Changing the Ethernet Protocol - Benefits and Drawbacks

100GET- Ericsson cluster networking research activities

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Outline

- Introduction of 100GET Ericsson Cluster
  - Participants
  - Topics
- Development of Ethernet
- Increased Ethernet frame size
  - Use case
  - Benefits
  - Drawbacks

100GET - Ericsson Cluster

Participants

Germany

- Ericsson
- Micram
- Heinrich-Hertz-Institut
- Universität Stuttgart (IKR, INT)
- Christian-Albrechts-Universität zu Kiel

Sweden

- Ericsson
- Acreo
- SP Devices
- KTH - Royal Institute of Technology
- Chalmers University of Technology

Topics in 100GET-ER

Complete Cluster

- Devices
  - Lasers
  - Modulators
  - ADCs, DACs
- Transmission and modulation
  - DQPSK
  - Sub-Carrier Multiplexing
  - OFDM
- Networking aspects

→ Majority of 100GET-ER participants dealing with non-networking topics

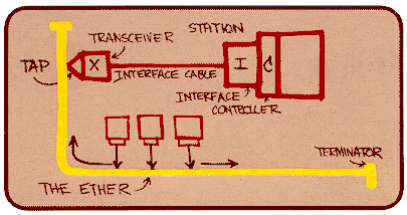
Networking Aspects

- Overall network architecture
- Protocol aspects
- Network Control Plane

Developments

Ethernet

- 1973-75 Experimental Ethernet by Metcalfe & Boggs
- 1983 IEEE 802.3 Ethernet Standard 10 Mbit/s
- 1995 Fast Ethernet 100 Mbit/s
- 1998 Gigabit Ethernet 1 Gbit/s
- 2002 10 Gigabit Ethernet 10 Gbit/s
- ??? 100 Gigabit Ethernet 100 Gbit/s



x 10,000

Access Bandwidth

- Modem 300 bit/s - 56 kbit/s
- ISDN 64 kbit/s
- DSL 3 Mbit/s (down), 768 kbit/s (up)
- VDSL 250 Mbit/s
- GPON 2.5 Gbit/s (down), 1.2 Gbit/s (up)

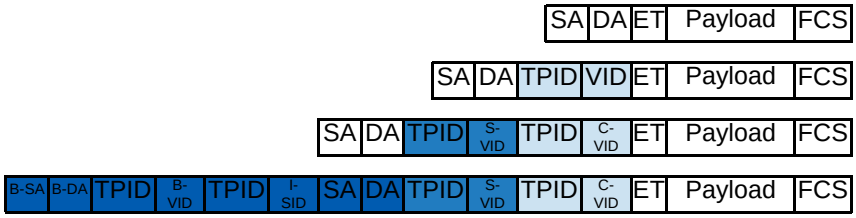
x >10,000

→ Tremendous increases in speed

Ethernet Frame

Standards

- 802.3
- 802.1Q (VLAN)
- 802.1ad ("Q-in-Q")
- 802.1ah ("MAC-in-MAC")



→ Changes triggered by additional requirements, not by increased speed

→ Payload size (46-1500 bytes) untouched

Reality Check

- ~9000 byte frames (*Jumbo-Frames*) supported by most Gbit/s equipment
- Usage of Jumbo-Frames in closed systems

→ Larger frames beneficial for specific applications (e.g. storage)

Questions addressed within Ericsson cluster

- Consequences of increased maximum frame size
- *Optimal* maximum frame size

Increased Frame Size

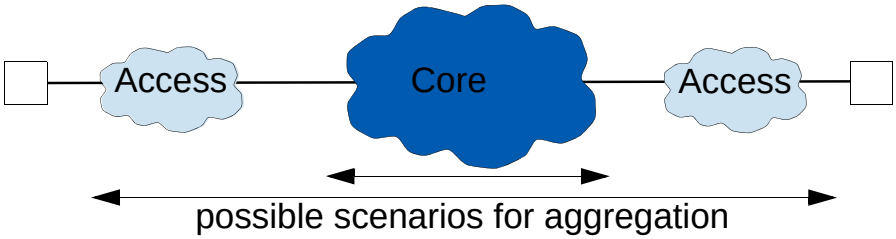
How to fill large frames

Services

- Video on Demand
- HD Video Streaming
- File Transfer
- File Sharing
- ...

→ Many (emerging) end-to-end services with bulk data transfer

Aggregation of Ethernet frames



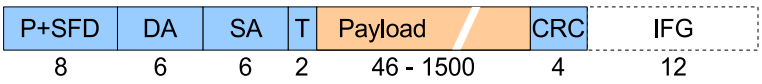
- Hugh traffic amount especially for aggregation at core

→ Only small additional aggregation delay required

Increased Frame Size

Benefits

Capacity Usage Efficiency



- Overhead of normal Ethernet ~2.4%
- Worst case scenario (MAC-in-MAC, ...) < 5%

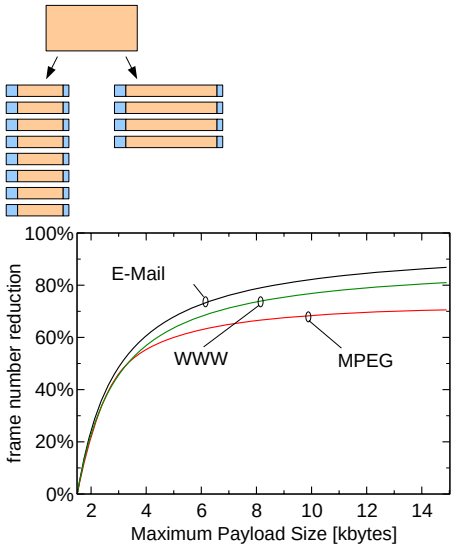
→ Increasing frame size improves efficiency but **not significantly**

Frame Rate

- At most linear decrease with increasing frame size
- Actual impact depends on traffic properties
  - Savings in range of 50% and above possible
  - Saturation with increasing size

→ **Less hardware processing requirements** in core as well as end systems

→ Cheaper hardware



Increased Frame Size

Drawbacks

Incompatibility

- Maximum payload 1500 bytes according to standard
- Huge amount of legacy equipment
- One legacy device in communication path inhibits usage

→ Main reason for not using larger frames so far

MTU Discovery

- MTU Discovery especially necessary in inhomogenous networks
- Current approaches based on probing and ICMP
- ICMP often filtered due to potential denial of service attacks

→ Current approaches insufficient

Crosslayer Effects

- Influence on performance of other protocols (e.g. TCP)

→ Detailed investigation necessary

→ Impact on **Future Internet**?

Conclusion

- Basic Ethernet frame format fixed in 1983
- Since then 25 years of technological progress
- Payload size of Ethernet frame never changed in standardization

- Jumbo frames already used in closed scenarios
- Increase of frame size would have beneficial effects
- Potential issues and drawbacks have to be investigated

→ How long do we stick to the current Ethernet protocol?