

# 100 Gbit/s is not enough!

IEEE 802.3 Higher Speed Study Group



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A major motivation for HSSG is to avoid the need for LAG

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## 802.3ad Link Aggregation (LAG)

- **Temporary fix for increased bandwidth demand**
- **Increased complexity**
  - Difficult to plan for capacity and traffic engineering
  - Harder to manage & troubleshoot multiple physical links based on a single logical interface
  - Cable & link management
- **Uneven distribution of traffic**
  - Limitations in the standard
  - Inefficient distribution of large flows
  - Load balancing requires packet inspection or other knowledge

# HSSG avoids LAG for today's demands

But not for tomorrow's demands!

## Service Providers

- High growth projected as broadband penetration and speed increase
  - Core links and aggregation to core links:  $n \times 10 \text{ GbE LAG}$
  - Customer links:  $10 \text{ GbE}$  and  $n \times 10 \text{ GbE LAG}$
- Current interfaces and bundling technologies will be challenged to meet future demand in largest networks
- Level 3 (Source: Joe Lawrence, Level 3 Communications)

### – Today (4Q05)

- Edge router connectivity ranges from  $N \times \text{GbE}$  to  $N \times 10 \text{ GbE}$  redundant
- Backbone router connectivity can range up to  $8 \times 10 \text{ GbE}$
- Most major routes operate at  $2-4 \times 10 \text{ GbE}$
- One major corridor operates at  $8 \times 10 \text{ GbE}$

4Q05  
Demand

### – Future (2010)

- Backbone to LAN aggregation demands grow to  $>100 \times 10 \text{ GbE}$
- Most major routes projected to require  $20-60 \times 10 \text{ GbE}$
- One major corridor projected to require over  $100 \times 10 \text{ GbE}$

2010  
Demand

# Trends in Bandwidth Growth

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- 70% growth year over year forecast
- 10x bandwidth increase every four years
- HSSG necessary and sufficient for 4Q05 bandwidth demands
- HSSG is INSUFFICIENT for 2010 bandwidth demands without LAG or other aggregation technique
- Will terabit Ethernet (project start 2010) be realistic to achieve in 2014 to meet 2010 bandwidth demands?

# Conclusions

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- We will always be behind in our ability to build a single physical interface large enough to carry the largest aggregate of traffic.
  - 10 x 100 Gbit/s LAG will NOT be any more satisfactory than 10 x 10 Gbit/s LAG
  - A Generic Architecture is needed to accommodate the fact that bandwidth growth will ALWAYS exceed the fastest interface we know how to build