PAR Proposal for High Speed extensions in 2.4 GHz band

John Fakatselis, SG Chair

What follows is a proposal for a PAR for High Speed extensions for the 2.4 GHz band. This revision is an initial proposal by Chair then Naftali Chayat from BreezeCom , processed during SG meeting of 9 July 1997 (r1) and a correction by a chair Naftali Chayat (r2) to be revised once again on July (r3).

IEEE STANDARDS PAR FORM
(1/96)
Fill in the answers to the questions in the bracket provided. A Hard Copy of this document must be printed, signed with the appropriate signatures and mailed or faxed to the Standards Department for submission to NesCom.
1. Sponsor Date of Request _____
2. Assigned Project Number (confer with staff) _____
3. PAR Approval Date (leave blank) _____
4. Project Title, Copyright Agreement and Working Group Chair for This Project
I will write/revise a Standards Publication with the following TITLE (Spell out all acronyms)
[**X**] Standard [for] (Document stressing the verb "SHALL."), or
[ ] Recommended Practice for (Document stressing the verb "SHOULD.") or
[ ] Guide for (Document stressing the verb "MAY.")
TITLE:
[Supplement to STANDARD for Telecommunications and Information Exchange Between Systems - LAN/MAN Specific Requirements - part 11: Wireless Medium Access Control (MAC) Method and Physical Layer (PHY) specifications : Higher Speed Physical Layer (PHY) extensions in the 2.4 GHz band]
I hereby acknowledge my appointment as Official Reporter (usually the W.G. Chair) to the (Name of Working Group)
[**P802.11 Working Group for Wireless Local Area Networks**]
In consideration of my appointment and the publication of the Standards Publication identifying me, at my option, as an Official Reporter, I agree to avoid knowingly incorporating in the Standards Publication any copyrighted or proprietary material of another without such other's consent and acknowledge that the Standards Publication shall constitute a "work made for hire" as defined by the Copyright Act, and, that as to any work defined, I agree to and do hereby transfer any right or interest I may have in the copyright to said Standards Publication to IEEE.
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Name **Vic Hayes** Name [**Vic Hayes**] Date [**xx-xxx-1997**] Title [**802.11 Chair**] Company [**Lucent Technologies WCND B.V.**] Address [**Zadelstede 1-10**] City [**Nieuwegein**] State [**Netherlands**] Zip [**3431 JZ**] IEEE Member Number [**01550144**] Telephone [**+31 30 609 7528**] Fax [**+31 30 609 7556**] E-Mail [**vichayes@lucent.com**]

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5. Describe this project: (Choose ONE from each group below) a. [ ] Update an existing PAR [ ]Yes or [**X**]No If YES, project number/approval date)_____
Is this in ballot now? [ ]Yes or [ ]No
b. [ ] New Standard [ ]Yes or [ ]No [ ] Revision of an existing standard. [ ]Yes standard number/year_____ or [ ]No [**X**] Supplement to an existing standard [**X**]Yes standard number/year **802.11 -1997** or [ ]No
c. [**X**] Full Use (5-year life cycle) [ ] Trial Use (2-year life cycle)
d. Fill in target completion date for submittal to IEEE Standards Review Committee (RevCom).
[**31 December 1999**]
6. Scope of Proposed Project (*What is being done* including the technical boundaries of the project?)
[**To develop a higher speed PHY extension to 802.11 operating in the 2.4 GHz band.**]
7. Purpose of Proposed Project [*Why is it being done*, including the intended user(s) and benefits to that user(s)]
[**To extend the performance and the range of applications of the 802.11 compatible networks in the 2.4 GHz band by increasing the data rate achievable by such devices. This technology will be beneficial for improved access to fixed network LAN and internetwork infrastructure (including access to other wireless LANs) via a network of access points, as well as creation of high performance ad hoc networks.**]
8. Sponsor (Give full name; spell out all acronyms) Society/Committee:

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9(a.1) [**YES**] Are you aware of any patents relevant to this project? (*If YES, attach explanation, or No*) IEEE Patent procedure will be followed.
9(a.2) [**NO**] Are you aware of any copyrights relevant to this project? *(If YES, attach explanation, or No)*
9(a.3) [**NO**] Are you aware of any trademarks relevant to this project? *(If YES, attach explanation, or No)*
9b. [**NO**] Are you aware of any other standards or projects with a similar scope? *(If YES, attach explanation, or No)*
9c. [**YES**] Is this standard intended to form the basis of an international standard? *(Yes, or if NO, attach explanation, or Do Not Know)*
9d. [**NO**] Is this project intended to focus on health, safety or environmental issues? (If YES, attach explanation, or No, or Do Not Know))
10. Proposed Coordination/Recommended Method of Coordination (Coordination is accomplished in any of the following three ways: Circulation of Drafts or Liaison Membership or Common Membership.)
10a. **Mandatory Coordination** SCC 10 (IEEE Dictionary) Circulation of Drafts IEEE Staff Editorial Review Circulation of Drafts SCC 14 (Quantities, Units, and Letter Symbols) Circulation of Drafts
10b. **IEEE Coordination requested by Sponsor**: (Use additional page if necessary). If you believe your project will require a Registration Authority, please list IEEE RAC (refer to Working Guide).
[**US TAG to JTC-1 SC6 (Circulation of Drafts)**]
If coordination is not required, please attach an explanation.
10c. Additional Coordination Requested by Others. (Leave blank. This will be completed by the Standards Staff).

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11. Submitted by: (This **MUST** be the Sponsor Chair or the Sponsor's Liaison Representative to the IEEE Standards Board)

Signature of Submitter_____

Name [**Jim Carlo**] Title [**IEEE 802 LMSC Sponsor Chair**] Date [**xx-xxx-1997**] Company [**Texas Instruments**] Address [**9208 Heatherdale Drive**] City [**Dallas**] State [**Texas**] Zip [**76243 - 6332**] IEEE Member Number [**05572953**] Telephone [**+1-214-480-2524**] Fax [**+1-214-480-2611**] E-Mail [**jcarlo@ti.com**]

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[**Supplement to a "Higher Speed Wireless LAN PHY in 2.4 GHz band" PAR**
Scope of the Project

The scope of this project is to develop a higher speed PHY extension to 802.11 operating in the 2.4 GHz band.
The project will evaluate the possibility of taking advantage of the provisions for rate expansion that are in place on the current standard PHYs.
The 802.11 MAC defines a mechanism for operation of stations supporting different data rates in the same area. The current 802.11 standard already defines the basic rates of - 1 Mbit/s and 2 Mbit/s for both Frequency Hopping (FH) and Direct Sequence (DS) PHYs. The two rates are supported by having same header for both rates with length and rate information passed in the header at the lowest ("basic") rate; then the body of the packet is transmitted at the rate chosen and with the corresponding modulation method.
The header structure of the two PHYs already supports passing rate information up to 4.5 Mbit/s (in 0.5 Mbit/s increments) for FH and up to 25.5 Mbit/s (in 0.1 Mbit/s increments) for DS. The proposed PAR targets further developing the provisions for enhanced data rate capability of 802.11 networks.
The 802.11 MAC incorporates already the interpretation of this information and the computation of expected packet duration even if the specific station does not support the rate at which the packet was sent. The 802.11 MAC is compatible and will accommodate the higher PHY rates.

Compatibility with 802.11 MAC

The 802.11 PAR mentions that the MAC will be capable of operation in the 1-20 Mbit/s range. The 802.11 MAC will be reviewed for it's capability to support rates up to about 10 Mbit/s targeted by the extended modulation methods.

Data rate

The data rates targeted by this project are at least 3 Mbit/s for FH PHY and at least 8 Mbit/s for DS PHY.

Radio Spectrum Availability

The proposed extensions will operate in the already allocated 2.4 GHz ISM band, in which 802.11 is already defined.
IEEE P802.11 will correspond with regulatory bodies worldwide in order to try to assure that the proposed extension will be applicable geographically as widely as possible.]

IEEE 802 Five Criteria

1. BROAD MARKET POTENTIAL

a) Broad sets of applicability.

The broad sets of applicability includes a number of applications presently supported with Ethernet speeds on wired networks. Some example applications that can be addressed with the higher rate capability include mpeg video, videoteleconferencing and applications requiring larger data sets, as well as larger number of users..

The increasing, and widespread adoption of today's computing and communications applications (email, Internet browsing, etc.) are placing increased demands on network services and bandwidth. This is evidenced by the rapid transition from 10 Mbps to 100 Mbps wired Ethernet, and shared to switched mediums. Additionally, applications under development such as voice and video over Internet Protocol will further accelerate the demand for higher bandwidth communications services.

The higher rate capability can potentially be used to improve network throughput beyond the capability of the existing 1 and/or 2 Mbps 802.11 networks in the 2.4GHZ band. The 2.4 GHZ band is presently available worldwide for such applications.

b) Multiple vendors, numerous users.

The higher rate extension will be supported by the same vendor base and to a great extent by the users utilizing the existing 802.11 standard. An indicator of such participation is the active 802.11 membership itself.

The 802.11 membership supportive of this PAR includes a broad range of international wireless industry leaders , ranging from semiconductor manufacturers to system integrators. There are over 15 companies represented at 802.11 in preparation of this PAR.

c) Balanced costs (LAN versus attached stations).

The costs to achieve the extended rates is projected to be within the range of the existing 802.11 systems. The changes are anticipated to impact the baseband processing, while the RF/IF front as well as the MAC protocol are estimated to remain equivalent to the existing standard. The baseband signal processing will change but the cost of the new processing HW is projected to be within the cost targets of the existing standard.

2. COMPATIBILITY

The compatibility with IEEE 802 requirements will result from the use of the MAC of the 802.11 standard which itself was developed and has been approved as being compatible with those requirements. Since the proposed extension will maintain the existing 802.11 MAC then, all LLC and MAC standards will be compatible and in conformance with 802.1 Architecture, Management and Internetworking. The MAC/PHY Layer interface will remain common to the existing 802.11 definition. An additional high rate PHY layer, not necessarily compatible with the existing PHYs, will be supported through the same interface.

3. DISTINCT IDENTITY

a) Substantially different from other 802 Projects

The speeds proposed are significantly higher than the existing 802.11 products at the 2.4 GHZ band.
It is the only proposed solution to expand the rate capability in the presently available (worldwide) 2.4 Ghz band as opposed to other initiatives addressing the 5GHZ band.
In addition it is the only proposed PAR with the potential for backward compatibility to the current standard, leveraging existing technology.

b) One unique solution per problem (not two solutions to a problem).

The PAR will define only one additional 2.4 GHZ PHY high rate extension in addition to the current 1 and/or 2 Mbit/s FH and DS PHYs.

c) Easy for document reader to select the relevant specification.v

A separate PHY section , addressing high rate applications, will be developed as an addition to the current standard. The additional document will address the requirements specifications and any other relevant information in regards to the high rate extension PHY.

4. TECHNICAL FEASIBILITY

a) Demonstrated system feasibility.

There are several modulation methods that have been presented as feasible solutions to the rate extension question.

For FH, an ad hoc study group for higher speed FH PHY reviewed a 3 Mbit/s modulation method. This modulation method is field proven (it is incorporated at the moment as a proprietary extension in BreezeCom products).

As for Direct Sequence, an initial proposal by Harris and a press release by Lucent Technologies indicate that a combination of phase keying with M-ary code keying are capable of achieving at least 8 Mbit/s (11 Mbit/s in Harris' proposal) rate. Both companies present their technology as being both feasible as a system and acceptable to FCC.

A similar system was described by Micrilor, involving bi-orthogonal signaling with code keying and polarity keying. A version of this modulation method has been approved by the FCC, and commercially available for one year.

b) Proven technology, reasonable testing.

The example technologies exist today in a form of prototypes or in some cases as FCC certified products. Test data is available for evaluation.

c) Confidence in reliability.

The data of the existing products and prototypes representing the canditate approaches provides confidence inthe reliability of the proposed solutions. This data has been partially presented within the 802.11 Working groups and the papers are available for review.
Radio technology as well as performance issues have been addressed by the presenters.

5. ECONOMIC FEASIBILITY

a) Known cost factors, reliable data.

The fundamental Radio architecture (RF/IF) of the candidate approaches is similar to that of the current 802.11 solution. The known cost baseline of the current 802.11 systems has been used to project the cost baseline for the extended rate system.

b) Reasonable cost for performance.

The primary Cost trade offs are vs. Rate vs. Range vs. Multipath resistance of the high rate solution in contrast to the current 802.11 PHY capability. These trade offs appear reasonable based on information presented to the 802.11 working group. The costs of the stations remains approximately the same .Any additional cost due to additional infrastructure is being offset by the increased number of users in the given area within a cell.

c) Consideration of installation costs.

The installation of extended devices is same as those of the current 802.11 devices. The infrastructure cost (Access Points) is expected to be approximately the same with the exception of cost incurred by somewhat smaller cell size than with lower rate 2.4 GHz equipment. Upgrading an existing network to a higher speed can be performed selectively in areas with a demand for higher instantaneous rate.