

Economics and market drivers behind the adoption of Higher Speed Ethernet Technologies

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Agenda

- Introduction to Ethernet switching terminology referenced in the presentation
- Economics and drivers of the Fast Ethernet to Gigabit Ethernet migration
- Economics and drivers of the Gigabit Ethernet to 10 gigabit Ethernet migration
- 100 GbE market adoption consideration

Purpose of the analysis

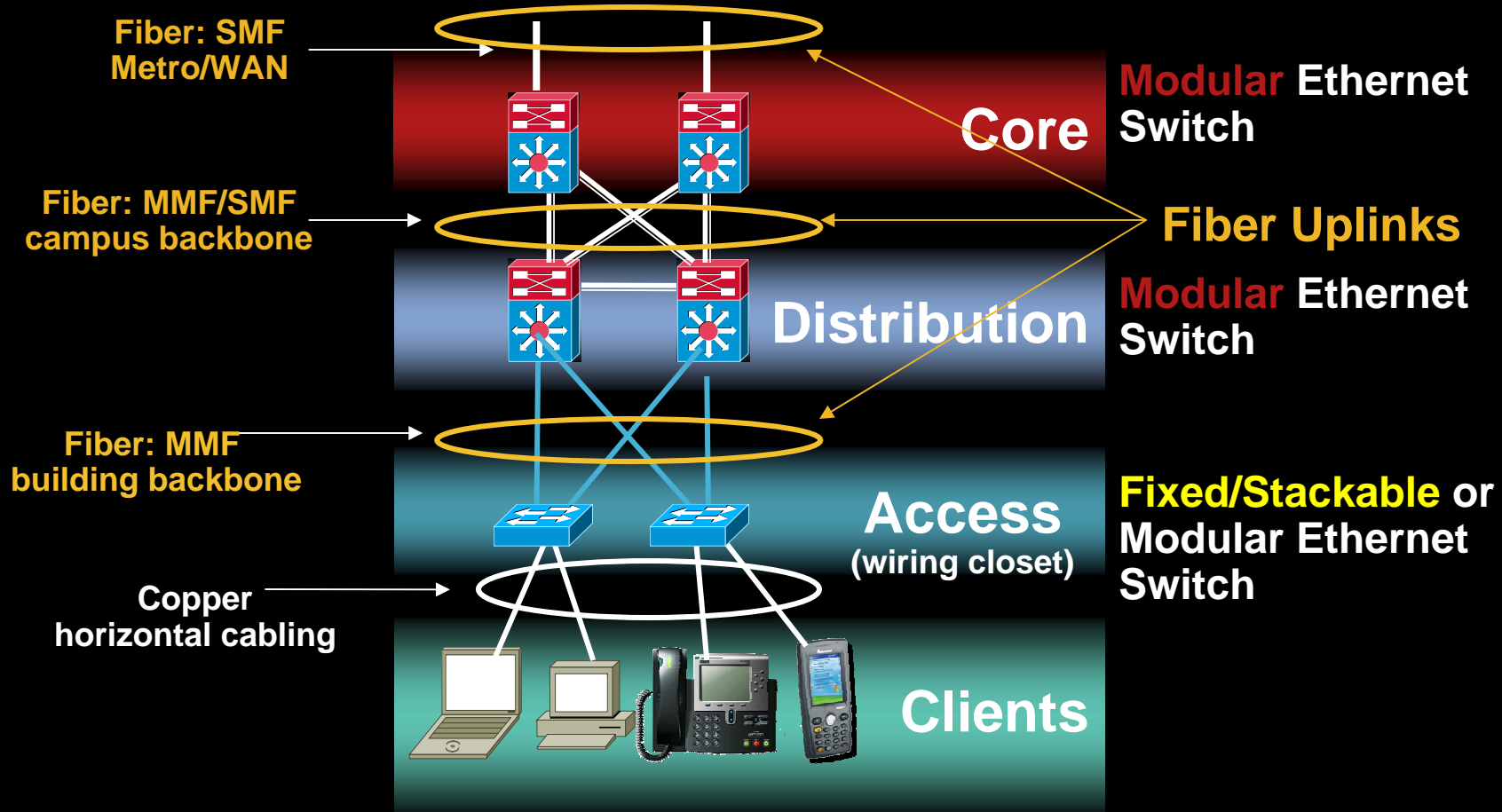
Understand both the economic, network drivers and barriers to adoption of the next generation of Ethernet

Ground Rules:

Historical data only are presented and they are based on Dell'Oro market research.

2006 figures represents historical data available for the first three quarters only.

Campus Ethernet Switching Terminology



3 classes of Ethernet switches:

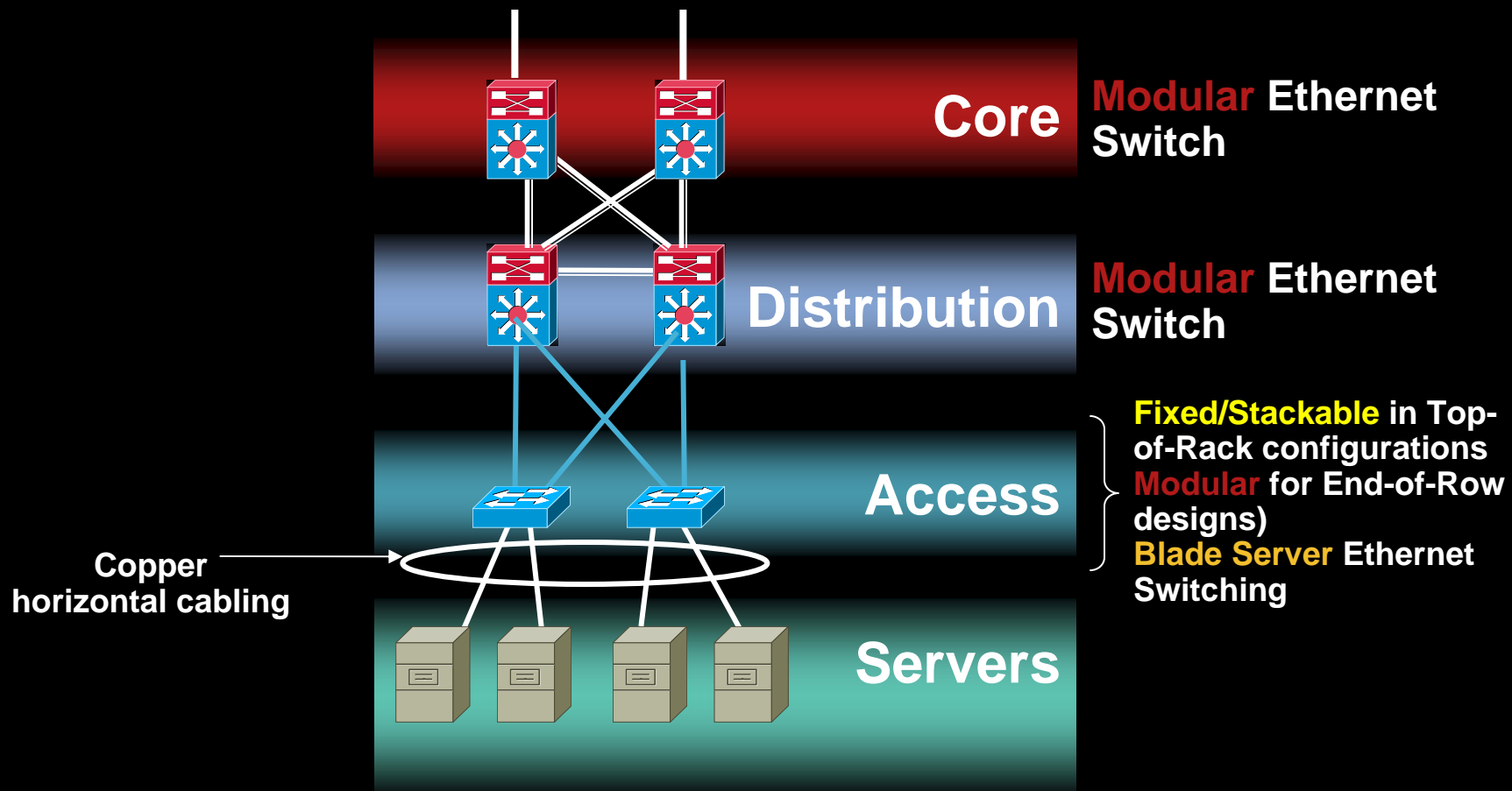
- **Modular**: chassis based with hot-swappable blades



- **Fixed** configuration: pizza boxes with a fixed number of ports.

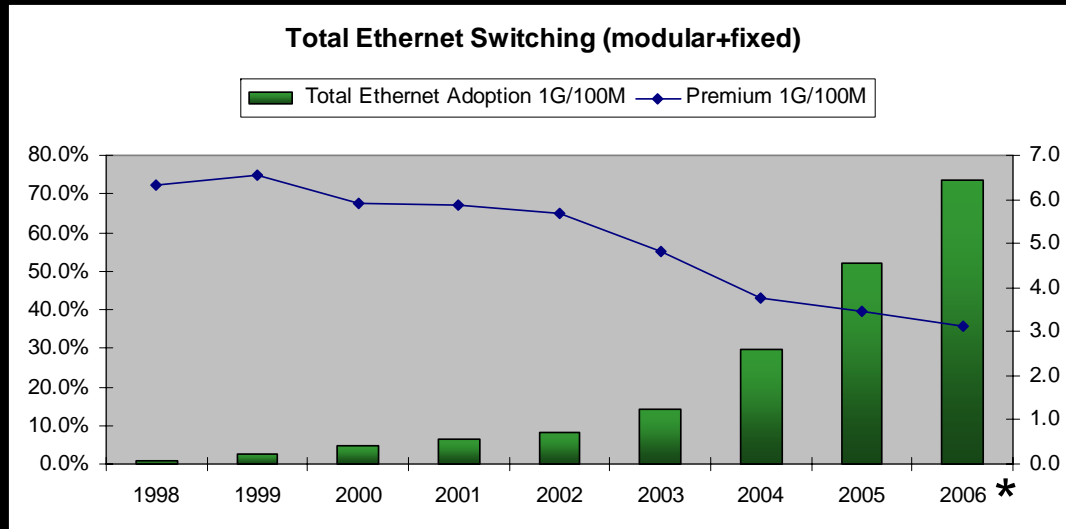
- **Stackable**: fixed config switches connected with some form of resilient high-speed interconnect mechanism between units.

Data Center Ethernet Switching

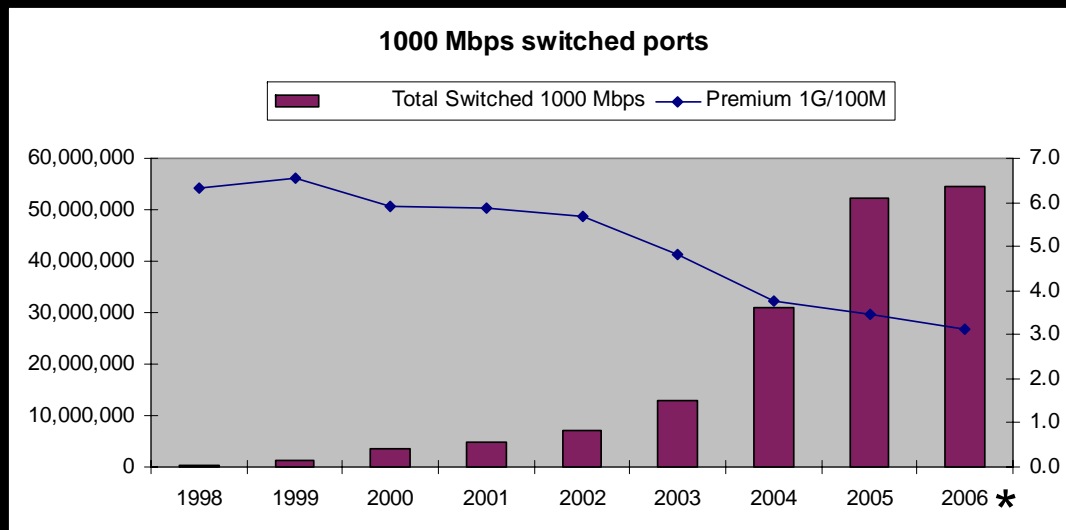


- Ethernet campus and data center despite supporting different applications have similar product deployment architectures.

Total Ethernet FE → GbE historical adoption curves



Adoption = Ratio of HSE to Low SE total ports. Expressed in %.
Premium = Ratio HSE to Low SE port average selling price.

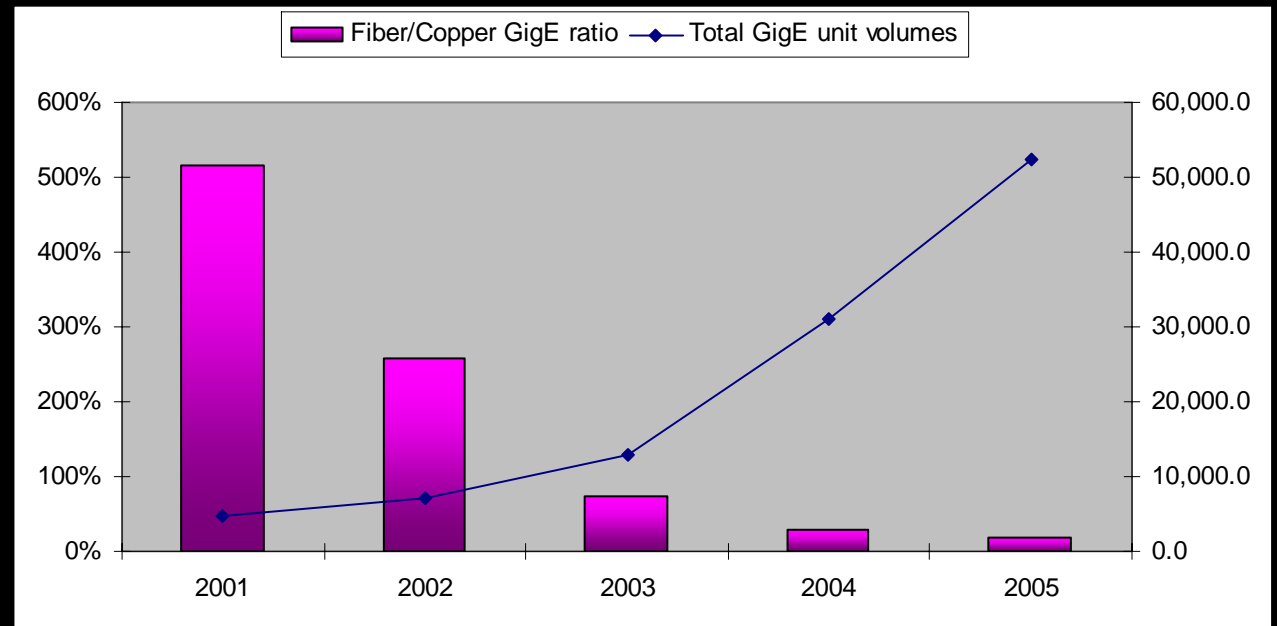
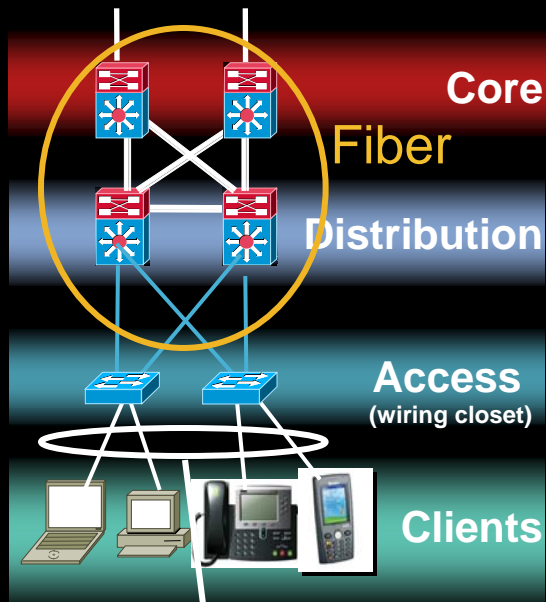


• While GigE ports units shipments grew over 1000% between 2000 and 2006, the premium over 100M reduced by ~55%.

• Price premium started at ~6.5x (1998/1999) and is currently at 3x.

*2006 historical data limited to the first three quarters

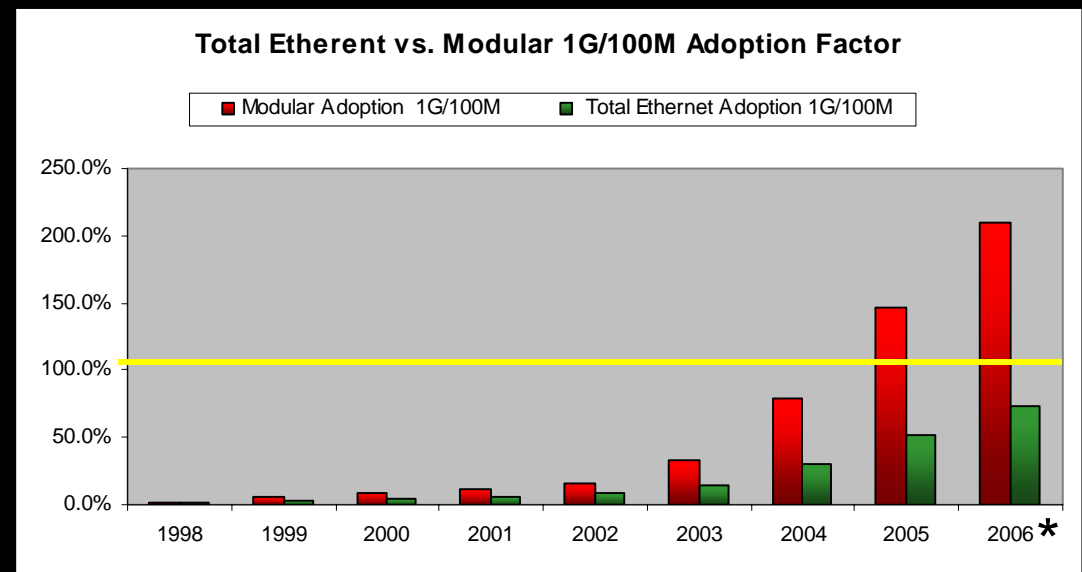
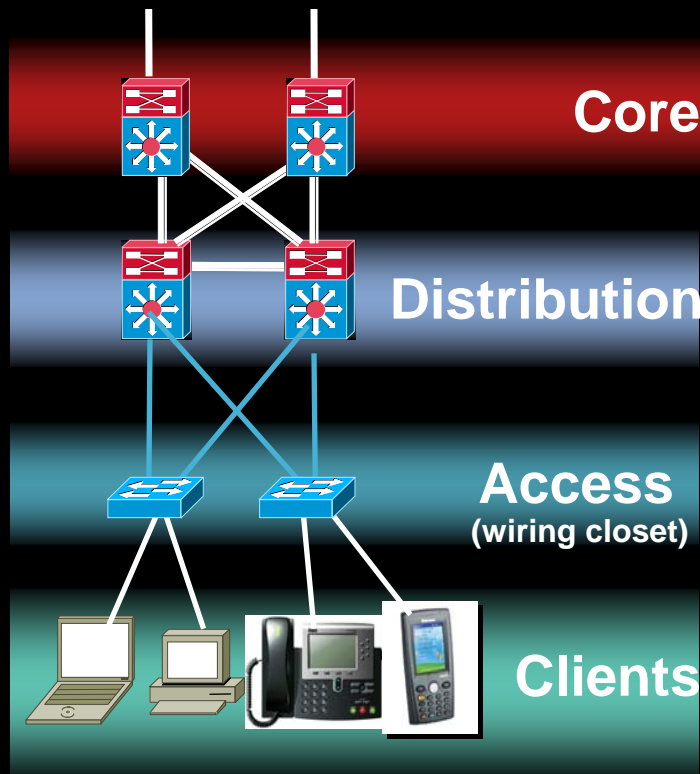
FE → GbE adoption drivers



Adoption of 10/100/1000 copper in the access layer fueled GbE port growth

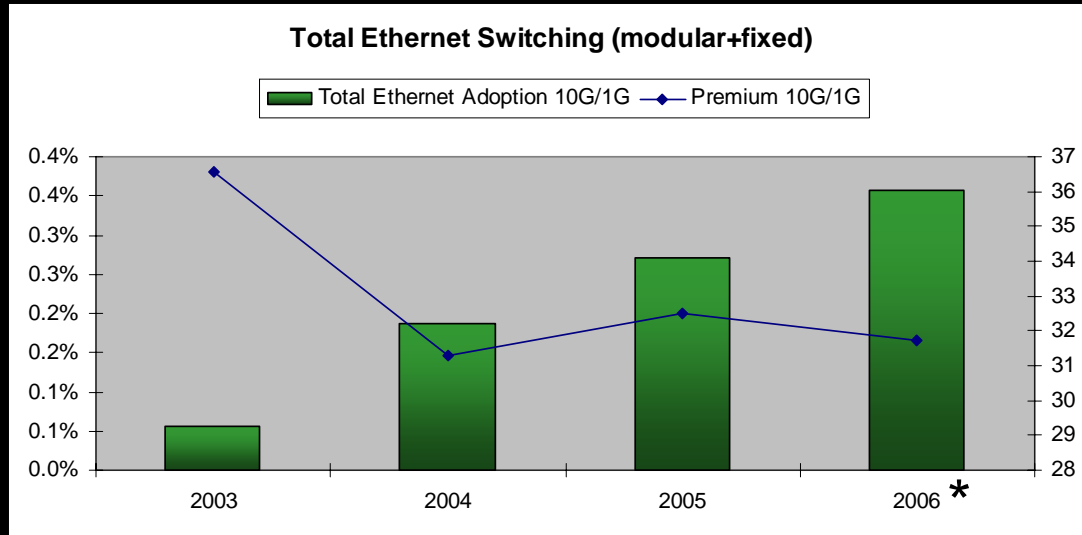
FE → GbE adoption in the modular space

As the access layer upgrades to 100M, the pressure on the distribution and core to upgrade explains a much faster adoption of 1G in the modular space.



• In 2005 units shipments of GigE outstripped unit shipments of FE in the modular space (adoption factor > 100%).

Total Ethernet GbE → 10 GbE adoption curves

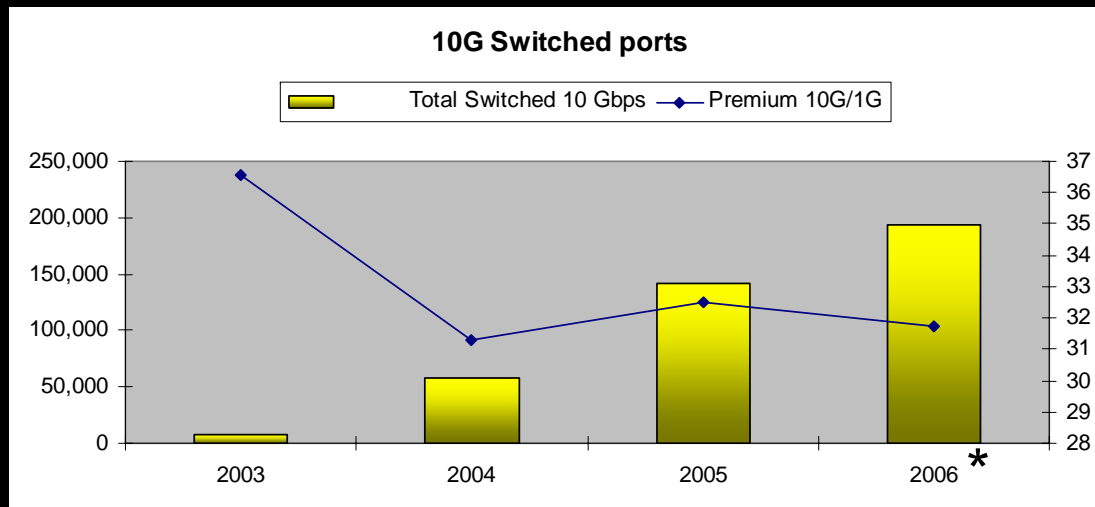


Adoption = Ratio of HSE to Low SE total ports. Expressed in %.
Premium = Ratio HSE to Low SE port average selling price.

• **10 GbE market still in the early adopters phase with an adoption factor well below 1% in 2006.**

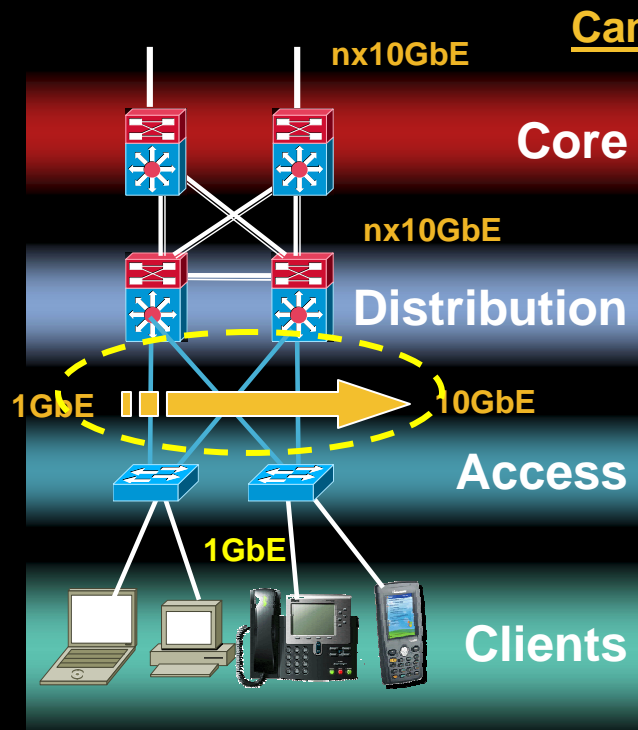
• **Premium over 1GbE still over 30x in 2006.**

• **Steep premiums are not preventing the market from growing at a CAGR of well over 130% (2003-2006).**



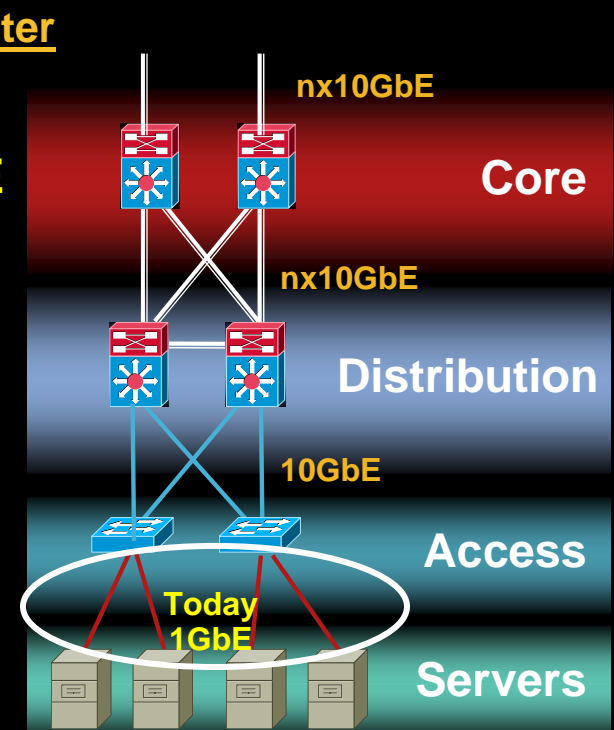
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10 GbE adoption in perspective



- Currently ~80% of the GigE volumes are on RJ45 copper deployed in the access infrastructure.

- Today 10GbE does not play in 80% of the GigE market.

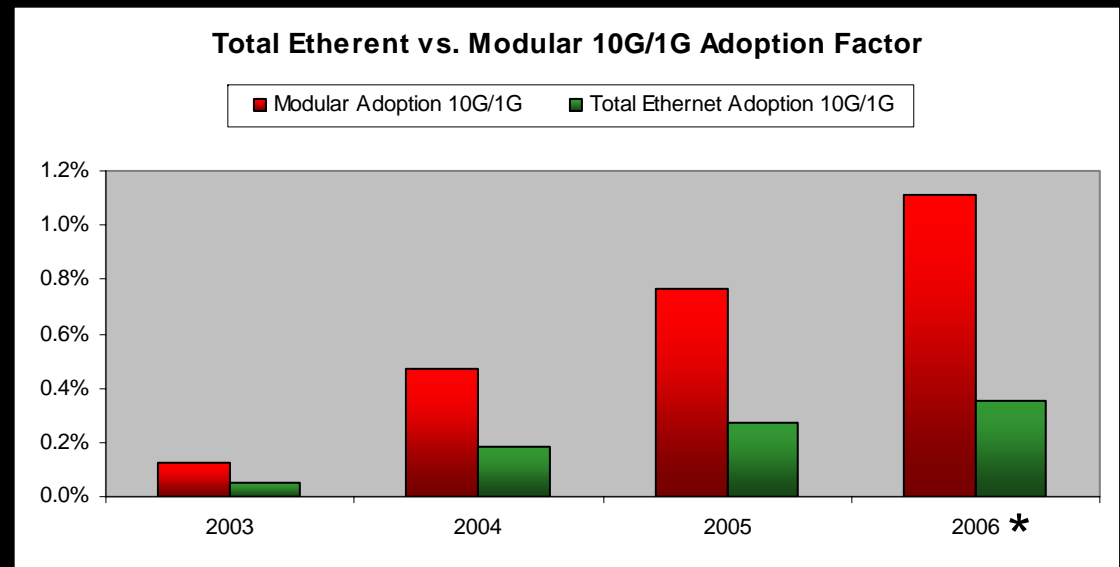
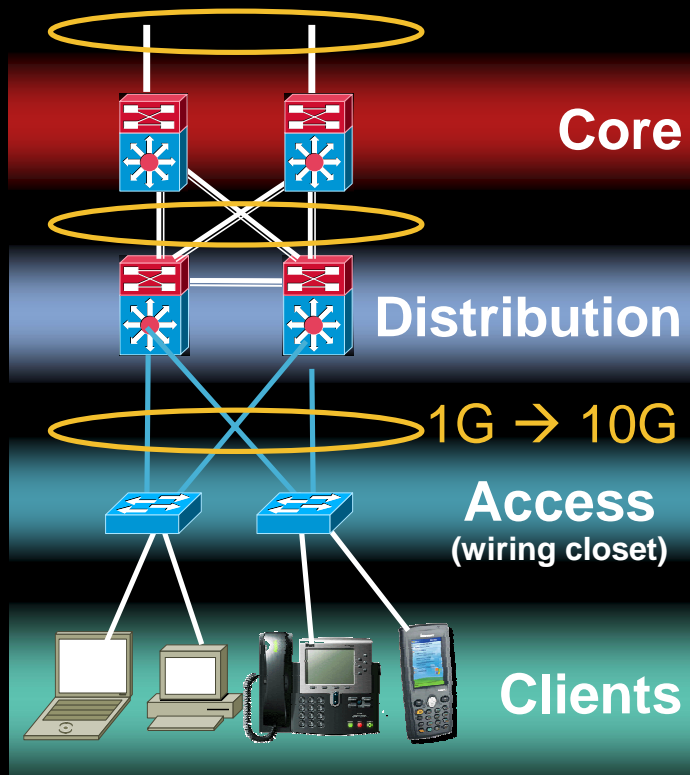


Today 10G penetration is limited by the lack of:

- Cost effective solution for campus access uplinks:
 - 10GBASE-LRM will alleviate this issue.
- Viable 10G copper solutions that enable data center access downlinks and uplinks:
 - 10GBASE-T will bring relief in the next few year.

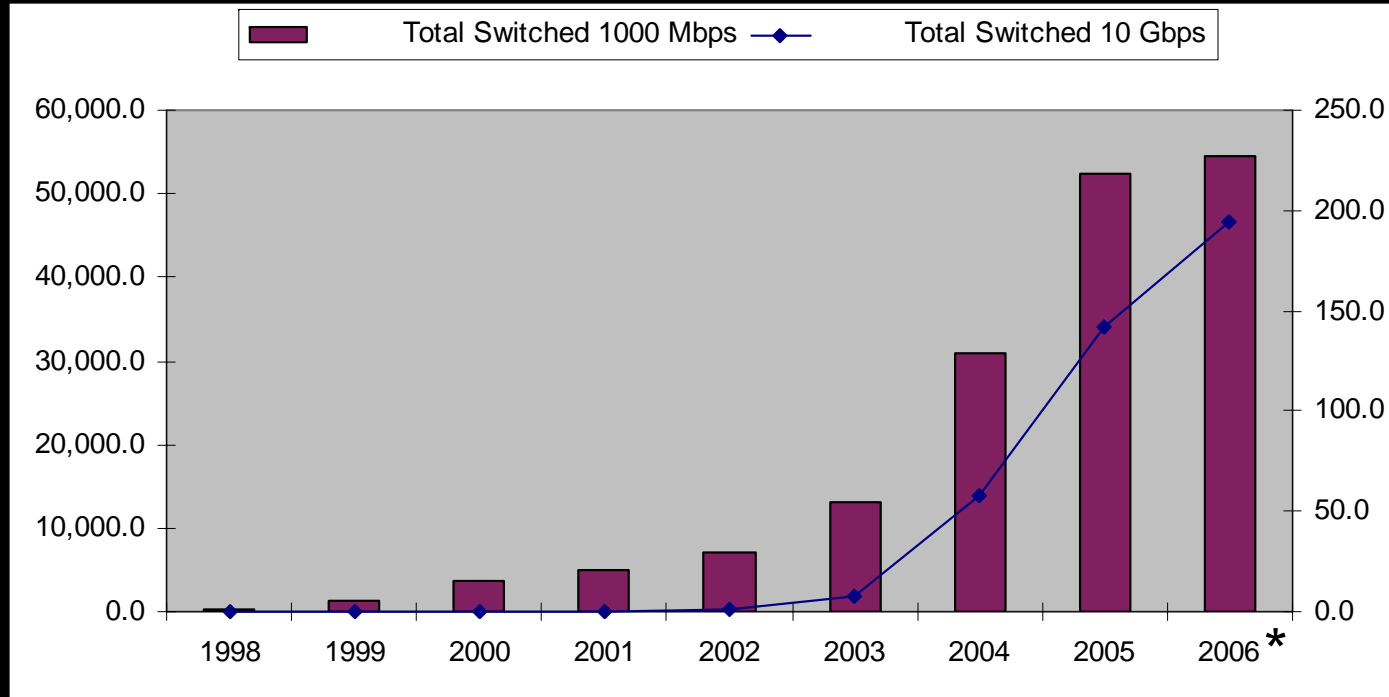
GbE → 10GbE adoption in the **modular** space

- As the Campus access layer upgraded to 1G, the distribution and core needed to upgrade to 10G. This explains the much faster adoption of 10G in the modular space.
- In the Data Center the same dynamic occurred, but at a much faster pace supported by the need-for-speed in the server layer. As a result 10 GbE has penetrated into the access uplinks much faster than in the Campus access (wiring closet).



*2006 historical data limited to the first three quarters

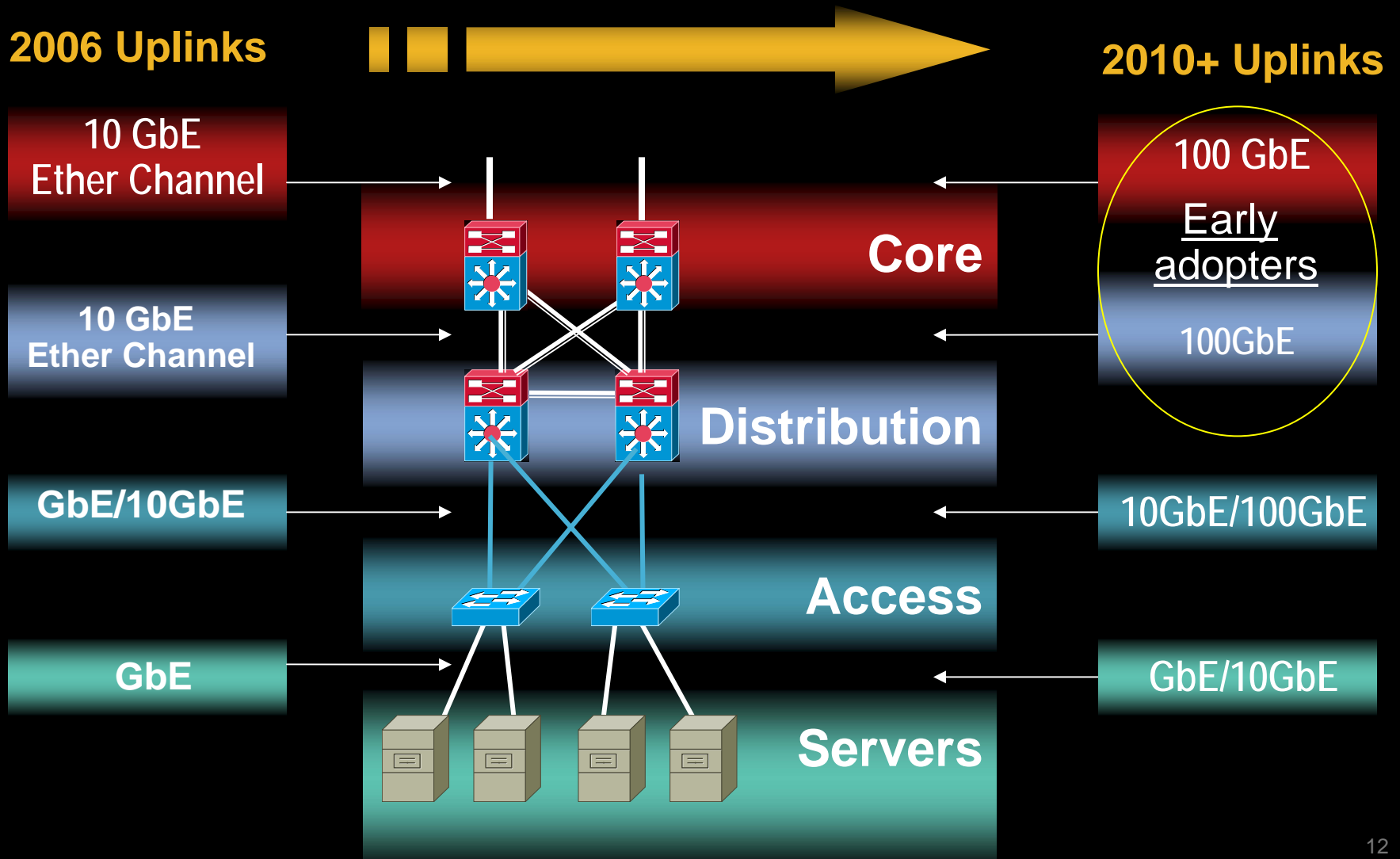
Correlation between GbE and 10GbE ports growth



Between 2003 and 2006, GbE growth stimulates the growth of 10GbE as the need of an efficient trunking/aggregation technology for GbE ports emerged.

100 GbE in the Data Center

Adoption of 10GbE on the server infrastructure will drive the need for 100GbE uplinks from the access to the core of the data centers.



100 GbE in Campus network

10 GbE to the wiring closet will push the need for 100GbE to aggregate multiple 10 GbE pipes at the distribution and core.

2006 Uplinks

10 GbE
Ether Channel

10 GbE/
10 GbE
Ether Channel

GbE/10GbE

100MbE/GE

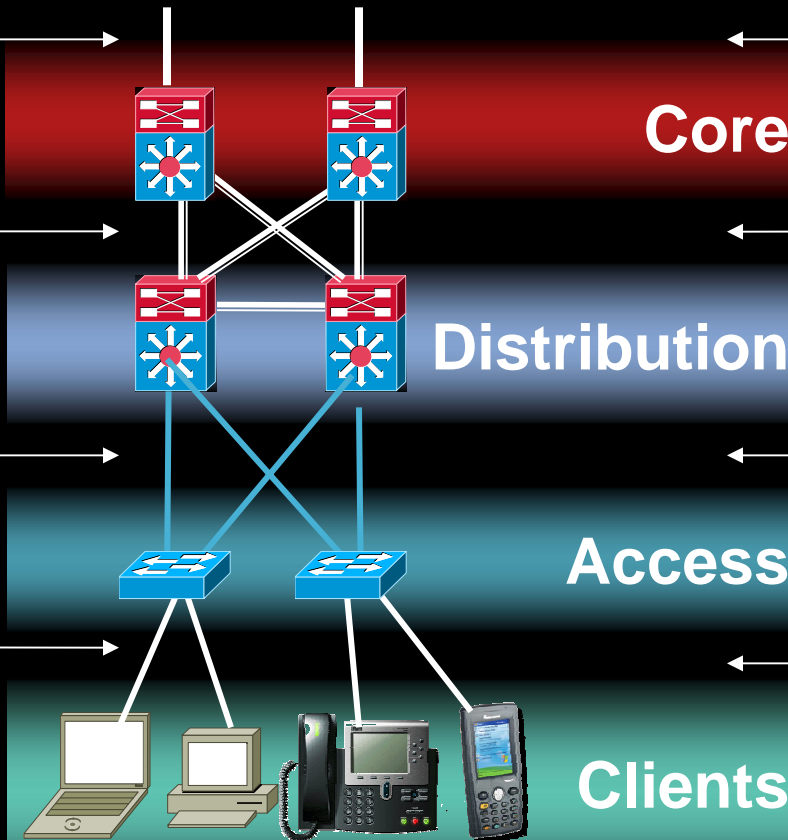
2010+ Uplinks

100 GbE
Early Adopters

100 GbE/10GbE
Ether Channel

10GbE

1GbE



100 GbE market adoption considerations

- Historical data shows that early adopters, those who deploy the technology because they need it, have paid significant multiples for HSE.
- The technical feasibility does not have to follow the cost multiples of previous generations as the market is not as price premium sensitive as early generations of Ethernet (as shown by the growth of 10 Gb/s).
- The economic feasibility is not the same as it was for 10/100/1000, but can be expected to be similar to 10 Gb/s
- High premiums (over 1 GbE) have not been preventing 10 GbE rapid market growth (over 130% 03/06 CAGR) and its success in the market place.

100 GbE market adoption considerations (2)

- The primary goal of a technical feasibility investigation should be to design 100GbE to solve scalability issues in data center, campus and metro networks. Affordability is important, but in the early stages, it will not determine the success of 100 GbE in the market place.
- The architecture should allow for future cost optimization, but the project is justified with market potential, economic feasibility and technical feasibility for less cost/price sensitive adopters and applications.
- The initial 100 Gb/s PAR does not need to address cost sensitive, high volume applications, but rather should be specifically targeted to the technology choices for timely introduction of products for the data center, campus and metro networks needs that will tolerate a significant price premium without abandoning the path to later technology introductions focused on cost reductions.