SOLARFLARE
COMMUNICATIONS

Basic Economics of
10GE over Structured UTP
IEEE 802.3 10GBASE-T Study Group
Ahmet Tuncay

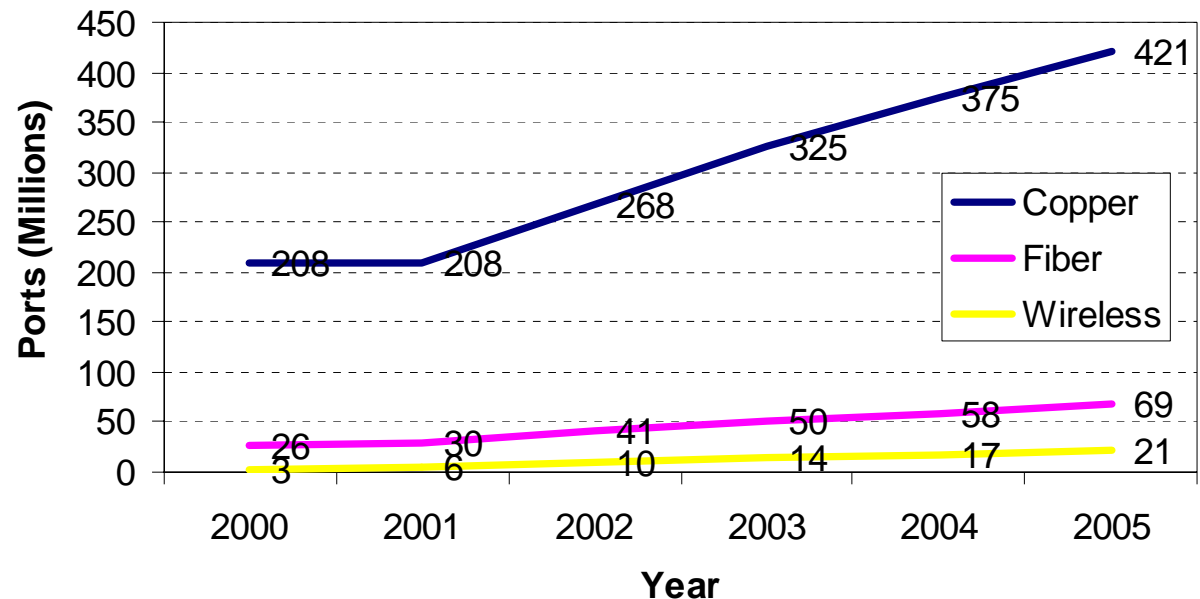# 10GE LAN Application Requirements

- **Gig-to-the-Desktop Migration**
  - Stackable Switch Aggregation (10GE uplinks)
  - 8 to 16 ports per data-center Switch
- **Distributed Computing**
  - Fat Pipes for system connection
  - 16 to 48 ports per data-center Switch (typical cluster size)
- **IP Storage**
  - Aggregation for storage systems
  - 32 to 64 ports per data-center Switch (typical SAN size)
- **All require < 10 x $[1000BASE-T] connection**

Enterprise (LAN) Statistics

- Over 600 million Ethernet UTP ports are installed

- Nearly all new installs are CAT5e & CAT6 UTP
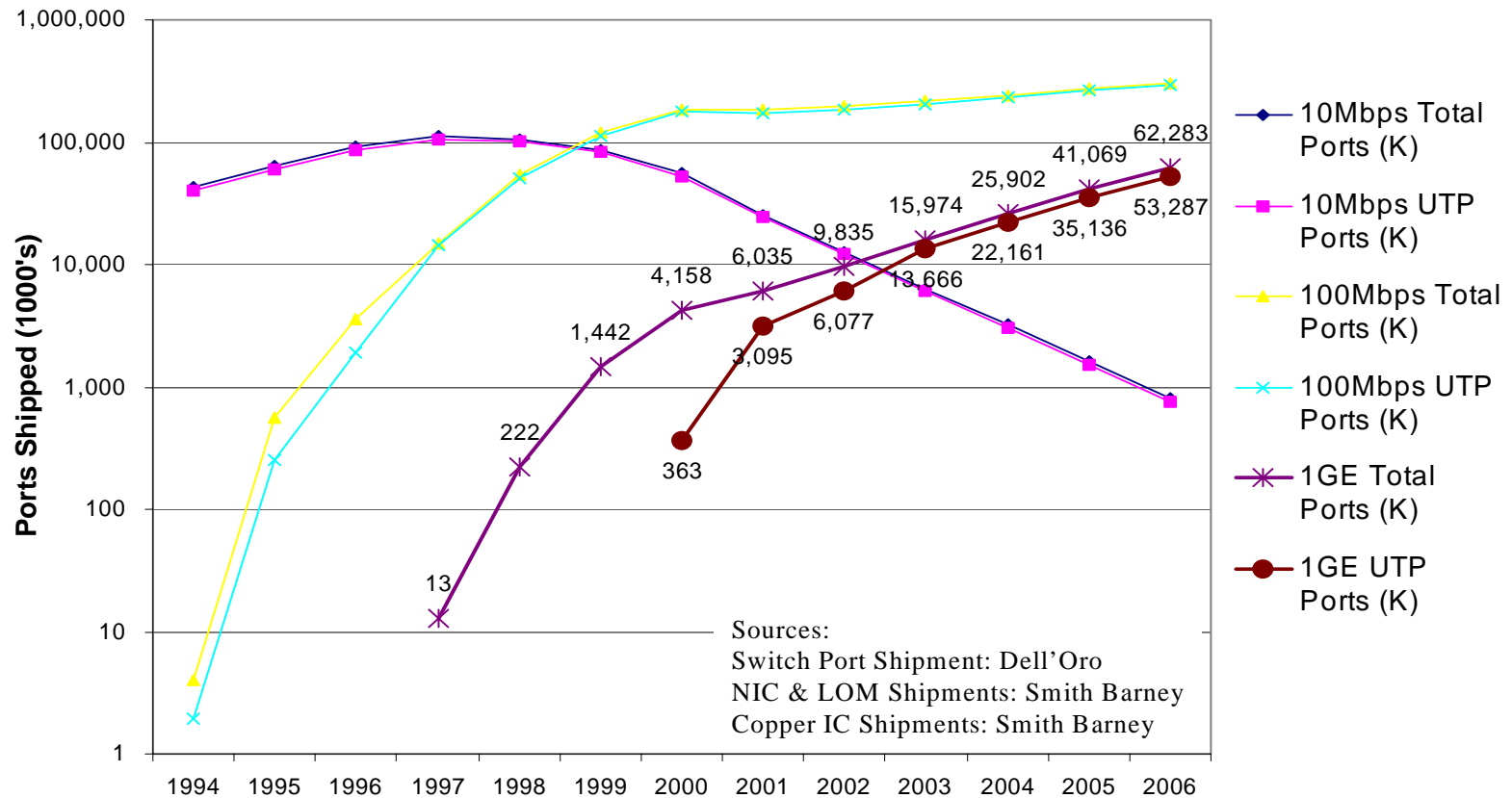
- 50% of data centers have only UTP

Ethernet Port Shipments per Year

Chart showing Ports (Millions) vs Year (2000–2005):

Year	Copper	Fiber	Wireless
2000	208	26	3
2001	208	30	6
2002	268	41	10
2003	325	50	14
2004	375	58	17
2005	421	69	21

Cahners In-Stat July 2001

It's about the Cost of Ownership
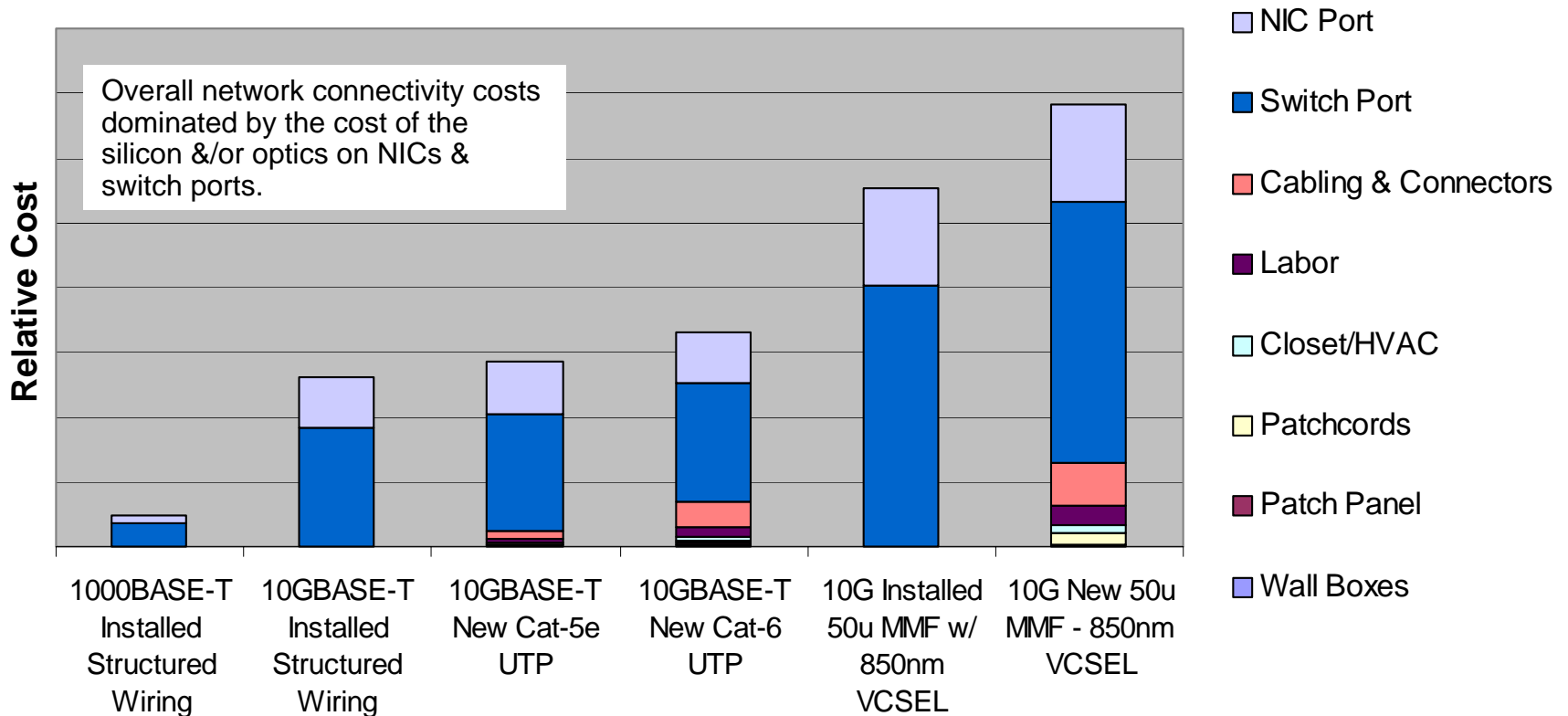
LAN Cost of Ownership Elements

- **Capital Equipment**
  - Switch (HW, SW) – Chassis, Module, Port
  - NIC Port (HW, SW)
  - Cabling & Connectors
  - Labor
  - Closet/HVAC
  - Patch cords
  - Patch panels
  - Wall boxes

- **Operating**
  - Moves, Adds, Changes
  - Maintenance & monitoring tools & time
  - Troubleshooting & repair tools & time
  - Training & materials
  - FCAPS (Fault, Configuration, Accounting, Performance, Security) Management

LAN Capital Cost Comparison

2007 Sample Network Cost Comparison

Overall network connectivity costs dominated by the cost of the silicon &/or optics on NICs & switch ports.

Legend:
- NIC Port
- Switch Port
- Cabling & Connectors
- Labor
- Closet/HVAC
- Patchcords
- Patch Panel
- Wall Boxes

Y-axis: Relative Cost

X-axis categories:
- 1000BASE-T Installed Structured Wiring
- 10GBASE-T Installed Structured Wiring
- 10GBASE-T New Cat-5e UTP
- 10GBASE-T New Cat-6 UTP
- 10G Installed 50u MMF w/ 850nm VCSEL
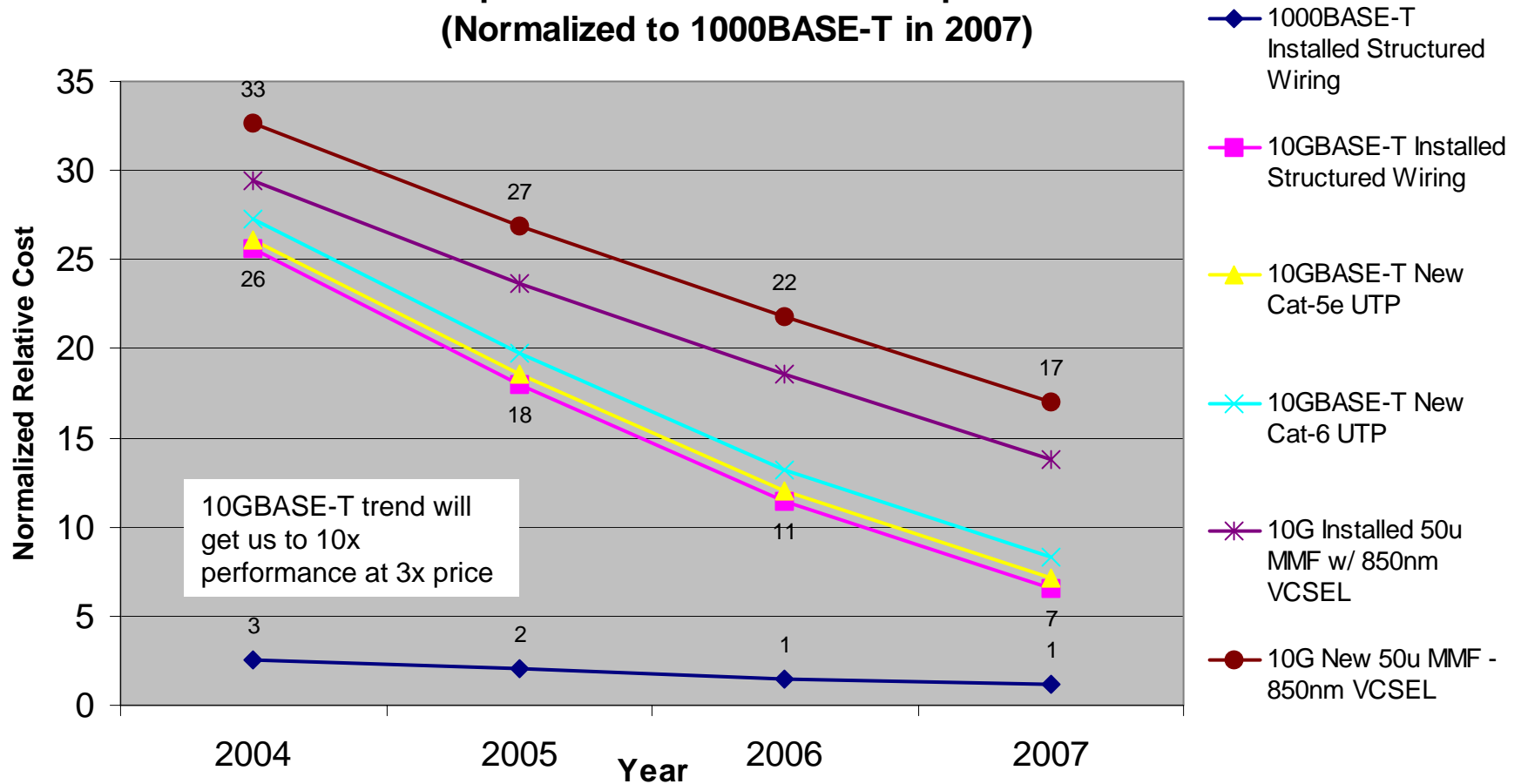- 10G New 50u MMF - 850nm VCSEL

Sample data-center network of 25 application servers, 6 back-end servers, Connected over structured cabling (average link 85m).
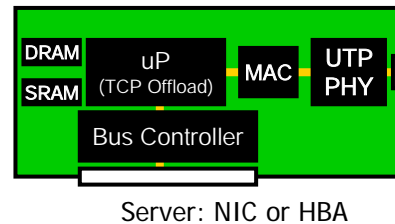
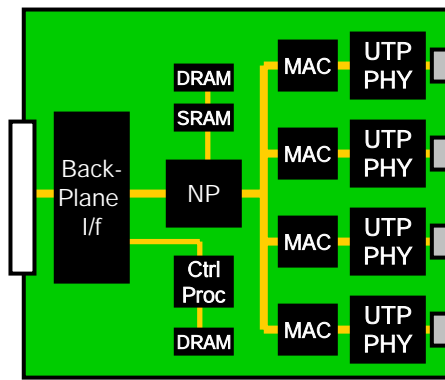# LAN Capital Cost Trends
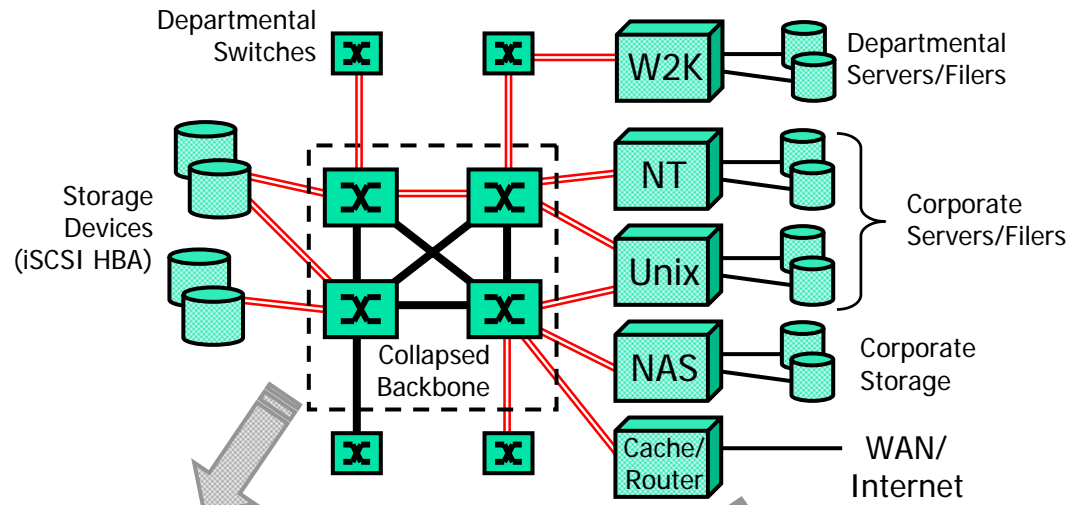

Sample Network Total Cost Comparison (Normalized to 1000BASE-T in 2007)

Legend:
- 1000BASE-T Installed Structured Wiring
- 10GBASE-T Installed Structured Wiring
- 10GBASE-T New Cat-5e UTP
- 10GBASE-T New Cat-6 UTP
- 10G Installed 50u MMF w/ 850nm VCSEL
- 10G New 50u MMF - 850nm VCSEL

10GBASE-T trend will get us to 10x performance at 3x price

Closer Look at Ethernet LAN Equipment

Departmental Switches

Departmental Servers/Filers

W2K

NT

Unix

Corporate Servers/Filers

NAS

Corporate Storage

Cache/Router

WAN/Internet

Storage Devices (iSCSI HBA)

Collapsed Backbone

Switch: Multi-port I/O Blade

Back-Plane I/f — NP — DRAM — SRAM — Ctrl Proc — DRAM
MAC — UTP PHY

Server: NIC or HBA

DRAM — SRAM — uP (TCP Offload) — Bus Controller — MAC — UTP PHY

LAN Equipment Cost Factors

Cost Factor	UTP	Optical	Wireless
Unit cost of the PHY Device	Low	High	Med
Number of ports per PHY Device	High	Med	Low
Integration of PHY+MAC+NP+Fabric	High	Low	Med
Number of PHY Devices per Module	High	Med	Low
System Level Port Density	High	Med	Low

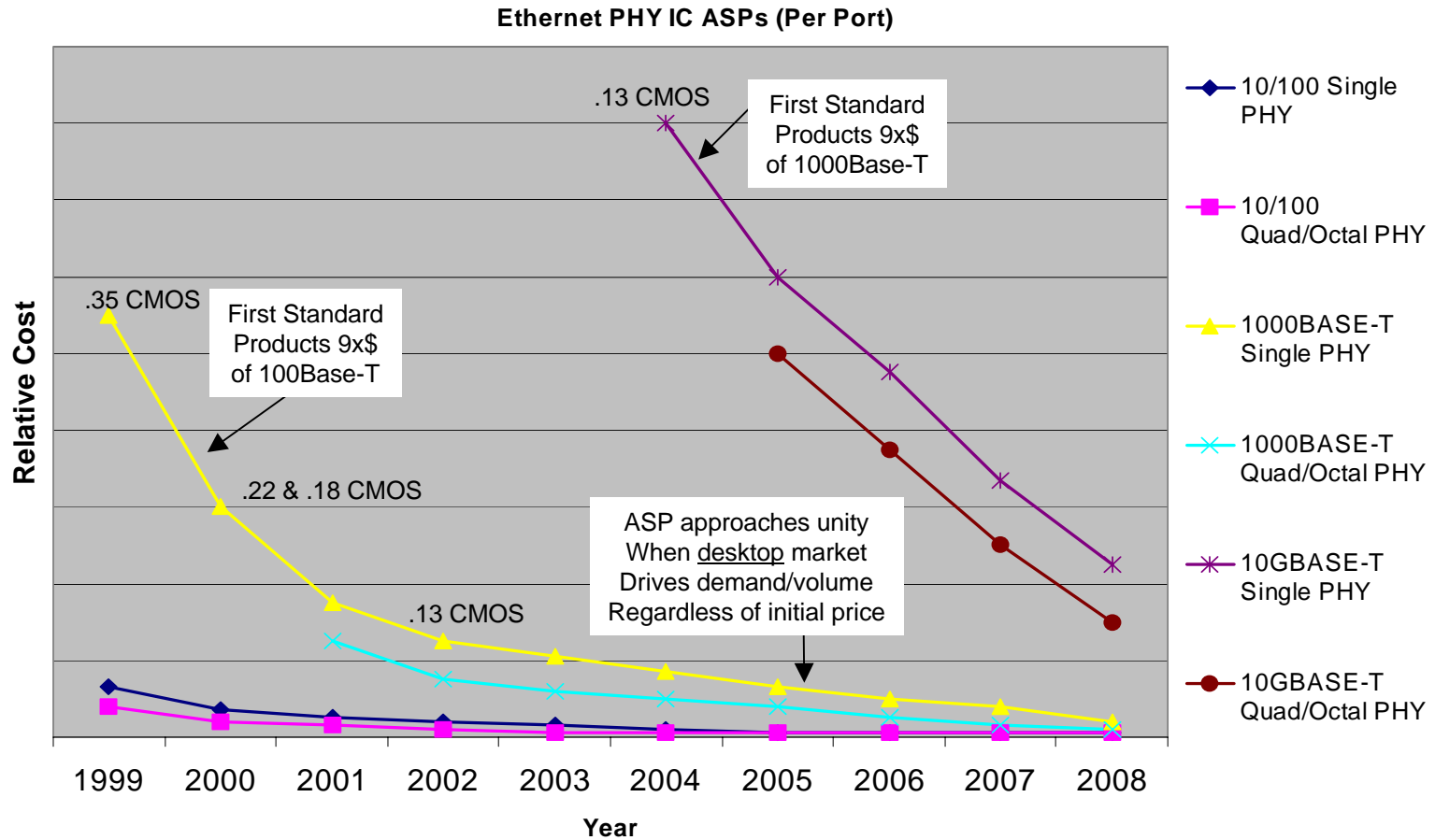## UTP solutions have significant cost advantages

PHY Cost Elements

- ## Analog Front End (AFE) & DSP
  - ### CMOS Process, Mask & Metal Layers
  - ### Die & Package Size, Package Pin Count
  - ### Gate & Transistor count, memory
  - ### Power supplies, heat sinks
  - ### Clocks, external circuits
- ## UTP Front End
  - ### Magnetics, Transformers, Regulator(s), Discretes

PHY ASP Comparison

Ethernet PHY IC ASPs (Per Port)

Summary

- UTP media dominates LAN cabling & will not be obsoleted by anything else

- UTP wins in the LAN due to operational experience & lowest cost of ownership

- Economic benefits of using UTP for 10GE in the LAN are apparent & easily quantifiable

- 10GBASE-T enables 10GE deployment by lowering capital equipment & ownership costs to levels expected by traditional Ethernet