Statement of Easwaren Siva

I, Easwaren Siva, of 177 Pacific Highway, North Sydney, New South Wales, make the following statement:

1 I am the General Manager – Technology Strategy & Governance at Vodafone Hutchison Australia Pty Ltd (**Vodafone**). I have held this role since mid-2014.

2 Except where I state otherwise, I make this statement based on the knowledge that I have obtained, as General Manager – Technology Governance & Strategy at Vodafone, from approximately 25 years in the telecommunications industry and from having consulted and made inquiries of relevant staff and the records of Vodafone.

3 I believe the information in this statement to be true.

A EXPERIENCE

4 I have been an employee of Vodafone for over 7 years. In my current role at Vodafone, I am responsible for all matters relating to Network and IT Technology Strategy, Planning and Architecture at Vodafone. This includes:

- defining and governing Vodafone's Network and IT Technology Strategy and Architecture;
- defining Technology annual delivery integrated Roadmap, Plan and the Long Range Plan, which includes both capital and operating Technology Budget;
- governing the overall Technology's Operating Expense and cost saving initiatives; and
- defining Technology vendor strategy.

5 I have an extensive career in the telecommunications industry starting from 1992. As a result I have a very detailed understanding of the technologies involved in telecommunications industry particularly relevant to mobile networks. Prior to my current position, I have held the following position:

- General Manager – Technology Strategy at Vodafone from May 2011 to April 2014;
- General Manager – Product Technology at Vodafone from June 2009 to April 2011;

- General Manager – Content and Product Technology at 3 Mobile - Hutchison Telecommunications Australia Ltd from September 2003 to June 2009;
- Product Technology Manager (Core & VAS) at Orange - Hutchison Telecommunications Australia Ltd from January 1999 to September 2003; and
- Principle Engineer (Core & VAS) at Vodafone Network Pty Ltd from June 1995 to December 1998.

6 I have a Masters of Business Administration – Technology Management from Deakin University, and a Bachelor of Electrical Engineering from the University of New South Wales.

B THE AETHA REPORT

7 I have read the report titled "*Potential declaration of domestic roaming in Australia – Technical issues*" for Telstra prepared by Aetha Consulting Ltd (**Aetha Report**) dated 1 December 2016.

8 The authors of the Aetha Report first considered what technical issues there are if domestic roaming was declared without any geographic limitations. The authors then considered how their opinion would differ if declaration was subject to geographic limitations.

9 I understand that the ACCC is considering the declaration of roaming with geographic limitations. The Aetha Report is therefore not relevant in its consideration of the declaration of domestic roaming without any geographic limitations. I also note that paragraph 13 of the Aetha Report comments that "*Whilst limiting the geographic availability of domestic roaming has the potential to mitigate these problem, it is by no means a panacea.*" [sic].

10 However, I consider that many aspects of the Aetha Report are either irrelevant or overstated because the Aetha Report focuses primarily on a scenario of full geographic availability, not limited geographic availability.

11 I set out in this statement my consideration of the technical issues identified in the Aetha Report in circumstances where domestic roaming is supplied on a limited geographic basis. I consider these issues to be minor and easily resolvable in practice.

12 I first outline some aspects of how a mobile device and network inter-work, in a manner to be understood for a layman.

13 For clarity, where I refer to a "home network" in this statement, I am referring to the mobile device's home network. Where I refer to a "roaming network" in this statement, I am referring to any other mobile network that a mobile device is authorised to connect to but not the home network of the device for the purposes of roaming.

C CELL SELECTION, NETWORK SELECTION AND LOCATION UPDATES

14 A mobile phone network is divided into thousands of overlapping geographic radiofrequency coverage areas, or cells. A typical cellular network can be envisioned as a mesh of cells, each connected to a base station. A base station supports one to many cells. The base station comprises of electronics located at and on a mobile tower, including transceivers that transmit and receive radiofrequency signals. The radiofrequency signals of cells for adjacent base stations overlap at the edges in geographic coverage to ensure that users always remain within range of a base station cell. For simplicity, I will refer to a base station cell as a "cell".

15 Radiofrequency signals are the physical medium used for transmitting and receiving information between each mobile device and the local cell to which it is connected at the time. The signal strength from the cell weakens as the distance between the mobile device and the cell increases. The mobile device itself determines the cell to which it is connected with the objective of maximising the signal strength and quality.

16 How a device connects to a network differs depending on whether it is in use or not. For simplicity, I refer to a mobile device which is switched on but NOT making either a voice call or maintaining connection to a data session as being in "idle" mode. Conversely, I refer to a device that is making a voice call or maintaining a data session as being in "active" mode.

Network Selection in idle mode

17 A function of a mobile device is to identify different mobile networks and determine the mobile network which it is authorised to connect to (or to choose between networks if it is authorised to connect to more than one available network). For simplicity I will refer to this function as "Network Selection". A mobile device will always perform a Network Selection when it is switched on, or when it finds network coverage, having lost it its connection to a mobile network earlier.

18 Paragraph C.17 of Annex C of the Aetha Report outlines how a device can connect to an authorised network. I generally agree with the process outlined at paragraph C.17 and therefore will not repeat this information.

19 A mobile device can identify mobile networks to which it is authorised to connect via the Universal Subscriber Identity Module smart card, known colloquially as the 'SIM' card. The SIM card contains various information, including a unique 15-digit International Mobile Subscriber Identity (**IMSI**) number, an authentication key, and various parameters.

20 The IMSI contained on a SIM card identifies the home network of the Mobile Service. The SIM card may contain parameters that allow it to recognise other networks such as a roaming network.

21 Most relevant to a roaming context are circumstances where a mobile device first enters the roaming network coverage area and exits the home network coverage area. A roaming network will permit a mobile device to establish a connection to a network if the IMSI of the mobile device is from a network that is authorised to connect.

22 If the device is leaving its home network coverage area and entering a roaming network coverage area, it would perform a Network Selection and select the roaming network to connect to for the first time. Connecting to the roaming network generally involves a two-step authorisation process.

23 The first check is performed by the roaming network via a Location Area Code (**LAC**) accessibility check that the mobile device is authorised to connect. Then, the roaming network checks with the home network directly that the relevant mobile device is authorised to connect to the roaming network. Once the roaming network confirms with the home network that the mobile device is permitted to connect, the mobile device will then be connected to the roaming network.

24 When a mobile device is connected to the roaming network, the device can be told to periodically perform a Network Selection. A mobile device connected to a home network will not be required to periodically perform a Network Selection.

25 The period at which a Network Selection is performed by a device connected to a roaming network depends on the setting of the Higher Priority Public Land Mobile Network Search Timer (**PLMN search timer**) parameter set in the SIM. The PLMN search timer can be set at a minimum of every 6 minutes to a maximum of 8 hours. This parameter in the SIM can be easily updated via 'Over-The-Air' Messages from the home network.

26 A mobile device does not perform Network Selection while in active mode except in circumstances where a hard handover occurs. I explain what a hard handover is at paragraph 38 below.

Cell Selection in idle mode

27 While in idle mode, a key function of a mobile device is to continuously scan for all the potential cells within reach in order to connect to the cell with the greatest signal strength and quality. For simplicity, I will refer to this function as "Cell Selection".

28 Cell Selection occurs independently of the Network Selection function. Cell Selection occurs continuously regardless of whether a mobile device is connected to a home network or roaming network.

29 Once a mobile device has selected the list of cells it can connect to, the mobile device prioritises the cells it has identified. The mobile devices sorts the cells according to an algorithm based on the quality and the strength of the signal from all the cells it has identified.

30 Minimum signal quality is required for a cell to be identified as a potential cell for a mobile device to connect to. Cells which do not meet this minimum quality threshold will not be considered by the mobile device as "present".

31 A mobile device will always connect to the cell with the highest priority on the network the device is connected to.

Cell Selection in active mode

32 Cell Selection also occurs when a mobile device is in active mode. Cell Selection in active mode is more sophisticated compared to cell selection in idle mode.

33 While a mobile device will simply connect to the cell with the highest priority in idle mode; in active mode, the mobile device will be primed to handover to an adjacent cell.

34 During a voice call, the home network tells the mobile device a list of potential home network cells which the mobile device can hand over its call to. This list is referred to as the "neighbour list" and is stored and periodically updated on the mobile device.

35 In active mode, the mobile device scans and prioritises the cells on the neighbour list in order to better handover traffic between cells.

36 While a voice call is being transferred between home network cells, the device will briefly establish two connections concurrently before discontinuing one of the connections based on quality parameters. I referred to this process as a "soft handover".

37 I briefly outline the process of a soft handover by way of an example. If a mobile device is connected to cell A and it is moving out of the coverage of cell A and into the coverage of another cell B which is on the neighbour list, the mobile device will establish a second connection to cell B once the signal from cell B reaches a predetermined threshold, measured by the signal quality and signal strength. As the mobile device travels further into cell B coverage area and further away from cell A coverage area, the device will maintain the connection to both cell A and B until the connection to cell A degrades past a predetermined threshold, measured by the signal quality and signal strength, at which point the connection to cell A is terminated. Once the mobile device disconnects from cell A, the mobile device is now only connected to cell B. This soft handover process will continue to occur as an end user travels from cell coverage area to another cell coverage area until the voice call is terminated.

38 In the roaming context, the home network also tell the mobile device neighbouring cell sites authorised for roaming in a separate list called the "IRAT neighbour list". The mobile device prioritises the cells on the IRAT neighbour list in the same manner as it prioritises the cells on the neighbour list. However, only a "hard" handover is possible for transferring a device in active mode between a home network cell to a roaming network cell.

39 I briefly outline the process of a hard handover by way of an example. Suppose a mobile device is connected to cell A which is a home network cell and is traveling towards cell B which is a roaming network cell. As the mobile device travels further into cell B coverage area and further away from cell A coverage area, the device will contact cell B when the signal from cell B reaches a predetermined threshold, measured by signal quality and signal strength. Cell B will then tell the mobile device that it is authorised to connect and roam on cell B via a LAC accessibility check. At this point, the home network will authorise the handover with the roaming network directly. Once authorisation is granted by the roaming network, the home network will instruct the mobile device to disconnect from cell A and connect to cell B. Once the mobile device has connected to cell B, the mobile device will be handed over to the roaming network. Through this process, a Network Selection is also performed.

Location Update in idle mode

40 Another function of a mobile device is to notify a mobile network its location status, which the mobile network then records. For simplicity I will refer to this function as "Location Update".

41 A mobile device will perform a Location Update in the following circumstances:

(1) while the mobile device is in idle mode, according to a timer in the network;

(2) when a mobile device in idle mode moves from one LAC to another LAC; or

(3) when a voice call or data session is terminated.

42 Relevant to paragraph 41(1), the function of this timer does not change, regardless of whether the device is connected to either the home network or a roaming network. This timer is set by the network the mobile device is connect to. Typically, a network operator will set this timer to 1 or 2 hours.

43 A mobile device will not typically perform a Location Update when it is in active mode, but will perform a Location Update when the device first enters idle mode.

D IMPACT ON BATTERY USAGE

44 A conclusion of the Aetha Report states:

"Reduced battery life of user devices – The battery power required to search for a new network and also to send a location update to the network are both relatively high."[1]

45 In my view, this conclusion overstates the impact of roaming on the battery life of user devices in practice. The battery power required to search for a new network and also to send a location update to the network is relatively high, only if one is comparing to a device that is completely switched off.

46 As I have outlined above, a mobile device will continuously perform Cell Selection and periodically perform a Location Update while it is powered on. These functions do not change, regardless of whether the mobile device is connected to a home network or connected to a roaming network as long as the device is powered on.

47 Therefore the only difference between a mobile device connected to the home network and when it is connected to a roaming network is the PLMN search timer, which is only relevant while a mobile device is roaming while in idle mode.

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[1] Aetha Report, paragraph 23.

48 The impact on battery life will be negligible in practice if the PLMN search timer is set to the same period at which the device performs a Location Update while in idle mode, as the incremental battery usage from performing a Location Update to performing both a Location Update and a Network Selection would be negligible in practice.

49 [redacted] Vodafone SIM cards can be configured so that the PLMN search timer is aligned with the Location Update process. The PLMN Search Timer can be easily updated via an Over The Air message.

50 For the above reason, I believe the issue of impact on battery is overstated in the Aetha Report.

E OVERLAPPING COVERAGE

51 At section 6 of the Aetha Report, the authors discuss issues arising from how roaming boundaries are defined. The conclusion reached at paragraph 76 of the Aetha Report depends on an assumption that the objective is to limit overlapping coverage. This assumption does not reflect how roaming arrangements are implemented in Australia today.

52 I briefly explain how overlapping coverage is defined in roaming arrangements in practice in a manner that can be understood by a layman before addressing the issues identified in the Aetha Report relevant to overlapping coverage.

Defining the boundaries of a roaming network

53 The roaming network operator provides a home network operator with a list of cells authorised for roaming. The cells are defined by reference to a LAC. The LAC is a unique identifier assigned to one or more cells to identify the location of the cell or cells. LACs are set by the mobile network operator. LACs are, in effect, a list of numbers in a database and these are updated from time to time for various reasons.

54 LACs may be updated for reasons unrelated to roaming. For example, a mobile network operator may update LACs to define a geographic coverage area that may be geographically more efficient from an operational perspective. LACs are optimised so that they are large enough that mobile devices do not need to constantly perform a Location Update as they move from location to location; but small enough that the core network can efficiently page a mobile device when needed within a specific coverage area, as determined by a LAC. If a LAC is too large, the core network consumes too

many resources to locate a mobile device, for example to connect to an incoming call. If a LAC is too small, this forces the mobile device to perform unnecessary Location Updates and can impact battery life of the device.

55 In practice, the overlapping boundaries of a home network and a roaming network are generally not minimised because of technical reasons but because of commercial reasons. In practice, roaming partners will have some overlapping coverage in regional centres and towns. By this, I mean that there are some areas in a roaming arrangement where a mobile device still has the capability to roam onto the roaming network, even though it can also connect to the home network. Overlapping coverage, especially where it is geographically limited, ensures contiguous mobile coverage and also ensures that roaming is simpler to implement.

56 To implement a roaming arrangement, the roaming network operator would first identify its cell sites into two categories of "roaming areas" and "non-roaming areas". For example, a roaming arrangement could be implemented in a manner where roaming is supplied regionally, but not in metropolitan areas. This would create large blocks of areas where roaming is authorised and not authorised. Once the roaming partners agree to the boundaries surrounding metropolitan areas, this roaming arrangement would be simple to implement.

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59 The Aetha Report identified two potential adverse consequences arising from roaming in overlapping coverage areas which are implied to be a reason to limit overlapping coverage:

(1) ping-ponging at section 5.6, and

(2) a cascading risk of network failure at section 5.7.

60 I believe these risks are overstated in the Aetha Report and are negligible in practice.

Ping-ponging

61 Vodafone has mobile coverage in all metropolitan areas within Australia and would not need to acquire domestic roaming services in those areas. [redacted] Areas of overlapping coverage between networks will not arise in metropolitan areas and would be limited to low density coverage areas where a home network and the roaming network might overlap in regional Australia.

62 Mobile devices in overlapping coverage areas would be subject to the same Network Selection and Cell Selection and prioritisation process I have outlined above. This means the risk of ping-ponging identified by the Aetha Report is overstated in practice.

63 Ping-ponging typically occurs in home network coverage holes that can be closed by optimisation and minor densification by the home network and implementation of agreed prioritisation process to ensure mobile devices do not "ping-pong" between the home network and the roaming network. [redacted]

64 In my view, ensuring a home network and a roaming network overlap in some areas is good for consumers, as it allows for seamless network handover while a mobile device is in active mode and a better quality user experience. [redacted] I discuss this further below.

Cascading network failure

65 I am unaware of any instances of actual cascading network failure caused by domestic roaming in Australia. [redacted]

66 A cascading network failure event could theoretically occur when a home network goes into "failure" mode and produces error messages in a manner the home network was not designed for. This would cause a network problem in a home network, which could theoretically cascade into the roaming partner's network.

67 However this risk will be negligible in regional Australia where the mobile traffic would be limited compared with mobile traffic in urban areas. This means the circumstances where a cascading network failure could theoretically occur would be extremely rare. Moreover there are technical solutions and products from network vendors that can limit the volume of traffic including limiting unexpected volumes of signalling traffic from one network to another. These solutions will adequately protect networks from unintended outage scenarios or system failures.

F SEAMLESS HANDOVER

68 Seamless handover is relevant to situations where a device is in active mode and:

(1) leaves the roaming network coverage area and enters into the home network coverage area; or

(2) leaves the home network coverage area and enters into a roaming network coverage area.

69 I refer to the above instances as "inbound" and "outbound" scenarios and address seamless handover in both scenarios below.

Inbound scenario

70 In a 3G voice context, it is technically simple to achieve seamless handover in an inbound scenario. To achieve seamless handover in an inbound scenario, the roaming partners have to establish a protocol where the roaming network maintains the voice call until it is terminated by the end user. Only after a call is terminated will the roaming network hand the device back to the home network when a Location Update is performed. Whether this is implemented between roaming partners is driven by commercial reasons and not by technical reasons.

71 [redacted]

Outbound scenario

72 Technical solutions for seamless handover in an outbound scenario also exist, for example as I outlined the process of a hard handover in paragraph 38 above. [redacted]

73 The hard handover process is relevant to a 3G voice call context. I believe that Vodafone being the home network is more than capable of loading the roaming network neighbour cells appropriately into the IRAT neighbour list, which is a step to allow hard handovers to be performed with a roaming network partner. I believe the hard handover process can be easily implemented and is workable in practice.

74 In a 3G data, 4G data and 4G VoLTE context, the complexity of seamless handover in an outbound scenario decreases. This is due to the data centric architecture of 4G mobile networks (and 3G networks from a data only perspective). [redacted] I expect seamless handover in a 4G and 3G data context to be even simpler to implement compared to a 3G voice context.

G CAPACITY MANAGEMENT

75 I am unable to review any of the blacked out parts of the Aetha Report from pages 21 to 26, and as such, I am unable to provide direct comments on those parts of the Aetha Report.

76 However, in my view domestic roaming arrangements will not have a material impact on the way a roaming network operator would forecast and manage its capacity requirements.

77 Generally, a mobile network operator forecasts future capacity needs based on expected mobile traffic in the future. In a roaming context, the roaming network operator would forecast future capacity needs by taking into consideration of expected mobile traffic from its own subscribers and the mobile traffic estimated by its roaming partner within the relevant roaming areas.

78 This has worked well in practice. [redacted]

H CONCLUSION

79 For all the reasons I have outlined above, I believe the technical issues identified in the Aetha Report has been overstated and are easily resolved in practice. Those technical issues identified in the Aetha Report being:

(1) no handover calls between networks and no managed hand over of user devices between networks;

(2) the impact on the battery life of a mobile device;

(3) ping-ponging of devices between networks;

(4) risk of cascading network failure; and

(5) capacity issues on the roaming network.

Date: 10/3/2017

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