

10GBASE-T

Enabling 10x the bandwidth at 3x the cost

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Position Statement

- 10G Ethernet has been with us for almost a decade
- Although it is the fastest growing segment, it is still a small percentage of all Ethernet links
 - Primary impediment has been cost
- Rapid uptake requires the 10x performance increase to come in at ~3x the cost
 - 10GBASE-T is the technology that will enable crossing this performance/cost milestone but it has not had a smooth ride

10G Transition Dynamics

- Today, the majority of Ethernet ports shipped are 1000BASE-T (GigE)
 - The dominant medium is structured cabling
 - Category 5e, Category 6 and Category 6A
- Non-BASE-T 10G technologies have not been able to break out of their niches
 - Optics has gone through ~4 generations of modules
 - Short reach copper has gone from Infiniband cable to SFP+ direct attach cable
- 10GBASE-T has taken longer but is ready for prime time
 - Why it has taken so long?

The thermal challenge

- 10GBASE-T operates within ~5dB of channel capacity on UTP cabling
 - Requires high performance echo cancellation, and high complexity error correction
 - First generation parts were high in power (~10W/port)
- High power consumption limited density
 - Single port PHY chips, single port adaptor cards for servers
 - Challenging thermals for high density switches
 - Front to back airflow makes 24-port switches viable
 - Line cards for legacy platforms were a challenge
- Second generation parts brought power down to ~5-6W
 - Dual port PHY chips, dual port adaptors for servers
 - Higher density fixed form factor
 - 48 port switches with front-to-back airflow
 - Medium density line cards

Current status

- Third generation PHY chips (40nm technology) are imminent and will remove thermal challenges
 - 48 port switches will be easy
 - High density line cards for legacy platforms become viable
 - Power/price is approaching requirements for Lan On Motherboard
- Densities of 10BASE-T switches will match densities of GigE on a raw port count basis
 - And far exceed them in terms of throughput
- Power/Gig and cost/Gig already favor 10GBASE-T

What about the rest of the eco-system?

- Data centers have been deploying Category 6 or 6A cabling for several years now hence the cabling is ready
- Connectors, Patch panels and connecting hardware are not far behind
 - The higher frequency of operation imposes significant challenges on compliance testing
- Magnetics components (transformers) are catching up

Remaining challenges

- Latency of 10GBASE-T is worse than that of 10G fiber but better than that of GigE
- Concern exist about EM issues
- Emissions can be managed by good engineering practices
 - Spectral power densities are lower than that of a GigE transmitter but frequencies are higher
- Immunity concerns are harder to handle analytically
 - RF environment is hard specify
 - Computation of coupling of fields to differential modes of UTP cable is not easy
- Teranetics is addressing this concern by significantly enhancing signal cancellation capability in its 3rd generation PHYs

Manifestation

1000BASE-T



1 RU = 48 Gigabits

10GBASE-T



1 RU = 480 Gigabits

10 TIMES MORE BANDWIDTH IN 1 RACK-UNIT SPACE

COST: <3X Cost

1000BASE-T



Typical 48 Port Switch
ASP ~ \$6,000

<3X Cost

10GBASE-T



Typical 24 Port Switch
ASP ~ \$16,000

1 Gigabit BW ~ \$125

1 Gigabit BW ~ \$65

HALF THE COST PER GIGABIT OF BANDWIDTH

POWER – 10G Vs 1G

1000BASE-T



240 Gigabit BW
Ten 24-port Switches
60 Watts each

POWER = 600 Watts

10GBASE-T

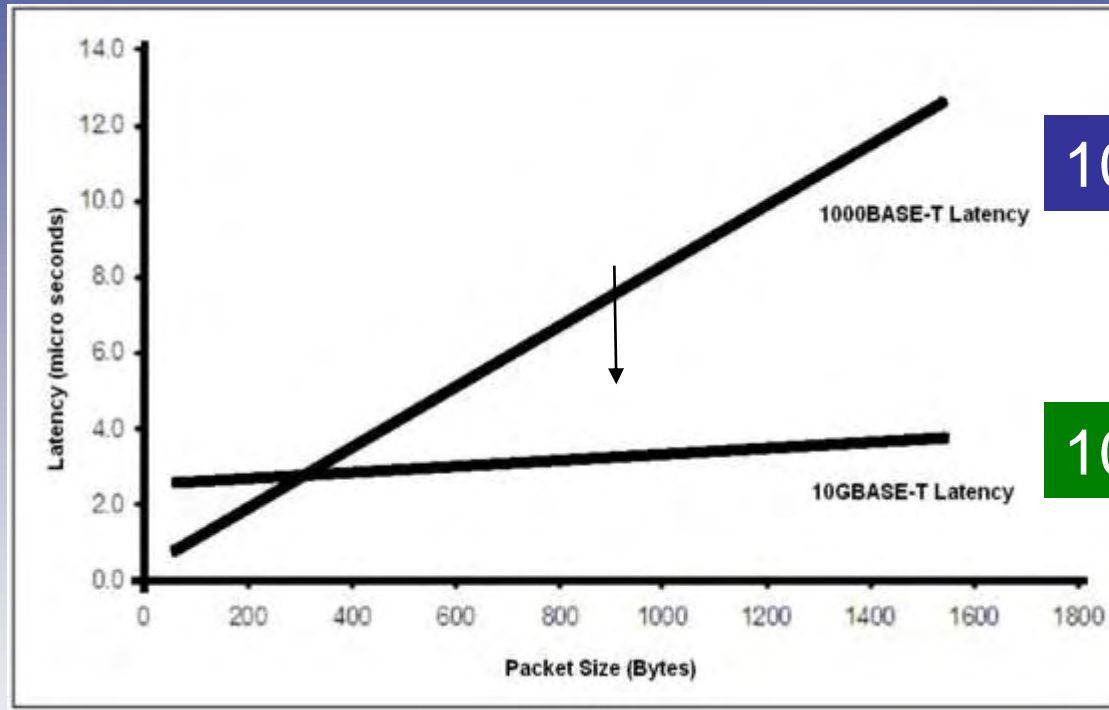


240 Gigabit BW
One 24-port Switch
350 Watts

POWER = 350 Watts

SAME BANDWIDTH FOR 1/2 THE POWER

LATENCY - 10G Vs 1G



1000BASE-T

10GBASE-T

4 TIMES LOWER LATENCY THAN 1G

- 10GBase-T
 - 10X Bandwidth → increased density for 1RU systems
 - 3X cost → economize \$ per 1G of bandwidth
 - Power:
 - Dense systems are shipping *now*
 - Tier 1 Multi-port NICs are shipping *now*

Driving Further 10GBase-T Penetration

- Process: TSMC 40nm
- Technology: Energy Efficient Ethernet

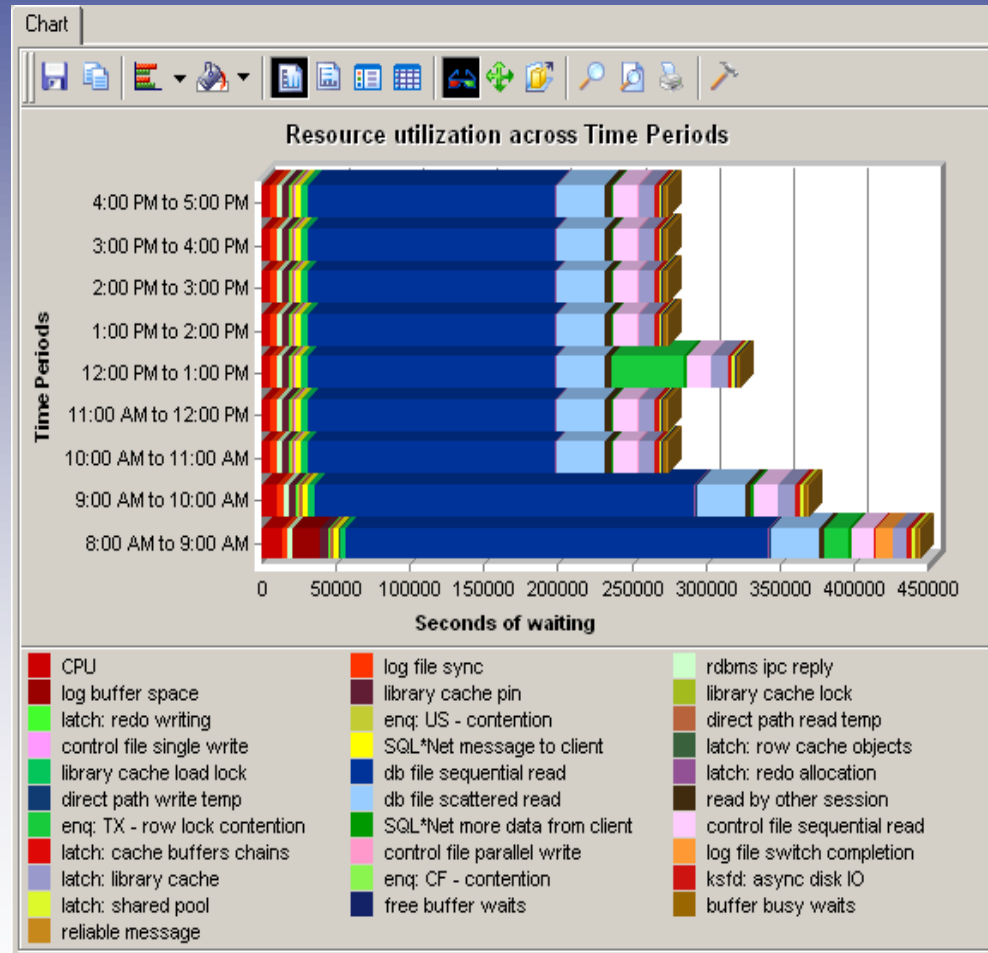


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