Five Criteria for the PAR:

Supplement to STANDARD FOR Telecommunications and Information Exchange Between Systems – LAN/MAN Specific Requirements – Part 11: Wireless Medium Access Control (MAC) and physical layer (PHY) specifications: High Speed Physical Layer in the 5 GHz band

Broad Market Potential

To support the claim for the broad need for high speed wireless networking, let us quote from the "*Need for U-NII Devices and Spectrum*" part of the FCC ET 96-102 Docket:

> "In the *NPRM*, the Commission recognized that recent developments in a number of different digital technologies have greatly increased the need to transfer large amounts of data from one network or system to another. For example, technological developments now permit digitization and compression of large amounts of voice, video, imaging, and data information, which can be rapidly transmitted from computers and other digital equipment to other devices within a network. The *NPRM* stated that these dramatic developments in digital technology have stimulated a need for spectrum to be used for wireless interconnection within and among these networks. The Commission tentatively concluded that providing additional spectrum for unlicensed wideband operation would benefit a vast number of users, including educational, medical, business, and industrial users. Further, the Commission recognized that unlicensed access to this spectrum would permit educational institutions to form inexpensive broadband wireless computer networks between classrooms, thereby providing cost-effective access to an array of multimedia services on the Internet. In addition, the *NPRM* requested comment on whether new U-NII operations should include longer-range community networks.
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> ... discussion ...
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> *Decision*. We find that there is a need for unlicensed wireless devices that will be capable of providing data rates as high as 20 Mbits/sec to meet the multimedia communication requirements envisioned by the U-NII proponents. To achieve these high data rates at a reasonable cost, we believe that these devices must use broad bandwidths of up to 20 megahertz each and therefore these devices must have access to a substantial amount of spectrum to accommodate a number of devices within the same area. Further, we believe that accessibility to a substantial amount of spectrum is necessary for these devices to develop and mature to their full potential. The record in this proceeding supports our belief that recent developments in digital technologies have greatly increased the requirements for transferring large amounts of information and data in relatively short time frames from one network or system to another. Specifically, we note that computers have much faster central processing units and substantially increased memory capabilities, which have increased the demand for devices that can more quickly transfer larger amounts of data. Further, digital equipment is capable of switching and directing large amounts of information within networks. In addition to these technical advances in hardware capability, there has been substantial growth in the use, size, and complexity of digital networks as well. Many of these networks are not only growing internally in the amount and types of data they contain, but are also increasingly being used in combination and interaction with other such networks.
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> Further, it is clear from the record that educational institutions, business, industry, and consumers are all looking for ways to begin taking advantage of the innovative technological developments that promise the delivery of multimedia services comprising voice, video, imaging, and data. We agree with the commenters who argue that existing wireline and wireless services, in some cases, may not be able to meet all of the communications requirements and demands that these technological developments bring in a cost-effective manner. The record here shows that U-NII devices may be able to provide cost-effective communications services that will both complement and compete with existing services. For example, the spectrum and associated regulatory structure developed for U-

> PCS devices were not designed to handle broadband multimedia computer applications. Equipment in the U-PCS bands is limited to a maximum bandwidth of 2.5 megahertz and would not support data rates of 20 Mbits/sec or greater as envisioned for U-NII devices. Further, if we were to authorize broadband, high data rate equipment to use the 30 MHz of spectrum available for U-PCS, that spectrum would quickly become congested and would have limited use for the types of operations it is intended to accommodate. Additionally, we believe that as the NII and other telecommunications infrastructures grow, new communications alternatives that are flexible and inexpensive will be needed to assure delivery of information and services to all members of our society, regardless of income or location.
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> Accordingly, we find that it is appropriate to provide spectrum for wireless unlicensed digital network communications devices to meet the foreseeable communications demands of multimedia network systems resulting from developments of new digital technologies. We believe that this will facilitate rapid and inexpensive wireless access to information resources by educational institutions, business, industry, and consumers. We also believe that making this spectrum available for U-NII devices will further the Commission's mandate, in Section 257(b) of the Communications Act, to promote vigorous competition and technological advancement. For example, allowing unlicensed devices access to the 5.15-5.35 GHz and 5.725-5.825 GHz bands would permit educational institutions to form inexpensive broadband wireless computer networks between classrooms, thereby providing cost-effective access to an array of multimedia services on the Internet. In addition, unlicensed wireless networks could help improve the quality and reduce the cost of medical care by allowing medical staff to rapidly and inexpensively obtain patient data, X-rays, and medical charts."

US government actively supports wireless access to information, as is reflected by issuing the FCC Report and Order on January 9, 1997, for Docket 96-102. The large potential of the US market alone is reflected in the over 50 commentors' market assessments contained in the responses to the FCC's Notice of Proposed Rule Making. The frequency band allocated in the FCC Docket overlaps with a 5.2 GHz band allocated in western Europe for high speed local networking (the HIPERLAN project). Coordination with worldwide regulatory bodies will be attempted to ensure even wider market potential for the technology to be developed in this Project.

High degree of interest expressed by multiple vendors and the history of active participation of multiple vendors in 802.11 PHY standardization process promise that the standard will be accessible to multiple vendors. In addition, semiconductor manufacturers are expected to provide solutions for the emerging standard, making the technology available to multiple system manufacturers.

The 5 GHz radio component technology is starting to develop and we believe that the U-NII rulemaking will give a boost to availability of such components.

The modem component technology needed to support 20 Mbit/s operation is of a scale comparable to cable modems or satellite Direct Video Broadcasting. This makes it reasonable to believe that components will be available from several vendors to implement the PHY resulting from the proposed Project.

We believe that the cost of the PHY resulting from this project will be comparable to the cost of wireless LAN adapters based on current 802.11 technology. The complexity of the PHY operating at 20 Mbit/s should be a few times higher than a solution for the current Direct Sequence Spread Spectrum PHY specification operating at 11 Mchip/s, but taking into account the progress in semiconductor device density the cost should be comparable, once appropriate ASICs are developed.

Compatibility with IEEE Standard 802

The compatibility with IEEE 802 requirements will result from the use of 802.11 MAC, which itself was developed to be compatible with those requirements.

Distinct Identity

The proposed Project is distinct from the present 802.11 Project in that it is not restricted by CFR47 15.247 rules. As a result, usage of spread spectrum techniques in no longer required, and wider bandwidths are allowed. These factors enable significantly higher data rates.

This proposed PHY standard will provide for high performance (circa 20 Mbit/s) asynchronous wireless data communications in a local area network utilizing distributed coordination. In addition, time bounded services are implemented utilizing a centrally coordinated function. Both of these provisions are supported in the 802.11 MAC. In addition, this PHY layer standard will extend the 802.11 wireless LAN specification.

Technical Feasibility

Radio Technology: The technical feasibility of the radio part is already proven by existing 5.7 GHz products. The requirements of a High Speed PHY are not significantly different from today's ISM systems.

Modulation Methods: There are several modulation methods, such as GMSK (Gaussian Minimum Shift Keying) and OFDM (Orthogonal Frequency Division Multiplexing), which are sound candidates for a High Speed Wireless LAN PHY technology. The decision on the method which is best for the task is expected to be a convergent process rather than an amorphous research project.

Modem Technology: The increased processing requirements of the digital modem part are in line with the progress in ASIC technology. There are demonstrations of modem technologies which we believe to be of comparable complexity, such as XDSL, cable modems, satellite DVB modems, etc.

Range and Cell Size: The tenfold increase in data rate, compared to 2 Mbps ISM device, is expected to reduce the cell radius by an estimated 40% (assuming fourth power propagation law). In addition, the 5 GHz band does not experience interference from microwave ovens.

Economic Feasibility

The economic feasibility of the proposed Project draws on the feasibility of 5 GHz radio technology available today and of our expectations of modem complexity. Once 5 GHz MMICs proliferate, the cost is expected to drop to that comparable to today's 2.4 GHz technology. Some cost penalty may be incurred by tighter filtering requirements at the band edges, as FCC requires. Test equipment for higher frequency range may cost more, incurring some additional penalty on product cost. The modem ASICs will be somewhat more expensive than current 2.4 GHz modems. The overall cost of a 5 GHz high speed LAN adapter should be marginally higher than the current 802.11 adapter.

The installation of 5 GHz devices at the stations is not different from a 2.4 GHz LAN, and has almost no associated cost. The infrastructure cost (Access Points) is expected to be higher, due to smaller cell size than with lower rate 2.4 GHz equipment. Taking into account the higher rate of the proposed PHY, the overall cost/performance ratio should improve over ISM type network.