lot higher. A more reasonable figure would be **[c-i-c]** Erlangs of voice traffic per customer.

74 In a practical implementation, the relevant capacity for voice would need to be set aside or a quality of service system would be required which would give higher priority to voice traffic. The costs associated with such implementation issues have not been included in the Analysys Model.

Sector throughput (transmitter has certain capacity)

75 Analysys assumes appropriate sector 'throughput' (or "bandwidth per sector") is 10 Mbps. Sector throughput is the number of information bits that a sector can deliver correctly to all data users that the sector serves. Based on my understanding of the capabilities of WiMAX equipment, I believe this figure to be an inaccurate representation of the throughput ordinarily achieved by such equipment.

76 In order to determine a more realistic sector throughput estimate **[c-i-c]** and other radio experts in his team conducted simulated modeling based on equipment specifications provided by equipment vendors.

77 The team modelled the throughput of a cell at 3.5GHz. The model assumed:

- 3 sectors per base station;
- each of the three sectors in a base station use distinct frequencies to avoid interference;
- external CPE antennas;
- channel bandwidth of 5 MHz.

and allowed for a range of inputs for cell radius, antenna height, site spacing and customer antenna gain (which is the ability of the antennas to amplify the received signal).

78 The maximum throughout calculated was **[c-i-c]** Mbps for non-line of sight (non-LOS) systems. Consistent with the Analysys assumptions, I believe that line of sight is unrealistic for many users within a given cell especially where the exchange area covers areas with dense foliage and or hilly terrain as is usually the case in rural Australia.

79 Reducing the sector throughput in the model has the impact of increasing the costs associated with providing WiMAX. This occurs because, given the lower throughput, it is likely that:

(a) more carriers will be required subject to the maximum available (4 using my assumption as set out in paragraph 66;

(b) more spectrum would be required to be purchased or leased for use, where that option is available; and

(c) more base stations will need to be built.

Tower costs

80 In rural and remote locations (which form the bulk of Band 4), Analysys assumes tower construction costs of $200,000 and assumes a price of $25,000 for land.

81 **[c-i-c]** has obtained recent estimates for the typical costs of constructing a base station of the type referred to in the Analysys Model based on Telstra data. Based on this information, I believe that a more realistic cost for construction of a non-metropolitan tower (inclusive of land cost) land is **[c-i-c]**.

Cell Radius

82 Analysys has assumed in their Model that the WiMAX technology has a range of 12 km from the base station in Band 4-Remote & Band 4-Minor Rural areas, because it assumes that customers in rural areas have an outdoor antenna and the chance of achieving line of sight in band 4 is higher than in other areas. I believe this is a significant overestimate of the coverage of WiMAX technology.

83 In practice, the process for determining the cell radius or "propagation distance" of a radio base station is extremely difficult. Propagation distance is affected by the following factors:

(a) the terrain over which the radio service operates;

(b) the power of the base station;

(c) the power of equipment at the customer's premises;

(d) the height of antenna; and

(e) interference levels of systems or other cells in the vicinity of the cell in question.

84 Cell radius will be impacted by things such as height of antenna sites, height of the customer antenna, antenna gain, the use of different propagation models or the use of different fade margins.

85 **[c-i-c]** and **[c-i-c]** have obtained technical specifications of WiMAX equipment from **[c-i-c]**. For the specified maximum transmit power level of such equipment they estimate the cell radius to be **[c-i-c]**. A greater cell radius may be achieved using more powerful transmitters at a higher cost.

86 I believe a radius of **[c-i-c]** km is more realistic than the 12 kms used by Analysys based on radio characteristics of typical WiMAX infrastructure and customer equipment using external antenna in a rural non-line of sight propagation environment.

87 It is worth noting that Austar, a strong advocate of WiMAX confirms that **[c-i-c]** is a realistic cell radius estimate of WiMAX systems at 3.4 GHz as shown in the following report.

54 COMPANIES Wec

Austar finds its voice in the bush

Tony Boyd

KEY POINTS

- Wi-max can reach 8km from a base station, compared with DSL's effective range of about 2km.
- Austar plans to offer a 'stripped down' product with no locked-in contracts to woo jaded consumers.

Regional pay TV monopoly Austar will begin offering voice services in rural areas from the first quarter of next year as part of its deployment of a wireless broadband network covering 750,000 homes.

The deployment of wireless broadband by Austar will pose a threat to Telstra, which earns margins of up to 80 per cent on its fixed-line phone services in rural and regional areas.

Austar chief executive John Porter said broadband wireless over wi-max technology would let Austar offer voice over internet protocol (VoIP) services, allowing Telstra customers who signed up with Austar to switch off their fixed-line phone.

"Voice is a very significant part of our business model," Mr Porter said yesterday.

"The bundle of having pay TV as well as voice and data services will be very important."

Mr Porter described voice services on broadband as a "Trojan horse" that would give Austar access to households in country towns outside the limited range available through Telstra's fixed line broadband services, called DSL.

A Telstra spokesman said that the company has always encouraged competition, "particularly in regional and rural areas".

Mr Porter said wi-max could reach about 8 kilometres from a base station and that this compared favourably with DSL services, which tended to suffer severe quality problems when extended beyond 2 kms from an exchange.

Apart from Austar's commercial roll out of wi-max in rural areas, the company is a member of a consortium seeking a share of the federal government's $1.1 billion Connect Australia subsidies for delivering broadband to rural areas.

The other members of the AUSalliance consortium are Unwired and SP Telemedia.

Mr Porter rejected recent comments made last week by Telstra questioning the suitability of wi-max broadband technology.

"Austar and Unwired are today successfully operating pre-wi-max networks," he said.

He said the government should use the Connect Australia funding to promote competition in rural areas because it would "double the bang for the buck".

He said Austar's plans to reach 750,000 homes would involve the deployment of 115 towers at a cost of about $50 million in capital investment and expenses; and that the AUSalliance plan was to deploy another 600 towers if the funds were available.

Mr Porter said Austar had conducted research in rural areas about what people thought of the current broadband products and found that consumers were concerned about the complexity of product offerings.

"Broadband consumers are a bit jaded," he said.

It was for this reason that Austar had launched a "stripped down" product offering with no locked-in contracts.

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88 Further WiMAX Forum's own estimate for the cell radius of rural areas, using external antennas (as assumed by Analysys) is 5.2 km as set out on page 15 of its publication "*WiMAX Deployment Considerations for Fixed Wireless Access in the 2.5 GHz and 3.5 GHz Licensed Bands dated June, 2005*" (which is Annexure E to this Statement).

89 If the cell radius is reduced to **[c-i-c]** km, the area covered by WiMAX will be reduced and the remainder of the area must be covered by satellite.

Distribution of customer premises from the exchange

90 Analysys also makes a number of invalid assumptions about the distance of customer premises from the WiMAX base station, leading to a significant overestimate of the number of customers in Band 4 who can be served by WiMAX. The remaining customers must be served by satellite.

91 Set out below is Telstra data provided by Telstra's Fundamental Planning group which shows the distribution of the distance of premises from the exchange within Band 4. The variance between Telstra data and that used by Analysys is particularly significant for Band 4 customers, as shown in the following graphs.

[c-i-c]

CPE

92 Analysys has assumed that customers within 1 km of the base station use indoor antennae and customers beyond that distance require outdoor antennae. Analysys has assumed that the cost of these outdoor antennae to be $400.

93 Based on industry sources, a more appropriate estimate for the cost of outdoor CPE is **[c-i-c]**, which is considerably more than the estimate used by Analysys.

Additional costs

94 Analysys has not included in its model the likely costs of Operation Management Centre ("**OMC**") or Wireless Access Controller ("**WAC**"). Both of these pieces of equipment are essential for network management of a WiMAX network.

95 A reasonable estimate of OMC and WAC costs cumulative over the 10 year period, based on industry sources, is **[c-i-c]**.

96 The Analysys Model makes the erroneous assumption that WiMAX towers can be 'co-located', or adjacent to, the local exchange. In reality, some towers will have to be located up to a few kilometres from the exchange due to terrain considerations.

97 In these circumstances it is necessary to transport the data from the tower back to the exchange. The cost associated with this additional transmission requirement has not been accounted for in the Analysys Model.

98 In certain rural and remote locations where mains power is not available (and generators are often used for electricity), it is necessary for Telstra to provide solar power facilities as back up to power CPE in the event that other power is unavailable. This is because it may be necessary (even vital) that these customers have access to the CPE and the network even if their power generators break down or power is not otherwise available. The Analysys Model does not include these costs.

Discount Rate

99 The Analysys report states that the a cost of capital of 9.95% was used for Telstra and 15% was used for a new entrant, in order to properly represent the higher risk for a new entrant. The risk associated with the introduction of new technology of this nature is no different for Telstra than for a new entrant and accordingly the 15% rate should be used in both cases.

Number of customers demanding broadband

100 The Analysys assumes that a WiMAX network will serve broadband needs of customers for the next 10 years. I consider this highly improbable given the foreseeable growth in broadband service demands.

101 For example, the Analysys Report states that penetration of high speed broadband (6+Mbps) will grow relatively slowly to less than 10% in 2015. Analysys' view of the likely demand is particularly short sighted. Given recent trends in broadband consumption, and the plethora of new digital content becoming available and which is expected to be delivered over broadband networks, I consider that demand well in excess of 6Mbps will be expected by the Australian community within 10 years. As such the required bandwidth is understated and likely to be insufficient.

102 I believe that the service speed assumed by Analysys also grossly underestimate future requirements. This is because I expect increasing demand over the next 10 years for video services and an increase in expectation for high definition video services as consumers increasingly acquire TV sets capable of displaying high definition signals. An increasing amount of the content delivered over broadband networks will be such high definition TV content. Even with advances in coding technology, high definition signals will require approximately 8Mbps per channel and I expect that the average home will need to be able to receive more than one channel simultaneously. Thus the required speeds would be in the order of 20 Mbps to be able to provide 2 High Definition TV channels along with other services. It is also worth noting that such high speed wireless connections will need to serve homes with multiple users, all simultaneously wanting to use the high speed access through a home network. Such practices, (i.e. simultaneous access by several users), are already evident in WiFi enabled homes with ADSL access.

Sharing of Network Resources

103 **[c-i-c]**

Conclusion

104 Providing services to customers in Band 4 areas using WiMAX as a replacement for copper cable would involve a significant (multi-billion dollar) investment in new and unproven technology at a cost significantly greater than that estimated by the Analysys Model. It would also require the deployment of new (VOIP) network infrastructure to provide voice services which has not been discussed in the Analysys Materials, but which would represent a significant additional capital and operational expense. Finally, the ability of a radio network to provide the long term service needs of fixed customers using today's technology is highly improbable. On this basis I do not believe the proposal by Analysys represents a viable alternative to copper cable in Band 4 areas.

Dated: 3 August 2006

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[c-i-c]

ATTACHMENT A TO THE STATEMENT OF [c-i-c]

ATTACHMENT B TO THE STATEMENT OF [c-i-c]

[c-i-c]

ATTACHMENT C TO THE STATEMENT OF [c-i-c]

[c-i-c]

ATTACHMENT D TO THE STATEMENT OF [c-i-c]

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