Energy Efficient Ethernet: Outstanding Questions

Bruce Nordman
Energy Analysis
Lawrence Berkeley National Laboratory
Berkeley, CA 94720
BNordman@LBL.gov
(510) 486-7089

EEE energy context: recap

- **All Electronics**
  - ~ $16 billion/year
  - ~ 6% of U.S. electricity use
  - % of this from digitally networked products rising

- **Power savings per EEE link**
  - 1 Gb/s links — 2 to 4 W AC
  - 10 Gb/s copper links — 10 to 20 W AC

- **U.S. energy savings from EEE**
  - 1 Gb/s EEE: ~ 250 to 380 $million/year *1, 1.5 W / NIC*
    - 50%+ residential
  - 10 Gb/s EEE: ~ 40 to 80 $million/year *5, 10 W / NIC*

- **"But isn't NIC power use a small % of U.S. total?"**
  - Yes, BUT All energy use is reduceable to many small uses
  - If act on no small uses, no progress ever made
  - If act on most/all small uses, enormous progress possible

What do we know already

- Energy consumption of IT equipment an increasing concern
- EEE is good for network industry, IT mfrs, IT users (esp. data centers), economy, and planet

- Goal is to eventually have all new NICs EEE-capable
- Energy efficiency community (e.g. Energy Star) ready to help

- Typical link utilization very low on average (not a problem — an opportunity)
- Aim is for EEE to be suitable for great majority of links (e.g. >99%) but able to be turned off if necessary
- Time needed to switch data rates should be low (e.g. 1 ms)

Outstanding questions

Control Policies (CP)

- **Assume**
  - CP is outside scope of 802 / EEE
  - Existence proof of ≥ 1 good CP needed to move EEE forward
  - Helpful to document good CPs somewhere

- **Do both NICs on a link need to use same CP?**
- **Can CP elegance be something mfrs compete on?**
- **Should EEE NICs exchange information about policies and perhaps parameters? (e.g. delay times, buffer sizes)**
- **Where should CP examples be documented?**
  - Informative annex to EEE standard?
  - Ethernet Alliance?
  - Academic literature?
  - Other standards organization?

Outstanding questions

Traces / Use patterns

- **Do we need more sample traces (beyond Ken's) as references for designing EEE?**
- **Do we need other information about current link use patterns?**
- **How about 10 G link use information?**

- **Burst pattern time scales of of possible interest**
  - Sub-second
  - Seconds to 100s of seconds
  - 1000s of seconds (hours) to days

Outstanding questions

Data Rates

- What are the advantages/disadvantages of using 10 Mb/s or 100 Mb/s as the low data rate for 1 G? Should both be facilitated?
- Is there any reason to consider a rate other than 1 G as the low rate for 10 Gb/s links?
- Any reason to consider data rates other than multiples of 10?
- Are asymetrical data rates feasible? Desirable?
- How about EEE between 100 Mb/s and 10 Mb/s?

Outstanding questions

Transitions

- **Signaling mechanism for transitioning between (among?) data rates**
    - (Many candidates listed in CFI presentation)
  - Is switch time fixed or potentially negotiated (potentially influencing control policies)?

- **Details / timing for resynchronization at new rate**
  - Can parameters be usefully stored to reduce time needed?
  - How else do we minimize transition time?
  - How do we know if the time needed is “quick enough”? (for great majority of applications)

Outstanding questions

Other Protocols / Layers

- **What interaction could there be with higher-layer protocols**
  - Should link rate switching ever be advertised? (e.g. so that links in series can all shift up at same time)
  - Do upper layers ever need to know that link rates are changeable / changing?
- **Is there any useful coordination with PoE on signaling, control policies, or something else?**

Outstanding questions

Outreach

- **Do we want more information about other link technologies that change link rates? (ADSL2+, 1394, …)**
- **Any other outreach (companies, countries) of importance to inform or engage?**

Conclusions

- **Should be helpful to maintain a list of outstanding questions on the EEE web site**
- **Could also keep a list of informal conclusions / answers as they emerge**