DECLARATION OF DOUGLAS DUET

I, Douglas Duet, declare the following:

1. I currently serve as a Principal Member of the Technical Staff at AT&T's Radio Access and Devices—Radio Technology, a division of AT&T Labs, Inc., a wholly owned subsidiary of AT&T Inc. In that capacity I am responsible for assessing emerging wireless technologies, evaluating new wireless technologies, and WCS spectrum management support. I hold BS and MS degrees in Electrical Engineering from Louisiana Tech University, and have worked in the field of radio telecommunications since 1973. My experience includes designing mobile, maritime, and microwave radio systems; switching and facility planning; development and integration of wireless local loop technology; assessing fixed and mobile wireless access technologies; spectrum management; developing wireless video delivery and broadband technology; and participating in standards development. I am a life member of the Institute of Electrical and Electronic Engineers and a registered Professional Engineer. I hold two patents. As a result of my experience and responsibilities with AT&T, I have personal knowledge of the following:

2. In my capacity as a member of the Technical Staff at AT&T's Radio Access and Devices—Radio Technology, I have been involved on AT&T's behalf in monitoring the work of the WCS Coalition and with the problems WCS licensees have experienced as a result of the FCC's technical rules for WCS. I am familiar with the FCC's May 20, 2010 *Report & Order* adopting certain revised technical and service rules for WCS licensees.

The Merits of LTE

3. WiMAX started as a fixed radio access technology and, although it has evolved into a mobile radio access technology, it is not as well-suited to mobile service as LTE. In a

mobile wireless network, the farther from the mobile network access point (*i.e.*, the cell site) the mobility functions (for instance, control of handoffs from one cell to another) are controlled, the greater the network delays experienced by the control signals. Mobility functions are very sensitive to these delays, especially for high-speed data traffic. In LTE systems the cell site equipment handles the cell mobility functions; this arrangement is optimal because the control signals have essentially zero distance to travel. By contrast, in WiMAX systems the cell mobility functions must go back to a centralized point for implementation and control. Because of this difference, LTE is superior to WiMAX when the mobile unit is in motion, and LTE is the mobile technology of choice for many of the wireless providers in the United States, including AT&T, Verizon Wireless, T-Mobile USA, and Leap Wireless, to name several.

4. As compared to WiMAX technology, LTE technology will reduce the potential interference of WCS handsets to the reception of SDARS receivers. LTE mobile transmitters use SC-FDMA modulation and operate with a peak to average power ratio ("PAPR") of 5.4 to 6.2 dB. WiMAX mobile transmitters use OFDMA modulation and operate with a PAPR of 7.9 to 8.2 dB. Therefore, LTE mobile transmitters operating at the same average power as WiMAX mobile transmitters have peak power outputs from 2 to 2.5 dB lower than the WiMAX mobile transmitters. As a result, LTE mobile transmitters operating at the same average power as a WiMAX mobile unit are less likely to cause interference to other services.

The Timeline to Deployment

5. There is currently no standard governing the use of LTE technology in the 2.3 GHz WCS band, so the use of LTE for WCS broadband service will require modification of the LTE standard. There is an LTE standard for Band 40 (2300-2400 MHz) that is used in China and is scheduled to be deployed in India. However, that standard must be modified for WCS

since the WCS band, 2305-2320 MHz and 2345-2360 MHz, consists of only a portion of Band 40. Further, the LTE standard for Band 40 is based on TDD technology, whereas most U.S. wireless providers use FDD technology.

6. It is not possible to add the 2.3 GHz WCS band to the LTE standard in time for AT&T to meet the performance requirements adopted in the *Report & Order*. In order to add WCS to the standard, a work item will need to be introduced at a plenary meeting of the standards-setting body for LTE, the 3rd Generation Partnership Project ("3GPP"). As a practical matter, the work item cannot be introduced until the FCC's technical rules for WCS have been finalized. Because of the current activity to finish LTE Release 10, the next realistic opportunity to introduce a work item at a plenary meeting will be in March 2011. Adoption of the item reasonably would be expected to lead approximately 15 months later—or approximately in June 2012—to an LTE standard incorporating the WCS band and both FDD and TDD.

7. Design and development of LTE network equipment cannot begin until the LTE standard includes the WCS band—*i.e.*, until June 2012. Manufacturers and carriers schedule the network equipment and handset development cycle for 18 months. Therefore, we expect that WCS LTE equipment would become available in December 2013 if the WCS band is included in the LTE standard in June 2012.

8. If equipment will not be available until December 2013, WCS licensees will be unable to deploy networks using LTE and offer service to 40% of the population of their license areas by May 2014, the requirement adopted by the FCC. The system design and some site selection and development work for any new sites that are required can proceed concurrently with the equipment design phase (and potentially could begin before the standard is set). However, site deployments—which will be the longest single phase of the entire process—

cannot start until equipment has been designed, tested, and become available from the manufacturers in reasonable quantities. And once equipment is available, AT&T must schedule installations using the same contractors used by other carriers as well as by AT&T for its other ongoing wireless operations.

9. Based on its extensive experience in deploying wireless networks, including its knowledge of the speed at which equipment manufacturers typically deliver equipment, the lead time for modifying existing facilities to incorporate new frequencies, and the time required to locate and construct the additional sites as necessary, as well as the amount of time other wireless providers have taken to deploy their networks or add new technology, AT&T estimates that it will take approximately 42 months from when equipment will become available to cover 40% of its licensed population and approximately another 36 months to cover 75%. Assuming LTE equipment becomes available in December 2013, AT&T would expect to meet the Commission's performance requirements in June 2017 (40%) and June 2020 (75%) absent unforeseen developments. If AT&T had to build an extensive number of greenfield sites instead of leveraging its existing mobile wireless network, it probably would take longer than the times it is projecting.

10. I understand that the WCS Coalition has projected that it would take between 12 and 18 months before WCS WiMAX equipment could be available, with shipments in volume several months thereafter.[1] Based on the Coalition's estimate, WCS licensees could begin deploying WiMAX networks at full scale in roughly January 2013. Once commenced, deployment of a WiMAX network should take approximately the same amount of time as an LTE network. Accordingly, AT&T estimates that it would not be able to deploy a WiMAX

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[1] WCS Coalition Reply Comments at 4; *see also* WCS Coalition's May 11, 2010 *ex parte.*

network to meet the 40% performance requirement until July 2016 and the 75% requirement until July 2019.

11. By way of comparison, Clearwire began offering commercial 2.5 GHz WiMAX service on January 6, 2009[2] and claims that, by August 2010, it was providing service in 69 service areas.[3] AT&T has estimated that about 1500 sites would be required in those 69 service areas. Based on this rough estimate, it appears that Clearwire's rate of site deployments is approximately 950 per year. At this rate, it would take AT&T over a decade to reach 40% coverage in its WCS license areas.

12. These LTE and WiMAX deployment schedules also assume that regulatory uncertainty or similar problems do not prevent AT&T and other licensees from committing capital to deploy facilities once the standards have been completed (*i.e.*, approximately 18 months before equipment becomes available in volumes suitable for deployment).

Duty-Cycle Limits

13. The 25% duty cycle the Commission imposed on FDD transmissions for mobile units will constrain the ability of WCS licensees to make full use of the spectrum. Video, video games, and other applications that require a substantial amount of throughput for both uplink and downlink transmissions are among the new services that are projected to grow substantially over the next several years.[4] Restricted duty cycles will cause customers of a stand-alone WCS

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[2] *See* Press Release, Clearwire, Clearwire Introduces Clear(TM) 4G Mobile Internet Service to Portland (Jan. 6, 2009), *available at* http://newsroom.clearwire.com/phoenix.zhtml?c=214419&p=irol-newsArticle&ID=1240894&highlight=.

[3] *See* Clearwire, 69 Markets and Growing, www.clearwire.com (screen 2) (last visited Aug. 31, 2010); *see also* Lynnette Luna, *Sprint Tests More Aggressive WiMAX Pricing in Select Markets*, Fierce Broadband Wireless, Aug. 19, 2010, http://www.fiercebroadbandwireless.com/story/sprint-tests-more-aggressive-wimax-pricing-select-markets/2010-08-19.

[4] *See* Caroline Gabriel, *Uplink Performance Could Be LTE's Dark Horse Advantage*, 4G Trends, Dec. 16, 2009, http://4gtrends.com/?p=2447 ("Uplink performance is increasingly

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network to experience, under certain circumstances, lesser throughput than they would using different mobile wireless broadband spectrum where the duty cycles are not restricted. Indeed, the duty-cycle limit might even cause customers served by multiband networks to experience what they consider to be unacceptable uplink performance when they are allocated WCS channels.

14. FDD mobile transmissions will not increase the risk of harmful interference to SDARS receivers compared to TDD mobile transmissions using the same duty cycle and power. The Ashburn tests demonstrated that harmful interference to SDARS receivers from TDD mobile devices is "negligible" even if the TDD device is transmitting for the full 38% of "each and every" frame, at full power and without ATPC.[5] An FDD device operating at the same 38% duty cycle and the same average power will be indistinguishable from the TDD device from an interference perspective. Both will transmit for the same proportion of the time at the same power levels. Thus, an FDD device operating at a 38% duty cycle will cause exactly the same negligible interference as the TDD device. The "activity factor" of TDD and FDD systems does not affect this conclusion. Allowing WCS licensees to operate FDD mobile units with the same duty cycle as TDD units will not harm SDARS and will enable WCS licensees to maximize throughput and to provide customers with a wide range of broadband services.

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important as mobile Internet usage patterns shift from downloading of web information to two-way communication and content generation."); *In re Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993 Annual Report & Analysis of Competitive Mkt. Conditions with Respect to Commercial Mobile Serv.*, WT Dkt No. 09-66, Reply Comments of CTIA, at 10 (filed Jul. 13, 2009) ("According to Cisco, wireless data use is expected [to] double every two years through 2012. . . . According to YouTube's blog, mobile uploads to YouTube have increased 1700% in the last six months—and an increase of more than 400% per day in the week following the launch of the iPhone 3GS.").

[5] *Report & Order* at ¶ 66.

15. Indeed, it is likely that multiple TDD devices would cause more interference than an identical number of FDD devices operating at the same power level and duty cycle. TDD devices are limited to transmitting in the same time slots, so their impact necessarily would be cumulative. Transmissions from the FDD devices, however, would be spread over the whole frame and, thus, would not aggregate to the same degree.

16. Base stations in FDD systems operate with a 100% duty cycle independent of any mobile transmit duty-cycle limit. Therefore, the downlink throughput of an FDD system can be substantially greater than that of a TDD system, without any additional potential for interference.

17. The 2-2.5 dB reduction in interference due to the lower peak power of LTE systems suggests that the mobile transmit duty cycle for LTE mobile transmitters can be increased over the duty cycle allowed for WiMAX mobile transmitters without generating any more potential interference than the WiMAX mobile transmitters.

Power Spectral Density

18. The 50 mW per MHz power spectral density ("PSD") limit on mobile transmissions adopted by the Commission, which was not incorporated into the equipment tested at Ashburn, will prevent WCS licensees from using spectrum flexibly to accommodate large numbers of users with varying demands for spectrum. In short, it will call into question the viability of LTE—and quite possibly WiMAX—mobile broadband service using 2.3 GHz WCS spectrum.

19. The rules for other bands do not require PSD limits for sub-channel bandwidths, and the GSM, UMTS, and LTE standards do not include sub-channel PSD operation.[6]

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[6] Sub-channel bandwidths are called "resource blocks" in LTE and "sub-channels" in WiMAX. For convenience, I will use the LTE terminology in the rest of this Declaration when making points that apply both to LTE and to WiMAX.

Accordingly, AT&T's mobile devices—and I believe this to be true of other mobile wireless providers' devices as well—have not been designed to adjust power proportionally with occupied bandwidth.

20. Rather, when a mobile device is close to the cell site, automatic transmit power control ("ATPC") may reduce the PSD of the device's transmission to prevent overload of the cell site's receiver. As the device moves towards the cell edge, ATPC will increase the PSD to maintain the transmission's signal-to-noise ratio at the cell site receiver as much as possible despite the increase in distance. The PSD will increase until the cell boundary is reached or all of the device's power is concentrated in one resource block, so the PSD cannot increase further. The 50 mW/MHz PSD limit will interfere with this mechanism.

21. Physics teaches us that the radius of the cell site's coverage varies with the square root of the mobile device's power level. Because the PSD limit will constrain the power at which mobile devices can transmit as they near the cell edge, the signal-to-noise ratio will drop to unacceptable levels more rapidly than it otherwise would. In other words, the effective radius of the cell will shrink,[7] and the area covered by the cell (πr^2) will be reduced by the square of the diminution of the radius. Consequently, the PSD limit will require a network operator to construct many more cell sites in order to achieve a given level of performance. As a practical matter, the number of coverage holes likely will increase as well.

22. For voice traffic,[8] the mobile device will use only 2-4 resource blocks to accommodate the small speech packets that arrive once every 20 milliseconds. Without the PSD

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[7] AT&T estimates that roughly 50% of devices at one kilometer from the cell site and roughly 87% of devices at two kilometers will have hit the PSD limit and will have suboptimal signal quality.

[8] In both LTE and WiMAX, all voice traffic is carried using VoIP technology.

limit, the device could concentrate all 250 mW of power in those 2-4 resource blocks. With the PSD limit, an LTE device could transmit at only 50 mW. This approximately 7 dB power reduction will require roughly ***four times*** as many cell sites in an LTE network to compensate. Because WiMAX allocates sub-channels differently than LTE allocates resource blocks, a WiMAX device will experience a smaller—but still material—power reduction of approximately 3 dB. To compensate for this loss, a WiMAX network will require about ***double*** the number of cell sites.

23. For best efforts data traffic, the PSD limit will compromise spectral efficiency, which also will increase the number of cell sites needed in the network. Once the PSD limit is encountered as the device moves towards the cell edge in an LTE network, the device will have to transmit over a greater bandwidth to increase power. Thus, near the cell edge, it will need to occupy more of the available resource blocks than it would if there were not a PSD limit. These extra resource blocks will not be available for other users, diminishing the capacity of the cell site, and more cell sites will be required to serve a given level of traffic. For WiMAX, the mechanism is different, but there also will be a reduction in data rate at the cell edge, which will compromise the user experience and the network's spectral efficiency.

24. In short, the PFD limit will make it much more costly and time-consuming to construct a WCS mobile broadband network for either a new entrant or an existing provider and will handicap the network's ability to adjust flexibly to customer demand, reducing the quality, throughput, and efficiency of the service provided.

The C and D Blocks

25. The 2.5 MHz guard band for mobile devices and the 125 mW power limit adopted for WCS Blocks C and D effectively preclude using those blocks to provide mobile broadband

service. The Commission has precluded the use of half of each of the frequency block for mobile or portable devices, and, although the Commission allows WCS licensees to use the remaining 2.5 MHz, that is not sufficient spectrum for a mobile service, particularly since the spectrum is not paired with any other spectrum. In addition, because of the more limited duty cycle applicable to FDD mobile transmissions in the C and D Blocks than in the A and B Blocks, they cannot be used efficiently with the A and B Blocks, even by licensees that hold those blocks in the same license area.

26. Fixed facilities using WCS Blocks C and D under the adopted technical rules will not have sufficient throughput to support WiMAX or LTE backhaul. Moreover, the maximum power levels for fixed links in the C and D Blocks are as much as 13 dB lower than is permitted in the remainder of the band[9] and also are substantially lower than the 55 dBW power levels allowed for the 6 and 11 GHz microwave links typically used for mobile wireless backhaul.[10] Thus, maximum path lengths for point-to-point services in the C and D Blocks are limited, requiring the use of many more links than desirable for backhauling mobile wireless traffic.

Outdoor Antennas

27. AT&T has deployed low-power outdoor fixed CPE antennas to provide fixed wireless broadband services to residential customers in Alaska as well as to serve customers requiring point-to-point connections to the Internet from Wi-Fi access points. Although these antennas meet the previous, more restrictive OOBE standards, they are now prohibited under the new rules. AT&T believes that other licensees have built similar facilities. The wireless systems and outdoor antennas used at these sites provide customers with Internet access and other

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[9] *Compare* 47 C.F.R. § 27.50(a)(1)(i) (*average* EIRP of 2000 watts and PAPR of up to 13 dB) *with id.* § 27.50(a)(1)(ii) (*peak* EIRP of 2000 watts).

[10] *See id.* § 101.113(a).

broadband services in rural and other hard-to-serve areas. In many cases, they are essential to provide the service. As the Commission noted in Paragraph 141 of its *Report & Order*, Sirius XM has not reported any interference from existing outdoor antenna installations. Consequently, continued use of these antennas should not cause interference to SDARS receivers.

I declare under penalty of perjury that the foregoing is true and correct to the best of my information, knowledge, and belief.

Executed this first day of September, 2010.

Douglas Duet