**Before the**
**Federal Communications Commission**
**Washington, D.C. 20554**

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| In the Matter of | ) | |
| | ) | |
| Revision of Part 15 of the Commission's Rules | ) | |
| Regarding Ultra-Wideband Transmission | ) | ET Docket 98-153 |
| Systems | ) | |

**COMMENTS OF NORTEL NETWORKS INC.**

Nortel Networks Inc. ("Nortel Networks") hereby comments on some of the questions raised in the Commission's proposal to modify its Part 15 Rules to accommodate ultra-wideband transmission technologies for unlicensed devices.[1] As a general matter, Nortel Networks endorses the concept of fostering the use of ultra-wideband technologies as a means of efficiently utilizing spectrum for communications needs as well as other innovative purposes. Nortel Networks is concerned, however, that unlicensed use of ultra-wideband devices could potentially cause harmful interference to critical existing and proposed communications services. Thus, the Commission should not amend its rules until the public and the Commission have both had a chance to review thoroughly the interference studies underway, and any such rule changes should be designed to minimize the risk of harmful interference to present communications services. In addition, the Commission should take into account the effects of ultra-wideband transmissions on technologies expected to be deployed in the near future, including new wide bandwidth CDMA/OFDM systems and software defined radios.

Nortel Networks supports the Commission's goal in this proceeding of enhancing efficient use of spectrum by allowing unlicensed devices to "share" spectrum with other services

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[1] *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, FCC 00-163, released May 11, 2000 (hereafter cited as '*Notice*").

through the use of ultra-wideband technologies. Nortel Networks is the leading global supplier, in more than 100 countries, of digital telecommunications systems to businesses, universities, local, state and federal governments, the telecommunications industry, and other institutions. The company employs more than 30,000 people in the United States in manufacturing plants, research and development centers, and in marketing, sales and service offices across the country. Nortel Networks, a world leader in technology, provides solutions for a wide variety of wireless telecommunications service providers. Nortel Networks thus welcomes enhancements in spectrum efficiency, so long as it does not come at the cost of harmful interference to the current and future telecommunications services.

**Thorough Testing and Analysis Is Essential**

In light of the fact that ultra-wideband transmissions are designed to operate co-frequency with other licensed (and unlicensed) communications services, the Commission must be certain that such operations will not cause harmful interference. As the *Notice* acknowledges, although there have been some studies and limited experimental operations, comprehensive tests have not yet been completed.[2] Nortel Networks believes that comprehensive testing is a necessary adjunct to theoretical studies, and Nortel Networks strongly endorses the Commission's stated intention not to amend its Rules until the studies are completed and the public has been afforded an opportunity to comment on the tests and analyses. Such studies and tests must be conducted to ascertain not only the effects of interference to individual radio links, but also to ascertain the effects on communications system performance in terms of availability, traffic capacity, data throughput, battery lifetime and potential loss of revenue to operators.

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[2] *E.g., Notice* at ¶¶ 1, 7, 21, 31, 44 and 47.

Nortel Networks believes that the studies and analyses should also take into account the potential cumulative impact of multiple ultra-wideband devices operating near the potentially affected services. In a somewhat analogous situation, an interference analysis in the Unlicensed National Information Infrastructure ("UNII") proceeding assessed the cumulative effects of wide deployment of UNII devices on low-Earth orbit satellite services operating in the same bands.[3] The Commission relied on the "cumulative impact" studies to restrict the deployment and power levels of UNII devices operating co-frequency with the satellite services.

The proponents of ultra-wideband technologies have provided a sample "analysis" to indicate that the cumulative effect of multiple ultra-wideband devices provides no more interference than a single device. Nortel Networks is not convinced by this assessment. The scenario considered in the analysis is not sufficiently robust to allow extrapolation to different possible deployment situations. In that analysis one UWB device was always located one meter away from the receiver, and at such a distance one device will always dominate the interference budget. This simplified analysis does not address the case where the potentially affected receiver (*i.e.,* a PCS base station or mobile) is immersed in a "sea" of the ultra-wideband devices (*i.e.,* there may be many ultra-wideband devices surrounding the PCS receiver (and closer than the PCS transmitter)). Preliminary Nortel Networks analysis indicates potential UWB interference to PCS receivers at distances up to 12 meters. As there may be multiple UWB devices operating

[3] *See, Amendment of the Commission's Rules to Provide for Operation of Unlicensed NII Devices in the 5 GHz Frequency Range*, 12 FCC Rcd 1576 (1997) ("U-NII Report and Order"), *aff'd on recon.*, 13 FCC Rcd 14355 (1998).

within this range, increased interference will be observed. Clearly further analysis and tests should be applied to the ultra-wideband technologies in assessing the risk of interference.[4]

Nortel Networks also believes that the Commission must consider the potential impact of unlicensed ultra-wideband transmissions on technologies expected to be deployed in the near future, not just on present services. For example, ultra-wideband transmissions may pose a significant interference threat to wideband software defined receivers. These receivers include a wideband front end coupled to a digitizer operating at 65 - 75 mega-samples per second. The digitizer input typically covers a full PCS bandwidth (*e.g.*, 15 or 20 MHz). While current receivers are not quite capable of resolving the ultra-wideband pulses, the bandwidths and sampling rates of wideband Software Defined Radios may be expected to increase for future generation communications devices, and these will be more susceptible to UWB interference. A 50 MHz bandwidth receiver does not seem unreasonable in a few years. A 1% duty cycle UWB transmission at the proposed emissions levels could result in the loss of 1% of the samples in a digital receiver. This would significantly reduce the performance and capacity of this new technology.

The UWB proponents' literature suggests that some communications systems would have pulse duty cycles of about 1%. During their active interval, the ultra-wideband emissions will be at a level equivalent to the PCS or other licensed systems transmissions (for a 50 MHz bandwidth receiver). Under these circumstances, an ultra-wideband device within about 60 meters of a wide-band receiver will thus deliver an inband noise signal, equivalent to the sensitivity level, roughly 1% of the time. For those desired incoming signals operating near the

[4] *Cf., Notice* at ¶ 47 (tentatively finding that only the closest transmitter needs to be considered, although under some scenarios the cumulative impact may need to be assessed).

sensitivity level, about 1% of the samples will be disturbed and this will affect the link performance and result in increased error rates and degraded system availability. While a CDMA spreading gain may mitigate this effect in some spread spectrum systems, the usual communications system design allocates this gain for multi-user interference and not extra noise. In addition to the impact on system availability due to interference with the reverse link, system capacity may also be reduced due to interference with the forward link. Thus, potential interference from ultra-wideband transmissions will diminish the flexibility, cost advantage and performance of the emerging technology of software defined radios.

The current and new technologies for radio systems are designed to make ever more efficient use of the spectrum resources. Many of theses make efficient use of the spectrum down to the noise level. Any increase in the noise level results in a decrease in the radio system capacity, giving fewer calls available, lower data rates and consequent lower revenues for the system operator. For example, in a CDMA system, a 1 dB increase in the noise level results in a 1 dB loss in system capacity and consequent call blocking and loss of operator's revenue. This means that although individual radio links may continue to seem to operate normally, fewer of them can be supported, the data rates may be lower and the battery lifetimes may be shorter as a result of the increased interference levels. Thus, it is important when testing and assessing the potential effect of interference to consider not just the effects on a single radio link or receiver, but also to consider the effect on the overall system capacity performance and operator revenues. These are all affected by increased noise levels.

**The Commission Should Adopt Appropriate Safeguards for Current Services**

Nortel Networks believes the Commission should adopt rule changes to accommodate unlicensed ultra-wideband devices that will adequately protect current services. The proposed ultra-wideband emissions levels are significantly above current noise levels. Such emissions could adversely affect the performance, capacity, cost, coverage and data rates of many current offerings. Most modern communications systems utilize adaptive power control techniques and work down to the noise level. The lower frequency limits proposed in the *Notice* for ultra-wideband communications devices should be moved above 5.9 GHz in order to avoid interference to PCS, mobile, UNII and fixed wireless access systems.[5]

While the proposed ultra-wideband emissions are at a low level, they are not insignificant. One ultra-wideband device may be emitting at an average level of about -40 dBm within, for example, a PCS mobile receiver bandwidth. These emissions will produce interference that is equal to the sensitivity level (about -96 dBm) when within a range of about 12 meters of a PCS mobile receiver. Thus, interference may be expected to mobile terminals operating near their sensitivity limit from relatively distant UWB emissions. As many cellular mobile terminals operate near their threshold when indoors, and while indoors may be in close proximity to an ultra-wideband wireless LAN (for example), the mobile system will quite often be affected. Likewise, for the uplink, because CDMA systems are power controlled, the extra noise from many ultra-wideband transmitters would have the effect of raising the average power needed by the PCS mobiles by an amount equal to the ultra-wideband devices' power (in total). This would increase the inter-cell interference, and thus reduce the overall system capacity. The

[5] *Cf.*, *Notice at* ¶ 27 (proposing to restrict ultra-wideband transmissions to frequencies above 2 GHz).

preliminary view is that the danger of ultra-wideband devices causing interference to existing communications products would seem to be quite real. To alleviate these concerns, the Commission should set the lower frequency limit to ultra-wideband communications devices at 5.9 GHz.

Nortel Networks does not have the same concerns for ultra-wideband devices used for ground penetrating radar devices.[6] The use of the UWB technology for ground penetration radar seems unlikely to cause significant interference to communications systems when the energy is directed into the ground and the extraneous radiation level is low. Nortel Networks agrees with the Commission's proposal to require ground penetrating radar devices to include a switch or other mechanism to ensure that operation occurs only when it is activated by an operator and the unit is aimed directly at the ground. However caution should be taken in cases where UWB devices are used to penetrate walls. Their use could interfere with in-building communication systems. Also their use in penetrating the floor in multi-floor buildings may cause harmful interference to communication systems in the floors immediately below the devices. In addition, UWB applications for collision avoidance, for example, may pose harmful interference to PCS terminals in vehicles.

Nortel Networks agrees with the Commission's view (*Notice* at ¶ 40) that the emissions from UWB devices are considerably different from those of unintentional radiators and conventional Part 15 transmitters, and hence have a higher potential to cause harmful interference. Because of this, Nortel Networks believes that emissions limits should be set considerably below the general emission limits for intentional radiators (500 microvolts per

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6 *Notice* at ¶¶ 10-11.

meter at 3 meters). One argument used by the ultra-wideband proponents to justify this level of emissions is that this is the current limit for out-of-band and spurious emissions for existing intentional radiators. The proponents contend that because existing devices are allowed to radiate at these limits, and no interference problems are observed in practice, the ultra-wideband emissions will have no effect on current services. This is a very misleading argument. In reality, intentional radiators do not generate *broadband* emissions at the maximum allowed out-of-channel limits.

Devices typically have some emissions near the limit at the edge of their assigned bandwidth and fall off at 20 dB or more per decade beyond the edge. There may be isolated narrow spurs that arise at odd places that approach the emission limits, but there is very little broadband emission near the limits. An example of the emission characteristics versus Part 15 requirements for a PCS product is shown in Attachment A. In this example, the broadband emissions are some 30 dB below the allowed limits. This is simply a consequence of all the tuned circuits in the equipment and the cost of generating RF power. RF equipment designers prefer to put their power in the desired signal and not to waste it on unintended out-of-band emissions. The fact that "no problems" are observed with the present emission limits is a result of no devices emitting broadband noise at the limits, and not an indication of the "safety" of the limits. Thus, Nortel Networks' preliminary analysis suggests that the emission limits should be set considerably (as much as 30 dB) below the broadband emissions limits for intentional radiators in order to have some assurance of non-interference to existing systems based on past product experience.

Some (non-communications) equipment does emit "unintentional" broadband noise at levels that often exceed the Commission limits for intentional radiators. Typically these are electric motors in industrial and home appliances. The commutators on these can act as spark-gap transmitters and generate wide-band noise. These unintentional emissions (noise) do cause interference to communications equipment operating nearby (*i.e.*, TV receivers and cellular phones). These devices are an example of how broadband noise can affect nearby equipment, and are an illustrative reason why further uncontrolled broadband emissions should not be allowed.

**Conclusion**

Nortel Networks supports the Commission's efforts to facilitate spectrum efficiency enhancing technologies such as ultra-wideband transmissions. Nortel Networks cautions the Commission, however, that such technology should not be introduced at the cost of harmful interference to current and future communications services. This is new technology that is not well understood. It will take some time and research to get reliable engineering models from which we can make specific recommendations on factors such as bandwidth restrictions, peak power, average power, shape of waveforms, etc. Thus, Nortel Networks urges the Commission not to take any action until comprehensive testing and studies are completed and a second round of comments solicited. Regardless, any rule changes must incorporate adequate safeguards for current and future communications services.

The preliminary view of Nortel Networks is that:

- UWB devices with emissions at the levels proposed in the notice have the potential to cause interference to PCS devices at distances up to 12 meters;

- the increase in the noise level to PCS systems from UWB devices at the proposed emission levels has the potential to reduce system capacity, data rates and operator revenues;
- emissions from UWB devices at the proposed levels will severely restrict the economic and technical advantages of future software defined radios and new technology wider band radio systems (50 – 100 MHz bandwidths);
- the lower limit of UWB emissions should be set above 5.9 GHz to avoid interference to existing licensed and unlicensed radio systems; and
- the UWB emissions levels should be set much (perhaps as much as 30 dB) below the current limits for intentional radiators to correspond to the current interference environment.

Respectfully submitted,

/s/

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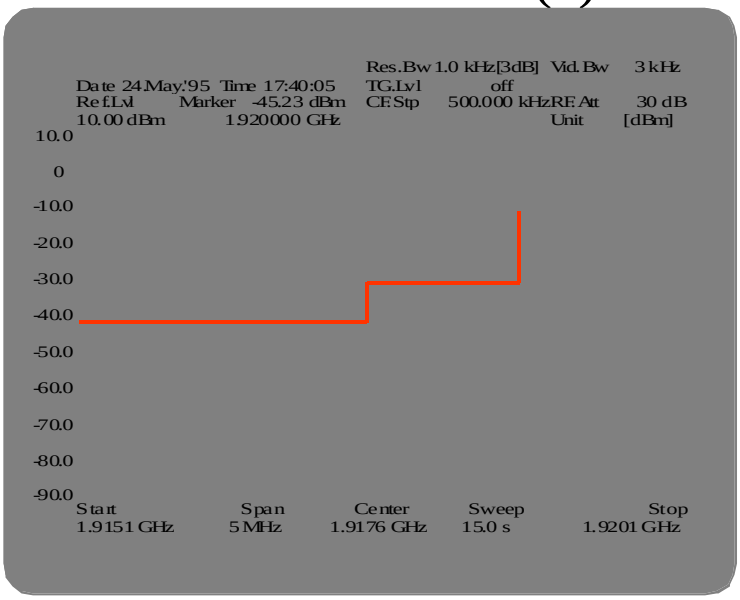
**Attachment A**

Example of emission characteristics versus Part 15 requirements for a PCS product.

# Part 15 emissions (a)




# Part 15 emissions (b)