

## 1000BASE-T 5 Criteria

### 1. Broad Market Potential

- Broad set of applications
  - Multiple vendors, multiple users
  - Balanced cost, LAN vs. attached stations
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Faster CPUs, graphic applications and general increases in network traffic are forcing the development of new LANs with higher bandwidth. Most Ethernet networks today incorporate nodes and cabling capable of 100 Mb/s operation. State-of-the-art network servers today can generate network loads of more than 400 Mb/s. A 1996 survey of 100 companies by Currid & Company found that more than 40% of the respondents indicated that they would need 100Mb/s-1000Mb/s backbone solutions by the year 2000. Many network backbones already require bandwidth in excess of 100 Mb/s today; some applications do as well.

Many applications and environments will benefit from this capability:

- Building-level backbone, server and gateway connectivity
- Multimedia, distributed processing, imaging, medical, CAD/CAM and pre-press applications
- Aggregation of 100 Mb/s switches
- Upgrade for large installed base of 10/100 Ethernet
- Upgrade for large installed base of Category 5 cabling and Class D links

Market surveys indicate that Category 5 balanced copper cabling is the predominant installed intra-building horizontal networking media today (see # 5 below.) The market acceptance of 100BASE-TX is a clear indication that copper cabling will continue to be the medium of choice wherever it can be applied. 1000BASE-T is the natural extension of this evolution and can expect broad market acceptance as the demand for network speed increases. 1000BASE-T will continue the Ethernet tradition of providing balanced cost solutions.

Interest in 1000BASE-T has been demonstrated by the attendance of more than fifty vendor and user representatives at technical meetings at the November '96 Plenary, attendance at a subsequent Interim meetings, and by participation in an email forum devoted to facilitating technical development in this area. More than 29 vendor companies have indicated that they plan to participate in the standardization of 1000BASE-T. This level of commitment indicates that the standard will be supported by multiple vendors, and that there will be a wide variety of equipment available to support gigabit speed applications copper links.

## 2. Compatibility with IEEE Standard 802.3

- Conformance with CSMA/CD MAC, PLS
- Conformance with 802.2
- Conformance with 802 FR

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The proposed standard will conform to the CSMA/CD MAC with currently authorized extensions, appropriately adapted for 1000 Mb/s use.

In a fashion similar to the 100BASE-T standard, the current physical layers will be replaced with new Physical Layers (PHY) as appropriate for 1000 Mb/s operation over the defined link: a link which meets the link requirements of 4 pair Category 5 100 ohm balanced copper component specifications as specified in ANSI/TIA/EIA-568-A or ISO/IEC 11801 : 1995 and the channel specifications of TIA/EIA568A Annex E.

1000BASE-T offers the maximum compatibility with the current installed base of more than 60 million CSMA/CD nodes, most of which copper cabling systems. Support of 802.3 Auto-Negotiation will ensure that 802.3 UTP solutions continue to be auto-configuring.

The Management Information Base (MIB) for 1000BASE-T will maintain consistency with the current 802.3 MIB for 10/100 Mb/s operation, allowing a consistent management model across all operating speeds.

Conformance with 802.2 is provided by the overlying 802.3z MAC sublayer.

The proposed standard will conform to the 802 Functional Requirements Document, with the possible exception of the Hamming distance.

The 1000BASE-T PHY will conform to the Gigabit Media Independent Interface (GMII) to be specified in 802.3z.

Two kilometer network spans, while not supported specifically by 1000BASE-T, will be supported by combination with other members of the 802.3 family of 1000 Mb/s standards.

## 3. Distinct Identity

- Substantially different from other 802.3 specs/solutions
- Unique solution for problem
- Easy for document reader to select relevant spec

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The proposed standard is a 1000Mb/s upgrade for 802.3 users based on the 802.3 CSMA/CD MAC.

It will be the only balanced copper solution for 1000 Mb/s capable of providing service over the defined link. As such, it offers an easy upgrade for the 1000s of users who have installed Category 5 cable plants.

It is substantially different from other 802.3 copper solutions in that it supports 1 Gb/s operation over the defined link.

The proposed standard will be a supplement to the existing 802.3 standard and supplements in progress and will be formatted as a new clause, making it easy for the reader to select the relevant specification.

## 4. Technical Feasibility

- Demonstrated feasibility
  - Proven technology
  - Confidence in reliability
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Technical presentations given to 802 have demonstrated the feasibility of using the digital signal processing technology in Category 5/Class D UTP network topologies at a rate of 1000 Mb/s. These solutions build on current 802.3 technologies, including 100BASE-TX and 100BASE-T2, and on technologies currently in use in other data communications areas.

In spite of the increased data rate, the signaling bandwidth required of each of the line coding implementations currently under consideration for 1000BASE-T is no greater than that required for 100BASE-TX. All of the line codes proposed have been simulated in mathematical models that have been verified by actual measurements and are widely accepted by the field as being a valid indicator of real life performance. Significant work has been done testing line code proposals over the defined link using simulation and actual cable links.

Experience with equipment using ADSL, HDSL and QAM based signaling techniques in the field has demonstrated the reliability of signaling techniques such as those proposed by 1000BASE-T. Similar modulation systems are widely used in cable modems, hard disk drives, etc.

#### 5. Economic Feasibility

- Cost factors known, reliable data
- Reasonable cost for performance expected
- Total installation costs considered

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The line code solutions proposed for 1000BASE-T are all based on existing data communications solution technologies.

Although an accurate cost model cannot be established until the line code solution has been selected, projections indicate that the cost/performance ratio for 1000BASE-T vis-à-vis 100BASE-TX will be about the same as that offered by 100BASE-TX vis-a-vis 10BASE-T at the time of initial introduction (1994.) The cost of proposed implementations are expected to be 4-6X that of 100BASE-TX. Given consistent progress on the standard, initial silicon implementations should be available in 1H98.

Customers will be able to use existing Category 5 balanced copper cabling that conforms to the defined link. The cost model for horizontal copper cabling is well established.

A variety of surveys conducted over the past five years have demonstrated that Category 5 cabling is the dominant cabling in place today. Payne (92) found that 65% of the 117 companies surveyed had Category 5 cabling as a corporate standard and projected that the number would grow to 83% in two years (1994.) A Sage Research survey (95) found that 70.5 percent of surveyed companies with more than 1000 employees used Category 5 cabling for horizontal links.

For companies with installed Category 5 wiring, 1000BASE-T offers the lowest cost Gigabit solution; all upgrade costs will reside in the silicon and magnetic components, not the link.