Mobile Coverage Programme Discussion Paper
Submission Cover Sheet

Submission Information

This cover sheet should be attached to submissions made to the Department of Communications in relation to the Mobile Coverage Programme Discussion Paper.

Contact Details

Name of respondent:	[redacted]
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Date:	3rd April 2014

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Do you want all or parts of the submission to be treated as confidential? **Yes** ☐ **No X**

If yes, identify below which parts of the submission are to be treated as confidential (and provide a reason):

If the submission contains personal information of any third party individual, indicate on this Submission Cover Sheet if that third party individual has not consented to the publication of his or her personal information:

Submission Instructions

Submissions are to be made by **5:00pm (AEST) Friday 28 February 2014**.

Where possible, submissions should be lodged electronically, preferably in Microsoft Word or other text-based formats via the email address mobilecoverage@communications.gov.au

Alternatively, submissions can be sent to the postal address below (to arrive by the due date):

The Manager
Mobile Coverage Programme
Department of Communications
GPO Box 2154
CANBERRA ACT 2615

All submissions lodged will be acknowledged by the Department of Communications by email (or by letter if no email is provided). Respondents lodging a submission who do not receive acknowledgement of their submission should contact the Department. Submissions which are not acknowledged by the Department as being received may not be considered. Respondents should be aware that emails greater than 10Mb may not be successfully delivered.

THE DIGITAL PRODUCTIVITY AND SERVICES FLAGSHIP
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CSIRO

Response to

Mobile Coverage Programme

Discussion Paper of 16th December 2013

Digital Productivity and Services Flagship
CSIRO
North Ryde, NSW

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Introduction

The Department of Communications is seeking input from the telecommunications industry, all levels of government and other interested stakeholders on the best way to deliver the Government's funding commitment of $100 million (GST exclusive) towards a programme to improve mobile coverage and competition in regional Australia.

Extending mobile cellular coverage to rural and remote Australia is an important issue and was highlighted in the 2012 Regional Telecommunications Review[1]. The government is seeking efficient solutions to addressing "black spots" and extending highway mobile coverage.

CSIRO's recommendations are limited to technical issues and a list of recommendations.

Summary of CSIRO Recommendations:

Part 1 - $80 million Mobile Network Expansion Project

1. That the selection criteria include *additional highway coverage* ("new coverage" in km) at minimum downlink data rates of 384 kbps and uplink data rates of 64 kbps (example data rates only) for mobile users.
2. That the selection criteria include the *longest contiguous highway coverage* ("new coverage" in km) created at minimum downlink data rates of 384 kbps and uplink data rates of 64 kbps (example data rates only) for mobile users.
3. That the selection criteria include the estimated additional population covered with 4G LTE services rather than square km of additional coverage.
4. That consideration be given to the minimum acceptable data rates required for highway coverage (mobile users) and emergency services (fixed or limited mobility) before setting dBm thresholds.
5. That the submissions require inclusion of backhaul capacity to carry the expected traffic generated by users operating with the achievable data rates in the cell.
6. In the event of multiple MNO's delivering additional coverage, that recommendations 1 through 5 apply to the combined proposal of the MNO's
7. That NBN Co infrastructure be allowed to be incorporated in a bid and that NBN Co provide to all bidders suitable information to allow infrastructure sharing.
8. That new network bidders benefit from concessions related to connection to the NBN points of interconnect

Part 2 - $20 million Mobile Black Spots Project

9. That "New coverage" should be prioritised with minimum acceptable data rates, rather than "Extended coverage".

[1] http://www.rtirc.gov.au/2011-12_report/

Part 1 - $80 million Mobile Network Expansion Project

Designed to improve mobile coverage along major transport routes, in small communities and in areas that are prone to experiencing natural disasters.

1.1 Delivery option 1 – Single mobile network operator contracted to deliver the programme

Under this option, the Commonwealth would call for bids from MNOs or consortia of MNOs. The bids would specify the number of proposed mobile network base stations to be built Australia-wide, the location of the base stations, and the improved coverage that would be provided from these base stations, in exchange for receiving funding of $80 million.

Question 1. *Would an appropriate minimum quality standard be that base stations must provide high-speed 4G LTE mobile broadband data communication services and also high quality 3G mobile voice and broadband data services? If this is not an appropriate minimum quality standard, what is?*

CSIRO Response: Coverage rather than high-speed data rate should be the predominant design requirement. For highway coverage, the major requirement is reliable cellular links for voice communications (including emergency calls), as well low rate data transfer of the order of 100's kbps to 1 Mbps (for telemetry, navigation services or web access). For emergency services or in natural disaster situations, the demands are similar however the requirement for reliability is significantly more important. For small communities however the data rate requirements are significantly greater and may be met through different technology options than those for highway or emergency services requirements. Small communities should be offered 4G LTE data rates.

In areas with low population density and low levels of telecommunications infrastructure, coverage rather than capacity (number of active users times data rate per user) should be the predominant design requirement for radio networks. As maximum data rate requirements are reduced, coverage is increased and so users further from the base station may be served.

Coverage Considerations

For a given technology choice (3G, LTE or others), maximum received data rates available to users will depend on their received signal strength and propagation channel conditions (fading or non-fading). Factors which influence the received signal strength include (see Figure 1)

- Carrier frequency
- Base station transit power
- Base station height
- Distance between user terminal and base station
- Directionality or gain of the base station antenna
- Directionality or gain of the user terminal antenna

- Line of sight conditions between user terminal and base station
- Terrain near the user terminal

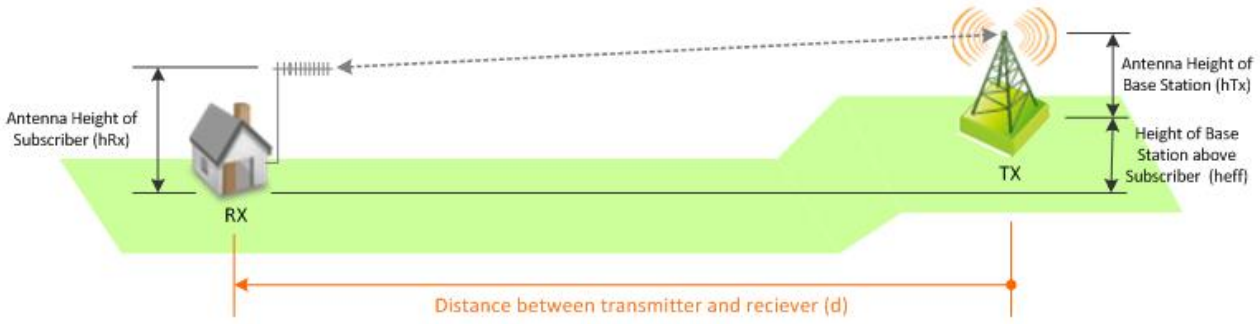

Figure 1. Model of major parameters impacting propagation (static environment).

Figure 2 shows an example of simulated LTE system with coverage limits corresponding to two different data rates with the highest data available in the area marked in "green" and the lower data rates marked in the area marked in "red". The simulation was performed using commercial available simulation tools for a hilly region near Walcha in NSW. By reducing the received signal threshold, substantially greater coverage is achieved. It should be noted however that this coverage is non-contiguous with coverage gaps created by terrain.

Figure 2 also compares coverage at two different carrier frequencies (700MHz and 2300MHz) when using the same transmit power, bandwidth and base station antenna height. The lower frequency signal has much greater coverage for each of the data rates (antenna height, antenna gain and transmit power the same in both cases). The selection of carrier frequency arguably has the most significant effect on the coverage available.

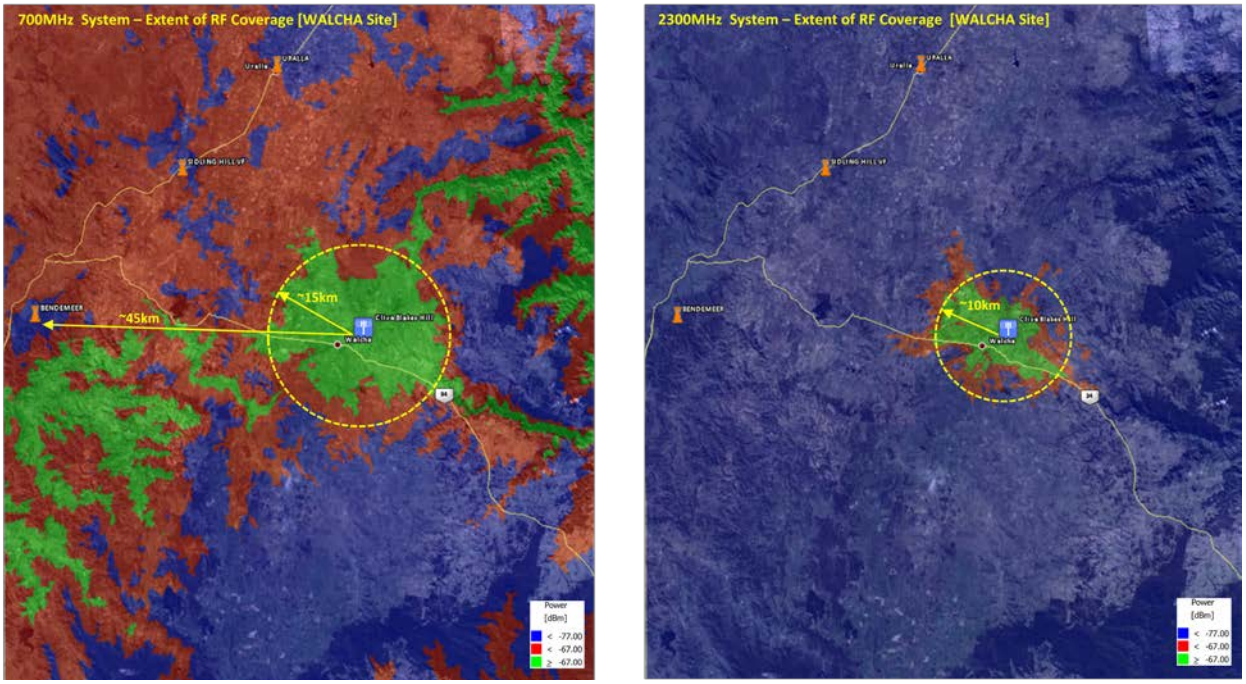

Figure 2. Example Coverage comparison 700MHz and 2300MHz for different SNR values (Data Rates)

Recommendations:

1. That the selection criteria include *additional highway coverage* ("new coverage" in km) at minimum downlink data rates of 384 kbps and uplink data rates of 64 kbps (example data rates only) for mobile users.
2. That the selection criteria include the *longest contiguous highway coverage* ("new coverage" in km) created at minimum downlink data rates of 384 kbps and uplink data rates of 64 kbps (example data rates only) for mobile users.
3. That the selection criteria include the estimated additional population covered with 4G LTE services rather than square km of additional coverage.

Question 2. *What are the most appropriate indicators that could be used to specify the minimum quality standards that should apply to the mobile services being provided through the programme? For instance, should it be a minimum received service signal indication (RSSI) in decibel-milliwatts (dBm)? A similar approach was adopted recently in the UK where a comparable programme specified a minimum RSSI for 3G voice and basic data service of -85dBm on roads and -75dBm in community areas (outside premises).*

CSIRO Response: As illustrated in Figure 2, this is a common approach to determining cell coverage. The selection of threshold values of -85dBm and -75dBm imply minimum data rates within the cell for a given technology (3G, LTE) under non-fading conditions, and the maximum data rate at cell edge. The coverage maps for each cell should be supported by evidence of sufficient network and backhaul capacity to carry the expected traffic generated by users operating with the achievable data rates in the cell.

A received signal strength thresholds specifies a minimum data rate at the cell edge for a given technology (3G or LTE) and a given bandwidth, under non-fading radio channel conditions. Radio channel fading, caused by user mobility, changes in the line-of-sight conditions between user and the base station or movement of significant reflective objects in the propagation environment, degrades the achievable data rate. Radio channel fading is also carrier frequency dependent and bandwidth dependent.

Within the coverage areas, users closer to the base station will typically have higher received signal power and so achieve higher data rates.

Recommendations:

4. That consideration be given to the minimum acceptable data rates required for highway coverage (mobile users) and emergency services (fixed or limited mobility) before setting dBm thresholds.
5. That the submissions require inclusion of backhaul capacity to carry the expected traffic generated by users operating with the achievable data rates in the cell.

1.2 Delivery option 2 – Order of merit from base stations proposed by multiple MNOs

Under this option, the Commonwealth would call for bids from MNOs or consortia of MNOs. Each bid would be specific to an individual base station or group of base stations and would specify the number of base stations to be built, the location of each base station, the improved coverage that would be provided from each base station, and the amount of funding sought by the bidder under the programme. This would allow an MNO to bid for only a portion of the $80 million funding.

Question 3. *Does delivery option 2 for the $80 million Mobile Network Expansion component raise any additional issues that need to be considered?*

CSIRO Response: The value of additional highway coverage is highly dependent on the reliability and contiguous nature of the coverage, specifically adjacent cells supporting smooth and reliable handover of mobile users moving between cell coverage areas. The requirement should include that multiple MNO's support contiguous highway coverage at minimum data rates.

MNO's should be permitted to share infrastructure. Care must be taken to prevent practical limitations on sharing by considering issues of electrical and mechanical load and backhaul capacity for each shared site.

An illustrative simulation of non-contiguous coverage based on base station selection for 700 MHz LTE UTM Zone 54 (Western NSW) is shown Figure 3. Whilst coverage is improved along the highway, there remain considerable "black spots" between the cells at either end of this route.

An incumbent MNO will have the greatest potential to incrementally improve the coverage provided by their own infrastructure. This is due to having the greatest knowledge of the physical, mechanical, electrical and communications capabilities of the site as well site access capabilities and maintenance arrangements. Sharing of infrastructure requires sharing of information and backhaul capacity.

Recommendations:

6. In the event of multiple MNO's delivering additional coverage, that recommendations 1 through 5 apply to the combined proposal of the MNO's

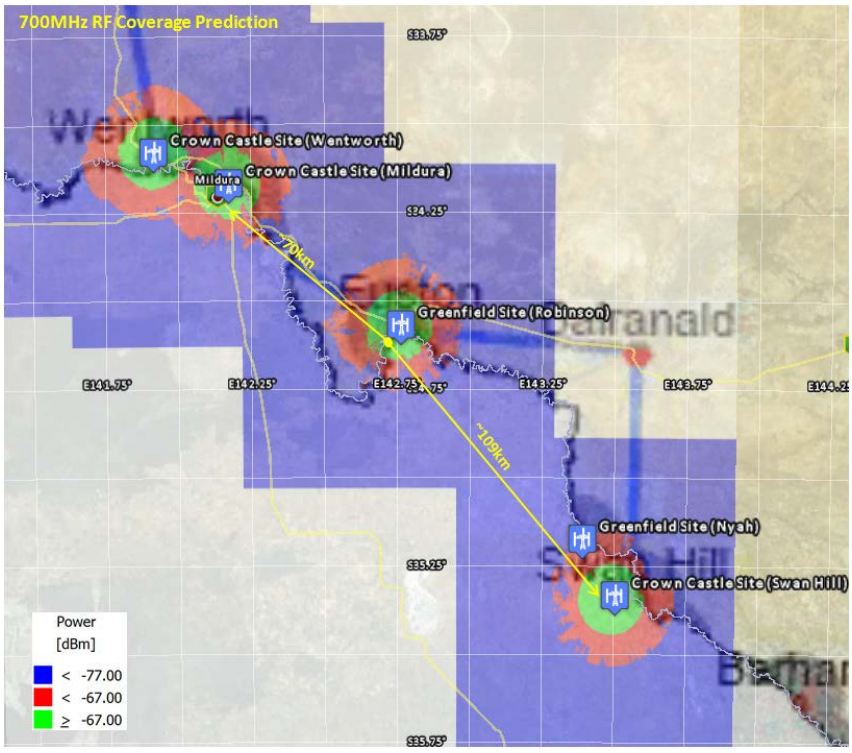

Figure 3. Simulation of non-contiguous coverage based on base station selection for 700 MHz LTE UTM Zone 54 (Western NSW)

1.3 Delivery option 3 – Network infrastructure provider to co-ordinate implementation

Under this option, the Commonwealth would call for bids from parties wishing to build, own and operate a network of base stations (and potentially other facilities such as fibre optic or microwave backhaul connecting the base stations). These base stations would be available to all MNOs to install their own network equipment on a commercial basis. Bidders might include specialist network infrastructure providers.

Bids might be for proposals to either:

a. build and operate mobile infrastructure (both base stations and linking backhaul) on which all MNOs could install their own network equipment on a commercial basis (i.e. MNOs contracting with the network infrastructure provider); or

b. develop a wholesale mobile network capability onto which MNOs could roam locally on a commercial basis (i.e. MNOs contracting with the network infrastructure provider). This sub-option would involve the network infrastructure provider building the infrastructure as in sub-option 3(a) and also installing and operating suitable mobile network equipment that can provide the wholesale mobile service that MNOs can use for local roaming. A key issue with this sub-option would be the need for the successful bidder to provide a suitable wholesale service onto which MNOs can roam locally and the question of access to suitable spectrum.

Question 4. *Could options 3(a) or 3(b) for the $80 million Mobile Network Expansion Project be delivered in conjunction with options 1 or 2 to enable network infrastructure providers to compete with MNOs?*

CSIRO Response: Existing MNO's with the highest infrastructure footprint are likely to be able to offer the greatest additional coverage.

A new network proposed by an infrastructure owner may benefit from concessions related to connection to the NBN points of interconnect (POI) as they are unlikely to connect to all 121.

Question 5. *Should bidders be able to propose to incorporate the use of base stations owned by NBN Co as part of their bid?*

CSIRO Response: Any infrastructure which is available to be used will reduce the capital cost of additional network roll out. Issues of electrical and mechanical load, backhaul capacity and site access should be considered when contemplating use of existing or future planned infrastructure.

Recommendations:

7. That NBN Co infrastructure be allowed to be incorporated in a bid and that NBN Co provide to all bidders suitable information to allow infrastructure sharing.
8. That new network bidders benefit from concessions related to connection to the NBN points of interconnect

Question 6. *Should a joint bid (between a specialist network infrastructure provider and a MNO) be permitted? Should it be encouraged?*

CSIRO Response: No response

Question 7. *Is it realistic to expect specialist network infrastructure providers to provide backhaul (recognising that they would presumably need to contract with a third party to provide this)?*

CSIRO Response: Backhaul is a critical component for all bidders. Demonstration of suitable backhaul capacity should be included in the bid requirements.

Question 8. Is option 3(b) suitable for Australia's regional mobile market?

CSIRO Response: No response

Part 2 - $20 million Mobile Black Spots Project

The Mobile Black Spots Project will improve mobile phone services in locations with unique mobile coverage problems, such as small communities that experience increased population during peak seasonal periods.

The Commonwealth would fund some of the costs of delivering improved mobile coverage to locations proposed by communities, with co-funding provided by other parties such as local governments, state or territory governments, commercial entities, MNOs and/or network infrastructure providers.

2.1 Open access and co-location provisions

Question 9. *What are the appropriate specifications for a base station to be able to accommodate at least two other MNOs?*

CSIRO Response: Many aspects of the shared radio infrastructure are defined by UMTS provision for Multi-Operator Radio Access Networks (MORAN) and Multi-Operator Core Networks (MOCN).

Other issues for consideration include

- Physical Site access including shared site security requirements
- Sharing of maintenance contracts and agreed maintenance schedules
- Availability of reliable power supply, cooling and cabinet space
- Mechanical load on the tower
- Sharing of information and capacity of backhaul

Question 10. *Will the proposed open access provisions be sufficient to encourage other MNOs to use the base stations to provide mobile services?*

CSIRO Response: No response

Question 11. *Should MNOs be required to pre-commit to/co-invest in the base stations for which they wish to share infrastructure?*

CSIRO Response: No response

Question 12. *What is the estimated additional cost of requiring all new base stations to meet the open access requirements?*

CSIRO Response: No response

Question 13. *Should the proposed open access provisions be applicable to base stations funded under the $20 million component, or should there be scope to exclude some base stations from these requirements?*

CSIRO Response: No response

Question 14. *What are the most appropriate models/benchmarks for establishing access and backhaul pricing, and for reflecting in that pricing the value of the public funding received by the owner of the facilities (such that access seekers receive an appropriate discount from the market price for access to the facility)?*

CSIRO Response: No response

2.2 Open access and co-location provisions

The following assessment criteria are proposed for each base station and group of base stations proposed for funding (some modification may be needed to suit particular options). These assessment criteria would be used by an external assessment committee as the basis of advice to the Government.

Question 15. *Do the proposed assessment criteria achieve the right balance to deliver the best value for money outcomes?*

CSIRO Response: See recommendations 1 through 5.

Question 16. *Should the proposed assessment criteria be weighted, and if so, how?*

CSIRO Response: See recommendations 1 through 5. "New coverage" should be prioritised with minimum acceptable data rates rather than "Extended coverage".

Much of Australia's landmass does not have mobile coverage. Taking Telstra's coverage map[2] (shown in Figure 4) as an example, there is very limited cellular coverage along Stuart Highway for example. Many other parts of Australia are in a similar situation.

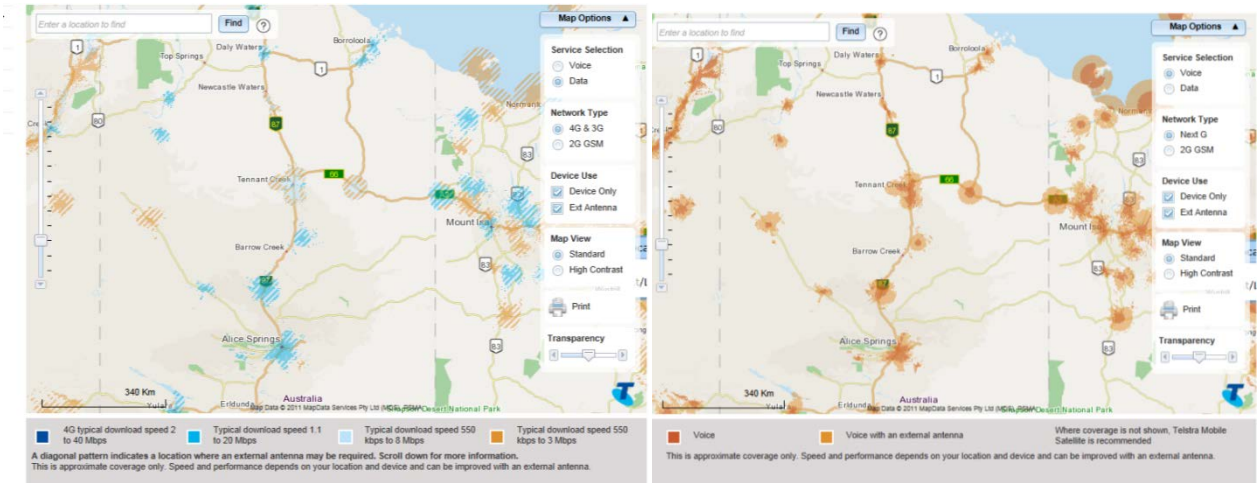

Figure 4. Telstra cellular coverage map Voice (left) and data (right) (Source: Telstra Website)

Recommendations:

9. That "New coverage" should be prioritised with minimum acceptable data rates, rather than "extended coverage".

[2] http://www.telstra.com.au/mobile-phones/coverage-networks/our-coverage/

Question 17. *Is there a more effective means of assessing seasonal demand than proposed in criterion 3(c)?*

CSIRO Response: No response

Part 3 - Utilising the NBN fixed wireless network

The rollout of the National Broadband Network (NBN) fixed wireless network provides an opportunity to improve mobile phone coverage and competition in Australia. These opportunities include co-locating mobile equipment on NBN facilities and NBN Co offering additional services such as backhaul to mobile base stations.

Question 18. *To what extent would the use of the NBN fixed wireless network result in improved mobile coverage outcomes in regional Australia?*

CSIRO Response: In principle, the backhaul capacity used for fixed wireless can also be used for backhaul purposes for mobile base stations. The NBN fixed wireless network has been optimised to provide broadband services to communities and premises in rural and remote areas so addition of mobile services are likely to significantly increase the demands on planned NBN backhaul networks. As a result, using the NBN backhaul infrastructure may only be possible if high capacity wireless links (such as CSIRO's Ngara backhaul[3]) are used in place of existing technology.

Question 19. *How best can a greater role for NBN Co improve competition and choice for consumers in regional Australia?*

CSIRO Response: If much wider wireless coverage can be provided by NBN to regional Australia, the competition between service providers will be improved in these regions thereby benefitting consumers. Technically, this can be achieved by a variety of fit-for-purpose wireless technologies beyond what is being deployed in NBN Co's plans.

Question 20. *In addition to base station location, design and backhaul access, what other considerations would NBN Co need to take into account if it were to also support mobile coverage and competition benefits as part of its mandate?*

CSIRO Response: The fixed wireless solutions being deployed by NBN Co have the technical capability to support mobile users. Supporting mobile users would however significantly change the Network Management, Service Management and Quality of Service requirements of NBN Co's offering. The cost of establishing or enhancing these parts of the network operation must be considered. The service offered by NBN Co may need to be a limited version of fully mobile service if these costs outweigh potential revenues in a fully competitive environment.

[3] http://www.afr.com/p/technology/csiro_to_revolutionise_wireless_m9IXoO9ZIbqrzcNL1CPFvK

Question 21. How can early engagement between NBN Co and MNOs be facilitated in the design of each base station? Is there a role here for the Australian Mobile Telecommunications Association (AMTA)?

CSIRO Response: NBN should specify the performance requirements of the network dictated by intended applications, not being restricted by vendors' existing products or the MNO's current practice. The AMTA may provide impartial advices in this regard.

Question 22. *How can the Mobile Coverage Programme best complement any role that the NBN fixed wireless service plays in improving mobile coverage and competition?*

CSIRO Response: It would reduce the total cost and deliver the maximum benefits to Australia if the *Mobile Coverage Programme* mandates that the MNO's network be designed in conjunction with NBN's fixed wireless plan, specifically from the viewpoint of backhaul requirements for mobile base stations. To this end, NBN Co should have a major consultation role in MNO's network design phase.

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