

## Ethernet Speeds, Feeds, & Facts – i5/iSeries



### Did You Know?

*Ethernet was named by Robert Metcalfe, one of its developers, for the passive substance called "luminiferous (light-transmitting) ether" that was once thought to pervade the universe, carrying light throughout. Ethernet was so-named to describe the way that cabling, also a passive medium, could similarly carry data everywhere throughout the network.*

For more information - <http://www.gstinc.com/store/Ethernet-C440.aspx>

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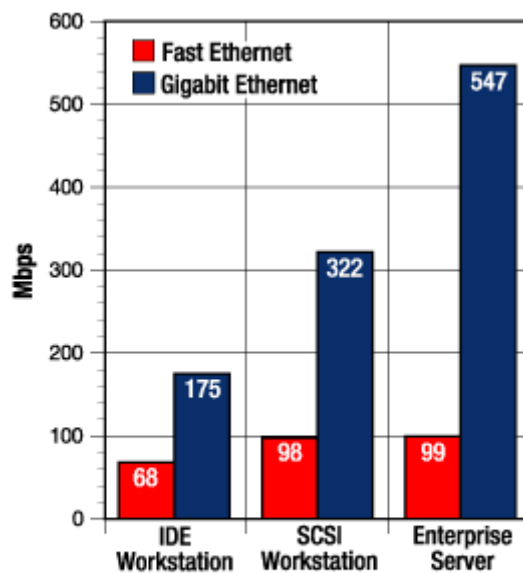
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### Executive Summary

Ethernet is the most widely-installed local area network (LAN) technology. Specified in a standard, IEEE 802.3, Ethernet was originally developed by Xerox from an earlier specification called *Alohanet* (for the Palo Alto Research Center Aloha network) and then developed further by Xerox, DEC, and Intel. An Ethernet LAN typically uses coaxial cable or special grades of twisted pair wires. Ethernet is also used in wireless LANs. The most commonly installed Ethernet systems are called 10BASE-T and provide transmission speeds up to 10 Mbps. Devices are connected to the cable and compete for access using a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol.

Fast Ethernet or 100BASE-T provides transmission speeds up to 100 megabits per second and is typically used for LAN backbone systems, supporting workstations with 10BASE-T cards. Gigabit Ethernet provides an even higher level of backbone support at 1000 megabits per second (1 gigabit or 1 billion bits per second). 10-Gigabit Ethernet provides up to 10 billion bits per second.



Fast Ethernet vs. Gigabit Ethernet  
Burst Throughput



## Ethernet Standards

### 10BASE-T

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10BASE-T, one of several physical media specified in the IEEE 802.3 standard for Ethernet local area networks (LANs), is ordinary telephone twisted pair wire. 10BASE-T supports Ethernet's 10 Mbps transmission speed. In addition to 10BASE-T, 10 megabit Ethernet can be implemented with these media types:

- 10BASE-2 (Thinwire coaxial cable with a maximum segment length of 185 meters)
- 10BASE-5 (Thickwire coaxial cable with a maximum segment length of 500 meters)
- 10BASE-F (optical fiber cable)
- 10BASE-36 (broadband coaxial cable carrying multiple baseband channels for a maximum length of 3,600 meters)

This designation is an Institute of Electrical and Electronics Engineers (IEEE) shorthand identifier. The "10" in the media type designation refers to the transmission speed of 10 Mbps. The "BASE" refers to baseband signaling, which means that only Ethernet signals are carried on the medium. The "T" represents twisted-pair; the "F" represents fiber optic cable; and the "2", "5", and "36" refer to the coaxial cable segment length (the 185 meter length has been rounded up to "2" for 200).

### 100BASE-T

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Fast Ethernet is a local area network (LAN) transmission standard that provides a data rate of 100 megabits per second (referred to as "100BASE-T"). Workstations with existing 10 megabit per second (10BASE-T) Ethernet card can be connected to a Fast Ethernet network. (The 100 megabits per second is a shared data rate; input to each workstation is constrained by the 10 Mbps card.)

### Gigabit Ethernet

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Gigabit Ethernet, a transmission technology based on the Ethernet frame format and protocol used in local area networks (LANs), provides a data rate of 1 billion bits per second (one gigabit). Gigabit Ethernet is defined in the IEEE 802.3 standard and is currently being used as the backbone in many enterprise networks.

Gigabit Ethernet is carried primarily on optical fiber (with very short distances possible on copper media). Existing Ethernet LANs with 10 and 100 Mbps cards can feed into a Gigabit Ethernet backbone. An alternative technology that competes with Gigabit Ethernet is ATM. A newer standard, 10-Gigabit Ethernet, is also becoming available.

### 10-Gigabit Ethernet

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10-Gigabit Ethernet (10GBASE-T), being standardized in IEEE 802.3a, is a telecommunication technology that offers data speeds up to 10 billion bits per second. Built on the Ethernet technology used in most of today's local area networks (LANs), 10-Gigabit Ethernet is described as a "disruptive" technology that offers a more efficient and less expensive approach to moving data on backbone connections between networks while also providing a consistent technology end-to-end. Using optical fiber, 10-Gigabit Ethernet can replace existing networks that use ATM switches and SONET multiplexers on an OC-48 SONET ring with a simpler network of 10-Gigabit Ethernet switches and at the same time improve the data rate from 2.5 Gbps to 10 Gbps.

10-Gigabit Ethernet is expected to be used to interconnect local area networks (LANs), wide area networks (WANs), and metropolitan area networks (MANs). 10-Gigabit Ethernet uses the familiar IEEE 802.3 Ethernet media access control (MAC) protocol and its frame format and size. Like Fast Ethernet and Gigabit Ethernet, 10-Gigabit Ethernet uses full-duplex transmission, which makes possible a considerable distance range. On multimode fiber, 10-Gigabit Ethernet will support distances up to 300 meters; on single mode fiber, it will support distances up to 40 kilometers. Smaller Gigabit Ethernet networks can feed into a 10-Gigabit Ethernet network



## Ethernet Features - i5/iSeries

Feature	Description
0620	Linux/AIX - Gigabit Ethernet-SX PCI-X Adapter
0621	Linux/AIX - Gigabit Ethernet-TX PCI-X Adapter PCI-X Adapter
0623	Linux/AIX - PCI 100/10Mbps Ethernet IOA
2723 / 9723	PCI 10Mbps Ethernet IOA IEEE 802.3
2743	1Gbps PCI Ethernet IOA
2760	PCI 1Gbps Ethernet UTP IOA
2838 / 9738	PCI 100/10Mbps Ethernet IOA
2849 / 9749	PCI 100/10Mbps Ethernet IOA
4723	PCI 10Mbps Ethernet IOA
4838	PCI 100/10Mbps Ethernet IOA
5700	PCI 1Gbps Ethernet IOA
5701	PCI 1Gbps Ethernet UTP IOA
5706	PCI-X Dual Port 1Gbps Ethernet-TX IOA
5707	PCI-X 1Gbps Ethernet-SX IOA
5718	10Gbps Ethernet Adapter
5719	10Gbps Ethernet IOA (Long)
5740	1Gbps BaseT Ethernet (4-Port)
6800	PCI 1Gbps Ethernet IOA
6801	PCI 1Gbps Ethernet UTP IOA



## Attachment > 5700, 5701, 5706, 5707

Machine	Model	5700	5701	5706	5707
9406	520	Y	Y	Y	Y
9406	550	Y	Y	Y	Y
9406	570	Y	Y	Y	Y
9406	595	Y	Y	Y	Y
9406	800	Y	Y	-	-
9406	810	Y	Y	-	-
9406	820	Y	Y	-	-
9406	825	Y	Y	-	-
9406	830	Y	Y	-	-
9406	840	Y	Y	-	-
9406	870	Y	Y	-	-
9406	890	Y	Y	-	-
9406	SB2	Y	Y	-	-
9406	SB3	Y	Y	-	-



### **Ethernet Details - i5/iSeries**

0620

Linux/AIX - Gigabit Ethernet-SX PCI-X Adapter

Cards controlled by a non-OS/400 operating system do not use/require PCI IOPs. Direct attach cards are supported only in a non-OS/400 partition.

#0620, #5700 and #6800 are physically the same adapter card but have different feature numbers to indicate to IBM configurator tools that an IOP is or is not being used in the configuration.

Prerequisites:

- #0140 Logical Partitioning Specify.
- #0142 Linux Partition Specify or #0145 AIX Partition Specify
- Attributes provided: #5700 controlled by AIX or Linux Operating System
- Attributes required: #0140 and (#0142 or #0145)

0621

Linux/AIX - Gigabit Ethernet-TX PCI-X Adapter PCI-X Adapter

#0621 is ordered when the function of a #5701 IOA is required but the card will be controlled by a non-OS/400 operating system.

Cards controlled by a non-OS/400 operating system do not use/require PCI IOPs. Direct attach cards are supported only in a non-OS/400 partition.

#0621, #5701 and #6801 are physically the same adapter card but have different feature numbers to indicate to IBM configurator tools that an IOP is or is not being used in the configuration.

Prerequisites:

- #0140 Logical Partitioning Specify.
- #0142 Linux Partition Specify or #0145 AIX Partition Specify
- Attributes provided: #5701 controlled by AIX or Linux Operating System
- Attributes required: #0140 and (#0142 or #0145)



0623

Linux/AIX - PCI 100/10Mbps Ethernet IOA

#0623 is ordered when the function of a #2849 IOA is required but the card will be controlled by a non-OS/400 operating system.

Cards controlled by a non-OS/400 operating system do not use/require PCI IOPs. Direct attach cards are supported only in a non-OS/400 partition.

- Attributes provided: #2849 controlled by Linux Operating System
- Attributes required: #0140, #0142

2723 / 9723

PCI 10Mbps Ethernet IOA IEEE 802.3

This adapter supports attachment to an Ethernet network operating in half-duplex or full-duplex mode. Internal code supplies Ethernet V2 and IEEE 802.3 Media Access Control (MAC) plus IEEE 802.2 Logical Link Control (LLC) functions.

#2723 has an RJ45 connector and a 15 pin D-Shell connector for attachment of customer-supplied cabling. The feature includes AUI and RJ45 wrap connectors.

One of the following cables is required:

1. Customer supplied Ethernet Cable (3-meter AUI) or RJ45 cable
2. #9025: Ethernet Cable AUI 3.0m

Requires (where appropriate):

1. MFIOP position or position in Integrated PC Server/Netfinity Server
2. OS/400 V4R2



2743

1Gbps PCI Ethernet IOA

#2743 requires a Gigabit Capable Switch with at least one port that supports a 1000BASE-SX interface with IEEE 802.3z and 802.3u compliance.

#### Attributes

1. The #2743 can be directly attached to a Linux partition.
2. When ordered as #0601: Linux Direct Attach #2743, an IOP is not required.

#### Restrictions:

1. #2743 supports 1000MBps (1Gbps) full duplex interface only. It cannot negotiate down to a lower speed.
2. Stations on the 10Mb and 100Mb switched LANs can communicate with the #2743 through a switch that is capable of handling all these speeds.
3. If #2743 is controlled by a #2790/2791/2799 Integrated Server, then specify code #0225 1Gbps Ethernet Specify must be ordered for each #2743 controlled by an Integrated Server.
4. When directly attached to a Linux partition, the #2743 cannot be accessed by OS/400 partitions.
5. #2743 only supports TCP/IP connection; SNA and IPX connections are not supported.
6. #2743 cannot be used with the #2890: PCI Integrated Netfinity Server.

#### Requires

1. 64-bit card slot.

Max: One per Multi-Adapter Bridge Boundary.

#### Min O/S Levels:

1. iSeries: V4R5
2. iSeries with #2790/#2791: V4R5 w/Package C1005450
3. iSeries with #2799: V5R1 plus PTFs
4. i5 Systems: V5R3





# GST Research Report

Ethernet Speeds, Feeds, & Facts

2760

PCI 1Gbps Ethernet UTP IOA

The #2760 PCI 1Gbps Ethernet IOA is used for attachment to IEEE standard 802.3Z high-speed Ethernet LANs (1Gbps). The adapter supports a UTP CAT 5 media interface.

#### Attributes

1. Supports TCP/IP.
2. #2760 can attach to 10Mbps, 100Mbps, or 1Gbps networks.
3. #2760 can be run under a #2790/#2791/#2890/#2891: Integrated Server features with OS/400 V5R1.
4. If #2760 will be controlled/driven by a #2790/#2791/#2890/#2891 then one specify code #0225: 1Gbps Ethernet Specify must be ordered for each #2760 controlled/driven by an integrated server feature.
5. The #2760 may be directly attached to a Linux partition.
6. When ordered as #0602: Linux Direct Attach - #2760, an IOP is not required. When direct attached to a Linux partition, the #2760 cannot be accessed by OS/400 partitions.

#### Maximum:

1. One per multi-adapter bridge boundary. Ignore this maximum for any #2760 controlled/driven by an integrated server feature.
2. Combinations of #2760 controlled by Integrated Server features or PCI IOP within a multi-adapter bridge boundary are permitted.

#### PCI Card Slots:

1. A 64-bit card slot except on the Model 270 where it is supported in a 32-bit slot.

#### Requires

1. OS/400 V5R1 or later is required.

2838 / 9738

PCI 100/10Mbps Ethernet IOA

PCI 100/10Mbps Ethernet IOA feature will allow the AS/400 to attach to standard 100Mbps high speed Ethernet LANs and also allow attachment to existing 10Mbps Ethernet LANs.

The adapter comes with an RJ45 connector for attachment to UTP-5 media.

#### Requires Supported slot on:

1. #2809: PCI LAN/WAN/Workstation IOP
2. #2810: SPD LAN/WAN IOP
3. #2824: PCI LAN/WAN/Workstation IOP
4. MFIOP Position
5. Position in Integrated PC Server/Netfinity Server

#### Requires

1. OS/400 V4R1 or later.



# GST Research Report

## Ethernet Speeds, Feeds, & Facts

2849 / 9749

PCI 100/10Mbps Ethernet IOA

2849 allows attachment to 100Mbps and 10Mbps Ethernet LANs.

### Attributes

1. The adapter comes with an RJ45 connector for attachment to UTP-5 media.
2. #2849 is not supported on any PC server feature.
3. Used for attaching the iSeries Server to IEEE standard 802.3Z high-speed (1Gbps) Ethernet TCP/IP LANs.
4. It can also be used to connect to existing 100Mbps Ethernet LANs via switches with 10/100/1000Mbps ports.
5. The adapter supports a multi-mode fiber interface with via a duplex (62.5 micron or 50.0 micron) SC connector cable.

### Requires:

1. 1 x 3V or 5V PCI Slot
2. OS/400 V5R2 or later

4723

PCI 10Mbps Ethernet IOA

Provides single attachment to a Carrier Sense Multiple Access/Collision Detect (CSMA/CD) LAN at 10Mbps.

The feature consists of an adapter card and internal code that supplies Ethernet version 2 and IEEE 802.3 Media Access Control (MAC) plus IEEE 802.2 Logical Link Control (LLC) functions.

The Ethernet/IEEE 802.3 IOA is capable of operating in half-or full-duplex mode.

#4723 has an RJ45 connector and a 15 pin D-Shell connector for attachment to customer-supplied cabling. A vendor AUI Ethernet cable or RJ45 twisted pair cable must be ordered separately.

#4723 is not supported by any PCI Integrated Server.

4838

PCI 100/10Mbps Ethernet IOA

Attaches the AS/400 to 100Mbps high-speed Ethernet LANs and/or existing 10Mbps Ethernet LANs. The adapter comes with an RJ45 connector for attachment to UTP-5 media.

PCI Card slots required: One.



# GST Research Report

## Ethernet Speeds, Feeds, & Facts

5700

PCI 1Gbps Ethernet IOA

The #5700 is a PCI-X IOA that allows an iSeries server to attach to IEEE standard 802.3Z high speed (1Gbps) Ethernet LANs. A #5700 can also be used to connect to existing 100/10Mbps Ethernet LANs. This adapter supports a multimode fiber interface with a 62.5 micron or 50.0 micron cable requirement. The adapter has a duplex LC fiber-optic connector for attachment to customer-supplied cabling.

The #5700s only supports TCP/IP, and requires an intervening switch/hub/router when connection to 1Gbps or 100/10Mbps networks.

Feature #5700 is supported by a #2892 or #4810 Integrated xSeries Server.

1. If a #5700 will be controlled/driven by a #2792 or #4810, then specify code #0226 (1Gbps Ethernet Specify) must be ordered. One #0226 for each #5700 controlled/driven by an integrated server.

#5700, #0620 and #6800 are physically the same adapter card but have different feature numbers to indicate to IBM configurator tools that an IOP is or is not being used in the configuration.

2. Attributes provided: 1000/100/10 Ethernet LAN Interface
3. Attributes required: One short or long, 3.3V or 5V PCI-X slot

5701

PCI 1Gbps Ethernet UTP IOA

#5701 provides PCI-X attachment to IEEE standard 802.3ab high-speed (1Gbps) Ethernet LANs. It can also be used to connect to existing 10Mbps or 100Mbps Ethernet LANs using switches with 10/100/1000Mbps ports. The adapter supports a UTP CAT 5 media interface, and only TCP/IP.

If #5701 is used with a #2792 or #2892, then one specify code #0226, 1Gbps Ethernet Specify, must be ordered for each #5701.

#6800 and #5700 are physically the same adapter card but have different feature numbers to indicate to IBM configurator tools that an IOP is or is not being used in the configuration.

#5701, #0621 and #6801 are physically the same adapter card but have different feature numbers to indicate to IBM configurator tools that an IOP is or is not being used in the configuration.

- Attributes provided: 1000/100/10 Ethernet LAN Interface
- Attributes required: One short or long, 3.3V or 5V PCI-X slot

5706

PCI-X Dual Port 1Gbps Ethernet-TX IOA

The #5706 is a 2-port 1000/100/10Mbps Base-TX Ethernet PCI-X Adapter. The #5706 is a Full Duplex, dual ported, Gigabit Ethernet adapter designed with highly integrated components. This adapter can be configured to run either port at 1000, 100, or 10 Mbps data rate. This adapter interfaces to the system via a PCI or PCI-X bus and connects to a network using a 4-pair CAT-5 Unshielded Twisted Pair (UTP) cable for distances of up to 100m. The adapter conforms to the IEEE 802.3ab 1000Base-T standard. The #5706 also supports jumbo frames when running at the 1000 Mbps speed.

i5/OS V5R3 does not support a #5706 function called 'Large Send' or sometimes known as TCP Segmentation. This function offloads the TCP segmentation operation from the IP layer to the adapter for outgoing (transmit side) TCP segments.

i5/OS V5R3 does not support a #5706 function known as "Checksum Offload" which offloads the TCP/UDP Checksum Operation or workload from the CPU to the adapter.

The #5706 does not support SNA.

The #5706 does not require a PCI IOP, even in an i5/OS partition.

**Note:** For optimum performance, the adapter should be placed in a 64 bit PCI-X card slot whenever possible.

Limitations: The 1000 Mbps speed is not supported in Half Duplex (HDX) mode.

- Attributes provided: Two full-duplex 1000/100/10Base-TX UTP connections to Gigabit Ethernet LANs.
- Attributes required: One 3 volt PCI or PCI-X card slot (either long or short)



### 5707

### PCI-X 1Gbps Ethernet-SX IOA

The #5707 is a 2-Port Gigabit Ethernet-SX PCI-X Adapter that provides two 1Gbps (1000 Base-SX) full-duplex Ethernet LAN connections with throughput on a standard shortwave multimode optical cable that conforms to the IEEE 802.3z standard. The adapter supports distances of 260m for 62.5 micron Multi Mode Fiber (MMF) and 550m for 50.0 micron MMF.

i5/OS V5R3 does not support a #5707 function called 'Large Send' or sometimes known as TCP Segmentation. This function offloads the TCP segmentation operation from the IP layer to the adapter for outgoing (transmit side) TCP segments.

i5/OS V5R3 does not support a #5707 function known as "Checksum Offload" which offloads the TCP/UDP Checksum Operation or workload from the CPU to the adapter.

The #5707 does not support SNA.

#5707 does not require a PCI IOP, even in an OS/400 partition.

**Note:** For optimum performance, the adapter should be placed in a 64 bit PCI-X card slot whenever possible.

**Note:** The 2-Port IBM Gigabit Ethernet-SX PCI-X Adapter incorporates an LC type connector on the card.

Limitation: Half Duplex (HDX) mode is not supported.

- Attributes provided: Two full-duplex 1000Base-SX fiber connections to a Gigabit Ethernet LANs.
- Attributes required: One 3V PCI or PCI-X card slot (either short or long)

### 5718

### 10Gbps Ethernet Adapter

Provides 10 Gigabit Ethernet PCI-X based server connections. Supports distances of up to 33m using 62.5 um multimode fiber or 300m using 50 um multimode fiber with 2000MHz km minimum model bandwidth at 850 nm. Adapter connector type is LC.

- Attributes provided: Provides high-end bandwidth for networking
- Attributes required: Supported in PCI-X slots only



5719

10Gbps Ethernet IOA (Long)

Ten Gigabit Ethernet PCI-X based server connections over a maximum of 10 kilometers of 1310nm single-mode fiber optic cable. The adapter conforms to the IEEE 802.3ae standard. The adapter requires 9um single-mode fiber optic cables and uses a SC connector type for connecting into network infrastructure components like 10 Gigabit Ethernet switch/router with SC connectors.

- Attributes provided: 10 Gigabit Ethernet connections
- Attributes required: Available PCI-X slot

5740

1Gbps BaseT Ethernet(4-Port)

Provides a 4-port 10/100/1000Mbps BaseT Ethernet adapter which supports four 1-Gigabit ports on a single adapter, delivering increased bandwidth for slot-constrained servers and providing high connectivity and reliability using two integrated, dual-port Gigabit Ethernet controllers.

Characteristics:

- Supports 64-bit Bus Mastering on the PCI-X bus
- Compliant with IEEE 802.3ab 1000Base-T, 803.u 100Base-TX, 802.3 10Base-T standards and supports 802.1q VLAN tagging
- Supports Interrupt Moderation
- TCP Segmentation off-load and encapsulation in hardware
- Checksum Off-loading of IP, TCP, and UDP frame
- Remote Management Support (WfM, RIS, SNMP/DMI)
- Delivers increased connectivity while significantly reducing CPU Utilization
- Provides 10/100/1000Mbps connectivity through four RJ-45 ports using CAT-5 cables
- Support for Boot ROM on two ports
- Supports advanced cable diagnostics
- Utilizes lead free components
- Adapter dimensions: 4.2" x 6.39"
- Attributes provided: 4-port 10/100/1000Mbps BaseT Ethernet Adapter
- Attributes required: One PCI slot



6800

PCI 1Gbps Ethernet IOA

Provides a PCI-X IOA which does not require an IOP and allows a System i5 to attach to IEEE standard 802.3Z high speed (1Gbps) Ethernet LANs. The #6800 adapter supports a multimode fiber interface with a 62.5 micron or 50.0 micron cable requirement. The adapter has a duplex LC fiber-optic connector for attachment to customer-supplied cabling.

The #6800 only supports TCP/IP and requires an intervening switch/hub/router when connection to 100Mbps or 10Mbps networks.

#6800, #0620, and #5700 are physically the same adapter card but have different feature numbers that denote to IBM configurator tools whether or not an IOP is required.

- Attributes provided: 1000/100/10 Ethernet LAN Interface
- Attributes required: One short or long, 3.3V or 5V PCI-X slot

6801

PCI 1Gbps Ethernet UTP IOA

Provides a PCI-X IOA which does not require an IOP and allows a System i5 to attach to IEEE standard 802.3ab high speed (1Gbps) Ethernet LANs. The adapter supports a UTP CAT 5 media interface.

The #6801 only supports TCP/IP and requires an intervening switch/hub/router when connection to 100Mbps or 10Mbps networks.

#6801, #0621, and #5701 are physically the same adapter card but have different feature numbers that denote to IBM configurator tools whether or not an IOP is required.

- Attributes provided: 1000/100/10 Ethernet LAN Interface
- Attributes required: One short or long, 3.3V or 5V PCI-X slot



### Network Definitions

#### **10/100 Dual speed**

Network components that support devices based on both Ethernet (10 Mbps) and Fast Ethernet (100 Mbps) technologies.

#### **10 BaseT**

A sub specification of IEEE 802.3 that requires the use of unshielded twisted pair telephone cabling with RJ-45 phone jacks to be used by Ethernet applications. The maximum length of a segment of twisted pair cable is 330 feet.

#### **100BaseT**

The IEEE specifications for Fast Ethernet networks.

#### **10Base2 coaxial cable**

The IEEE specifications for thin wire or thin net Ethernet network cable with a maximum segment length of 185 meters.

#### **10Base5 coaxial cable**

The IEEE specifications for thick wire Ethernet network cable with a maximum segment length of 500 meters.

#### **802.11**

An IEEE specification for wireless networking in the 2.4GHz frequency range with a maximum 2Mbps data transfer rate.

#### **802.11a**

An IEEE specification for wireless networking in the 5GHz frequency range with a maximum 54Mbps data transfer rate. The 802.11a specification also includes QoS (Quality of Service) technology to protect voice and multimedia data. At this time no 802.11a products are available on the market.

#### **IEEE 802.11b**

International standard networking technology for LAN wireless implementations that revised 802.11 to increase transmission speeds to 11Mbps.

#### **802.11e**

A proposed IEEE specification that will include QoS (Quality of Service) features, particularly the ability to recognize and prioritize different types of data, and security provisions. The specification draft has not yet been ratified by the IEEE.

#### **IEEE 802.3**

International standard networking technology for Ethernet implementations.

#### **Access point**

A wireless LAN transceiver that bridges a wired LAN to wireless devices.



### **Active Hub**

Self-powered USB hubs that have their own power supply and are able to supply power to USB devices that require 100mA or more power. USB hubs without power supplies are referred to as passive hubs.

### **Adapter**

An electronic card or that installs in a PC's PCI or ISA slot or plugs into a PC Card slot or USB port to expand the PC's functionality.

### **AppleTalk**

Apple Computer's networking application for Macintosh computers.

### **Asymmetric Digital Subscriber Line (ADSL)**

A version of digital subscriber line technology with a range of 18,000 feet that transmits over a single copper twisted pair cable at upstream rates of 16 to 640 Kbps and downstream rates of 1.5 to 9 Mbps.

### **Attenuation**

A decrease in a signal's strength (measured in decibels) as it transmits over wires or cables. The shorter the wire or cable the less attenuation occurs.

### **Backbone**

The centralized part of a large network that links two or more subnetworks and is the primary path for data transmission.

### **Bandwidth**

The amount of transmission capacity that is available on a network at any point in time. Available bandwidth is dependent on factors such as the rate of data transmission speed between networked devices and the type of device used to connect PCs to a network.

### **Baseband**

A transmission method in which digital signals are carried over the entire bandwidth of a transmission medium.

### **Bidirectional**

The ability to transmit signals in two directions.

### **Bits per second (bps)**

A measure of data transmission speeds over communication lines based on the number of bits that can be sent or received per second.

### **Bluetooth wireless technology**

A technology specification for linking portable computers, personal digital assistants (PDAs), and mobile phones for short-range transmission of voice and data across a global radio frequency band without the need for cables or wires. Bluetooth is a frequency hopping technology in the 2.4GHz frequency spectrum, with a range of 30 feet.

### **Bridge**

A device that links two local networks using the same communications protocol and allows them to interface with other networks as a single network.



### **Broadband**

A data transmission system that supports analog and digital transmission of multiple voice, data, and video signals simultaneously over the bandwidth of a single medium at relatively high speeds.

### **Bus**

A path inside a computer consisting of wires and other components for transmitting signals within a computer and among a computer and its peripherals.

### **Bytes per second (Bps)**

A measure of data transmission speeds over communication lines based on the number of bytes that can be sent or received per second.

### **Cable modem**

A modem that links a computer to a cable TV service for a 24/7 broadband Internet connection.

### **Cable networking**

Linking computers and peripherals with bundled wires for the purpose of sharing resources.

### **CardBus**

32-bit standard for PC Card expansion devices. Combines support for legacy 16-bit Release 2.0 PC Cards and 32-bit PCI bus. Maximum throughput in burst mode transferring double-words (dwords) is 132MB/sec, or 66MB/sec in word mode, and 33MB/sec in byte mode. Requires Windows 98 or later operating system with limited support by Windows 95.

### **Carrier Sense Multiple Access with Collision Detection (CSMA/CD)**

A method of managing traffic on an Ethernet network whereby a network device transmits data if it detects that a channel is available; if two devices transmit data simultaneously the sending devices detect a collision and retransmits after a random time delay.

### **Category 3 or Cat3 Cable**

Twisted pair copper cables rated for low data rate networks such as 10Mbps Ethernet.

### **Category 5 or Cat5 Cable**

Twisted pair copper cables rated for 10Mbps and 100Mbps data rates used for Fast Ethernet or 10/100 Ethernet.

### **Category 5e or Cat5e Cable**

Twisted pair copper cables rated for 10Mbps, 100Mbps, and 1000Mbps (1Gbps) data rates.

### **Category 7 or Cat7 Cable**

A proposed standard of twisted pair copper cables that with 600MHz frequency support (in contrast Cat5 and Cat5e each are 100MHz frequency standards).

### **Client**

A networked PC that takes resources from a server and does not share its resources with other devices on the network.

### **Coax**

See Coaxial cable.

**Coaxial cable**

Conductor used in Ethernet networks that is protected with shields of wire mesh and plastic insulation.

**Collision**

A CSMA/CD error condition that occurs when two computers transmit data simultaneously.

**Collision avoidance**

A network node characteristic for proactively detecting that it can transmit a signal without risking a collision.

**Communications protocol**

Hardware and software specifications for a network communication method.

**Convergence**

The evolution in networking whereby digital voice, data, and video are transmitted across networks within a common communications system.

**Cross-over cable**

Conductor for networking two computers without the use of a hub.

**Dial-up**

A communication connection via the standard telephone network or Plain Old Telephone Service (POTS).

**Digital Subscriber Line (DSL)**

Various protocols for high-speed data, voice, and video transmission over twisted-pair copper POTS telephone wires.

**Data-over-Cable Service Interface (DOCSIS) compliant**

In accordance with technical specifications for cable equipment used by both users and service providers.

**Domain Name System (DNS)**

A program that translates URLs to IP addresses by accessing a database maintained on a collection of Internet servers. The program works behind the scenes to facilitate surfing the Web with alpha versus numeric addresses.

**Downstream**

Data flowing on a network traffic path from a service provider to an end user.

**Dynamic Host Control Protocol (DHCP)**

A utility that enables a server to dynamically assign IP addresses from a predefined list and limit their time of use so that they can be reassigned.

**Ethernet**

International standard networking technology for wired implementations with a speed of 10 Mbps.

**EtherTalk**

Apple Computer's support for Ethernet on its AppleTalk networking application



### **Fast Ethernet**

International standard networking technology for wired implementations with a speed of 100 Mbps.

### **Firewall**

A system that secures a network and prevents network access by unauthorized users.

### **FireWire**

The IEEE 1394 standard for input/output technology for connecting high speed multimedia peripherals to a PC.

### **Forward Error Correction (FOE)**

A class of technologies for improving communications bandwidth by correcting data bit parity errors on the receiving side of a communications transaction rather than requiring retransmission of data from the sending side of the transaction. Acronym "FEC" also used to be common.

### **Frame Relay**

An efficient WAN technology that transmits data in packets or envelopes in bursts at standard speeds of 56Kbps.

### **Frequency**

A measure of radio waves in cycles per second.

### **Gateway**

Hardware and software for connecting networks using different technologies, such as Ethernet and powerline networks.

### **Gigabit**

One billion bits.

### **1 Gigabit Ethernet -**

There are two standards within the 1 Gigabit Ethernet specification: 802.3z standard 1000Base-X, which uses fiber optic media; and 802.3ab 1000Base-T, which uses twisted pair (copper) media. The maximum nominal data transfer rate is 1,000 megabits per second.

### **Gigahertz (GHz)**

A measure of frequency in one billion cycles per second.

### **Hertz (Hz)**

A measure of frequency in one cycle per second.

### **High-bit Rate Digital Subscriber Line (HDSL)**

A version of digital subscriber line technology with a range of 12,000 feet that transmits over two twisted pair cables at a rate of 1.544 Mbps.

### **Home network**

A home-based Local Area Network (LAN).



### **Home Phonenumber Networking Alliance (HomePNA)**

A networking industry group of companies working towards standardization of specifications for phonenumber networking products and an expansion in market demand for such products.

### **Home Radio Frequency Working Group (HRFWG)**

A networking industry group of companies working toward standardization of specifications for radio frequency networking products and an expansion in market demand for such products.

### **HomePlug Powerline Alliance (HomePlug)**

A networking industry group of companies working toward standardization of specifications for powerline networking products and an expansion in market demand for such products.

### **Hops Count**

A measure between two points on a network based on the number of adapter cards a transmission crosses.

### **Hub**

A multi-port device used to connect PCs to a network. Each networked PC using Ethernet or Fast Ethernet is cabled to a hub, which can have 4,5,8,12,16, or 24 ports and can transmit data at either 10 Mbps or 100 Mbps or 10/100 dual speed. A hub transmits packets it receives to all ports. Hubs can be cabled together for network expansion. A hub's primary advantage is that its LEDs signal problems with any networked PC, while a network's operation is not impacted by problems on any one PC.

### **Industry Standard Architecture (ISA) card**

An adapter that fits into an ISA slot of a PC motherboard.

### **Industry Standard Architecture (ISA) slot**

An expansion bus for adapter cards used in PCs since the IBM AT model. ISA slots do not automatically assign IRQs to enable plug and play functionality.

### **Infrared Data Association (IrDA)**

An international non-profit organization that develops and promotes technical standards for electronic data exchange between computing devices via wireless infrared light.

### **Institute of Electrical and Electronic Engineers (IEEE)**

An international organization that sets electronic and electrical standards.

### **Integrated Services Digital Network (ISDN)**

An ITU B64 standard for bidirectional transmission of voice, data, and video signals over public or private telephone digital networks.

### **International Telecommunications Union (ITU)**

A global organization whose mission is to adopt telecommunications treaties, regulations, and standards



### **Internet appliance**

A computer that is intended primarily for Internet access via dial-up, cable, or network access. The devices are simple to set up and do not support installation of third-party software. They generally offer customized browsing, touch screen navigation, PIM applications and possibly PDA synchronization.

### **Internet Protocol (IP) address**

A string of numbers assigned to each PC on a network. The IP address is used by the Internet Protocol to locate each device on the network.

### **Internet Service Provider (ISP)**

A company that provides Internet access to individuals and businesses, either fee-based or for free.

### **Internet Sharing Software (ISS)**

An application that allows all PCs on a network access the Internet simultaneously through a single modem and Internet Service Provider (ISP) account.

### **IP Telephony**

Technology that supports voice, data, and video transmission via IP-based LANs, WANs, and the Internet. Voice Over IP is one technology protocol in the broader concept of IP Telephony. The promise and advantage of IP Telephony is that applications will be less media and location dependent as with Public Switched Telephone Network (PSTN) telephony.

### **Jitter**

Signal distortion on an analog communication line.

### **Kilobits per second (kbps)**

A measure of data transmission speed over communication lines in one thousand bits per second.

### **Kilobytes per second (Kbps)**

A measure of data transmission speed over communication lines in one thousand bytes per second.

### **Latency**

A measure of packet transmission time from the time a data transmission request is made by a device to the time the data is actually transmitted.

### **Local Area Network (LAN)**

A system of connecting PCs and other devices within the same physical proximity for sharing resources, such as an Internet connections, printer, files, and drives.

### **Mapping**

Assigning a PC to a shared drive or printer port on a network.

### **Megabits per second (Mbps)**

A measure of data transmission speed over communication lines in one million bits per second.

**Megahertz (MHz)**

A measure of frequency in one million cycles per second.

**Modem**

A device that handles the modulation/demodulation process, i.e., from the sending device, digital computer signals are converted into analog signals that are transmitted over a phone line, and at the receiving point, analog signals are reconverted into digital signals.

**Multimedia**

Information that is simultaneously transmitted in multiple formats, including text, graphics, audio, and video

**Network access point**

Data exchange points for Internet Service Providers.

**Network adapter**

See Network Interface Card (NIC).

**Network Address Translator (NAT)**

A network capability that allows for the dynamic reuse of a single IP address for all PCs on a network.

**Network architecture**

The components and design of a network.

**Network Interface Card (NIC)**

A type of PC adapter card that attaches to a network cable to provide two-way communication between the computer and network devices, such as a hub or switch. NICs can operate at 10 Mbps (Ethernet) or 100 Mbps (Fast Ethernet) or 10/100 Mbps dual speed.

**Network operating system (NOS)**

The software that runs on a network server to control network functions.

**Noise**

Unneeded network signals that degrade network performance.

**Open Systems Interconnect Reference Model (OSI)**

An International Standards Organization network model based on seven integrated layers of communication standards for computers in a network.

**Packet**

A segment of data sent over a network whose size and format is governed by the communications protocol used.



### **PC Card**

A removable expansion card that fits into a PCMCIA standard slot – primarily used in portable devices, particularly notebook computers and PDAs. PC Card peripherals include memory cards, modems, NICs, hard drives, and interface adapters. All PC Cards are 85.6mm long and 54.0mm wide. Three types of PC Cards include Type I (3.3mm thick), Type II (5.0mm thick), and Type III (10.5mm thick). Release 1.0 cards supported memory devices only, release 2.0 supported memory and I/O. The original PCMCIA PC Cards were 16-bit devices with a maximum throughput of 20MBps for memory transfers and 7.84MBps for I/O transfers, both in word mode. 32-bit CardBus PC Cards have a 132MB/sec maximum burst transfer rate in double-word mode.

### **Personal Computer Memory Card International Association (PCMCIA)**

Personal Computer Memory Card International Association. A standards organization that defines the specifications for and promotes PC Card technology. Expansion cards now referred to as "PC Cards" were originally called "PCMCIA Cards."

### **Passive Hub**

USB hubs that do not have their own power supply and are not sufficient to power USB devices that require more than 100mA.

### **Peer-to-peer network**

A computer network that has no server. All networked PCs are equally able to act as a network server or clients.

### **Peripheral Component Interconnect (PCI) card**

An adapter that fits into a PCI slot in a PC motherboard.

### **Peripheral Component Interconnect (PCI) slot**

A high speed expansion bus for adapter cards developed by Intel and incorporated in Pentium computers. One advantage of PCI slots is that they automatically assign IRQs to enable plug and play functionality.

### **Plug and Play(PnP)**

A computer system feature that provides for automatic configuration of add-ons.

### **POTS**

Plain old telephone service, I.e., standard analog telephone service.

### **Proxy server**

A server that prevents direct communication between two or more networks but forwards allowable data requests to remote servers and/or responds to data requests directly from stored remote server data.

### **Public Switched Telephone Network (PSTN)**

The global public telephone network.

### **Redirection**

A networking application function that intercepts and reroutes input and output requests for networked devices.

**Residential**

Home-based.

**Residential Gateway**

A device that enables Internet access sharing by multiple PCs and other devices on a home network.

**RJ-11 connector**

A phone line connector used to connect a phone to a phone jack, to connect computers to a home phone line, and a modem to a phone line.

**RJ-45 connector**

An eight-pin serial connector for Ethernet cables that is slightly wider than a RJ-11 connector.

**Router**

A type of bridge that can link networks using different protocols and can link local and remote networks.

**Scalable**

A network characteristic related to its ability to expand and contract based on revised requirements.

**Server**

A PC that provides its resources to other PCs on a network. A dedicated server only provides resources; if its resources are used directly then it also functions as a client.

**Shared bandwidth**

The division of network transmission capacity among multiple networked devices.

**ShareWave**

Home networking wireless technologies that are an extension of the 802.11b standard and are optimized for multimedia content.

**Shielded twisted pair cable**

A casing containing one or more pairs of copper wires that are wrapped around each other that is used as a network communications transmission medium.

**Single-line Digital Subscriber Line (SDSL)**

A version of digital subscriber line technology with a range of 10,000 feet that transmits over a single copper twisted pair cable at a rate of 1.544 Mbps.

**Streaming digital audio**

Sound that is transmitted in a fashion so that it is received in a format that retains the order in which it was sent and therefore it can be played from the time the transmission initializes.

**Streaming digital video**

Moving images that are transmitted in a fashion that they are received in a format that retains the order in which they were sent and therefore can be played from the time the transmission initializes.



### **Subnetwork**

A network segment that is created to simplify addressing and is connected to the central network through a router, hub, or gateway.

### **Shared Wireless Access Protocol (SWAP) standard**

HomeRF standard for voice and data transmissions in the 2.4 GHz band of the Public Switched Telephone Network and the Internet to provide a range to cover a typical home and yard.

### **Switch**

A type of hub that efficiently controls the way multiple devices use the same bandwidth so that each can operate at full bandwidth resulting in faster performance than with a hub. Rather than transmitting packets it receives to all ports as with a hub, a switch transmits packets to only the receiving port.

### **TCP/IP**

Transmission Control Protocol/Internet Protocol. The standard Internet communication protocol.

### **Telephony**

The conversion of audio to electrical signals that are transmitted over copper wire or radio waves. With respect to the Internet, services that use computer networks to transmit voice with data.

### **Throughput**

The speed at which data travels through a network.

### **Token Ring**

A network architecture where one data packet at a time is passed around a loop in one direction until it connects with its receiving computer.

### **Transceiver**

A component of a Network Interface Card (NIC) that connects the card to a network cable and enables the two-way transmission of network signals.

### **UNIX**

The operating system developed by AT&T Bell Laboratories that is used for the Internet infrastructure and many server applications. Linux and BSD Unix are derivatives, as are many other versions.

### **Unshielded twisted pair (UTP) cable**

A wire transmission medium used in 10BaseT networks that is protected with light plastic versus heavy metal and is therefore prone to interference.

### **Uplink port**

A connector on a LAN hub to link a hub or a subnetwork to a port on a second hub. Some hubs have a separate port for uplinking; others have a single port that can be switched between a single device port or an uplink port.

### **Upstream**

Data flowing on a network traffic path from an end user to a service provider.



### **V.90**

Protocol for dial-up modems that supports nominal 56K transfer speeds. In reality the maximum transfer speed limits are 53K for downloading and 33.6K for uploading.

### **V.92**

Protocol for dial-up modems that supports nominal 56K transfer speeds and manual adjustments for downloading and uploading speeds that exceed those of the v.90 dial-up modem protocol.

### **Very High Data Rate Digital Subscriber Line (VDSL)**

A version of digital subscriber line technology with a range of 1,000 to 4,500 feet that transmits over a single copper twisted pair cable at upstream rates of 1.5 to 2.3 Mbps and downstream rates of 13 to 52 Mbps.

### **Virtual Private Network (VPN)**

A data network created by companies using the Internet with secured protocols to preclude unauthorized access.

### **Voice over IP**

Voice transmission in digital packets over the Internet, which is less expensive than voice transmission in analog packets using POTS.

### **WebCam**

A Web page that displays still images or video that is captured by a digital camera connected to a PC.

### **Wide Area Network (WAN)**

A communication system of connecting PCs and other devices across a large local, regional, national, or international geographic area.

### **Wi-Fi**

Wireless-Fidelity. A designation by the Wireless Ethernet Compatibility Alliance (WECA) that an 802.11b wireless network component meets the compatibility standard set for interoperability with other 802.11b products.



# GST Research Report

Ethernet Speeds, Feeds, & Facts

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## About the authorship of this paper

This GST Research Report was prepared by GST's Research & Engineering Group under the leadership of David Breisacher, CEO/Chairman at GST. David is the founder of several successful companies, including GST and BCC Technologies, a manufacturer of eServer disk, tape and memory storage devices. A visionary for the storage industry since the early 90's, David lends his market insight and predictions for the IBM midrange storage marketplace to the research conducted at GST. His experience in sensing shifts in technology and industry directions has made it possible for him to organize and structure successful companies to rapidly meet the evolving needs of storage users.

## About GST, Inc.

GST, Inc. (<http://www.gstinc.com>) engineers, manufactures, markets and sells a line of innovative storage products to meet the need for high-performance, continuous reliability and cost-effective data storage. These products include tape solutions available today, and will include storage-related services, software and disk subsystems in the future. A comprehensive array of tape solutions range from single and dual tape subsystems, autoloaders, midrange tape libraries, to modular enterprise-wide tape libraries, with focus on improved backup and disaster recovery solutions. Modular design enables field upgrades, scalability, investment protection for existing GST tape solutions, and lower life-cycle costs. GST's product development is guided by several advisory boards to closely track market needs and fully utilize the latest engineering developments in product design. Complete information about products, support and company background can be found at the company's Website.

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