

Ethernet Networking Moves to Greener Pastures

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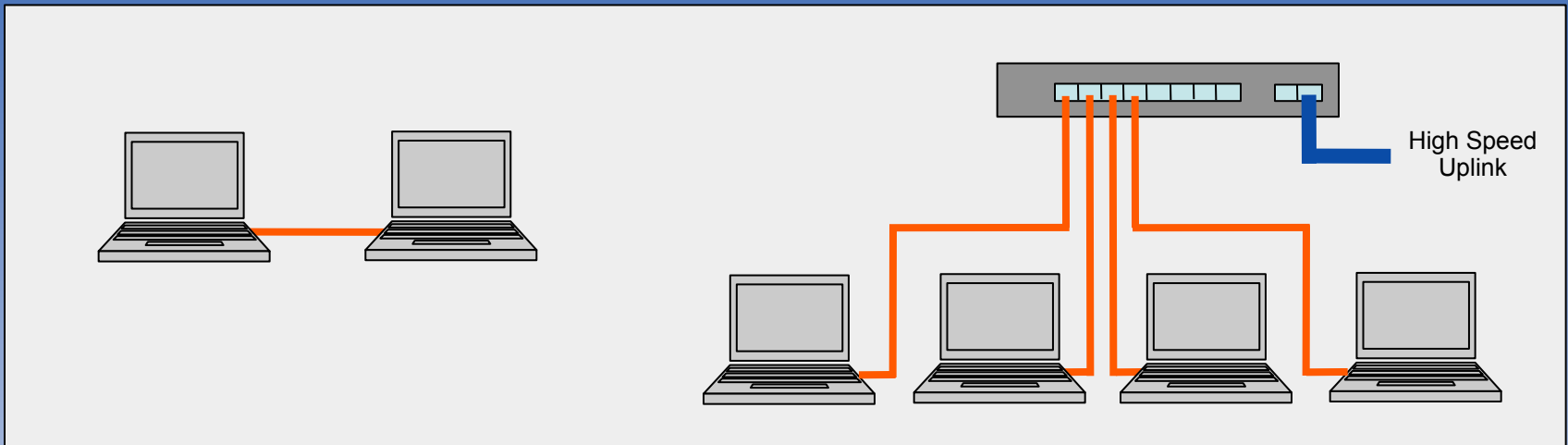
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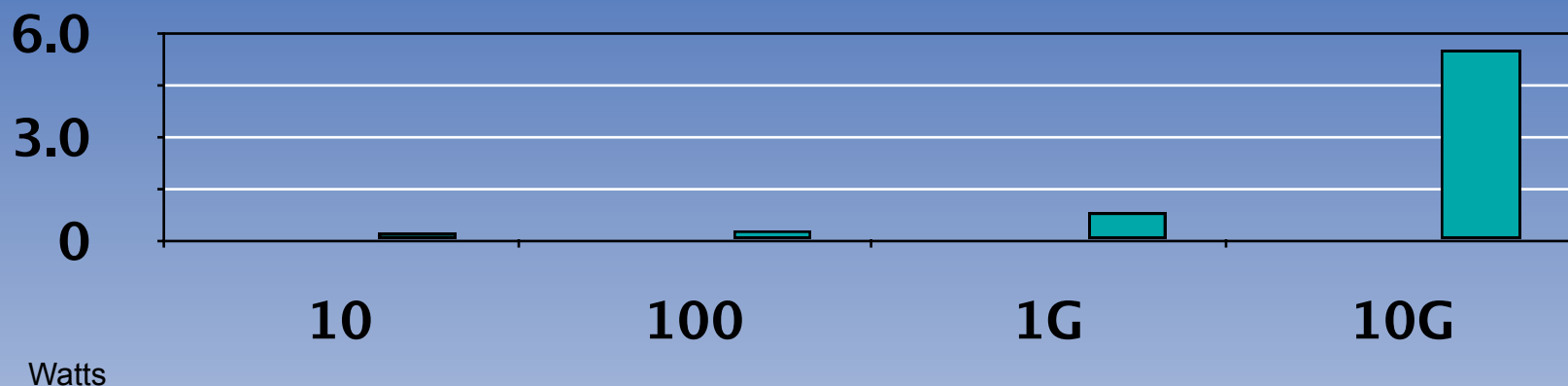
- The Ethernet Growth Problem
- Inherent Ethernet Fallacies
- What's Being Done Today
- Rethinking a Design's Power Calculation

The Growing # of Ethernet Links



- **Networking Two Devices with an Ethernet Link:**
 - $E_T = E_1 + E_2$
- **Networking Four Devices with an Ethernet Switch:**
 - $E_T = E_1 + E_2 + E_3 + E_4 + E_{\text{Switch}}$
- **In the case of a large number of devices networked together**
 - Energy use greatly increases as more switches & routers are added into the network
 - Higher speed links are usually added to interconnect switches, further increasing energy use

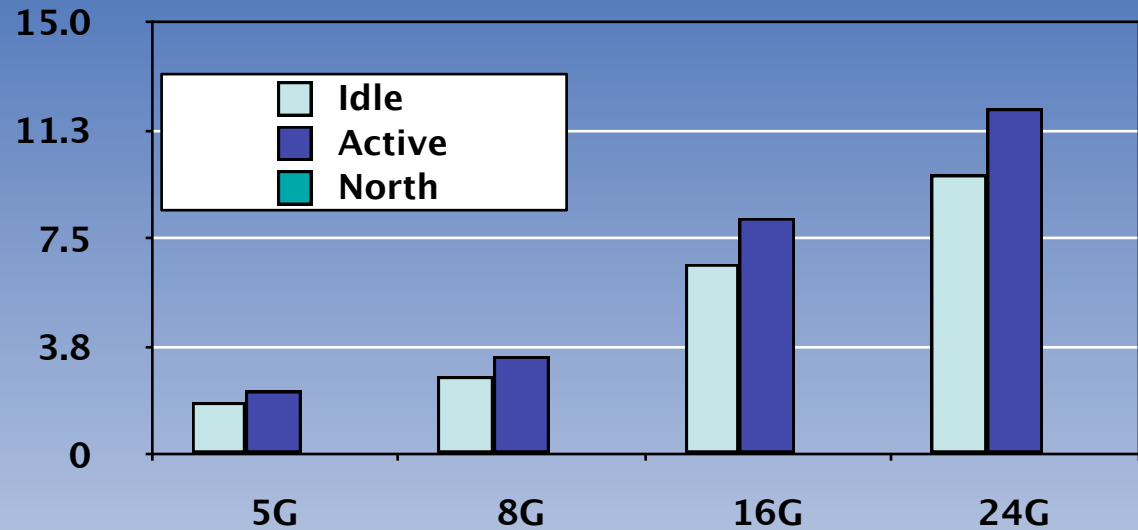
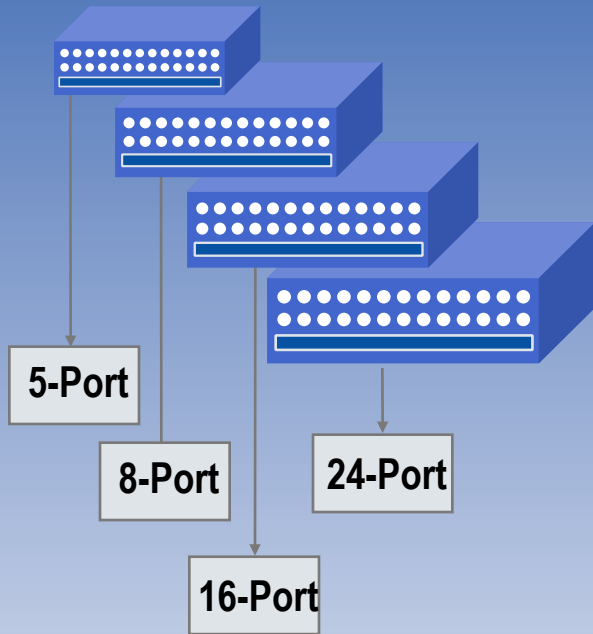
Higher Speed Ethernet Links



- A higher speed link uses more energy than a slower link

NOTE: most higher speed links deployed are used to upgrade existing lower speed links bottlenecking a system

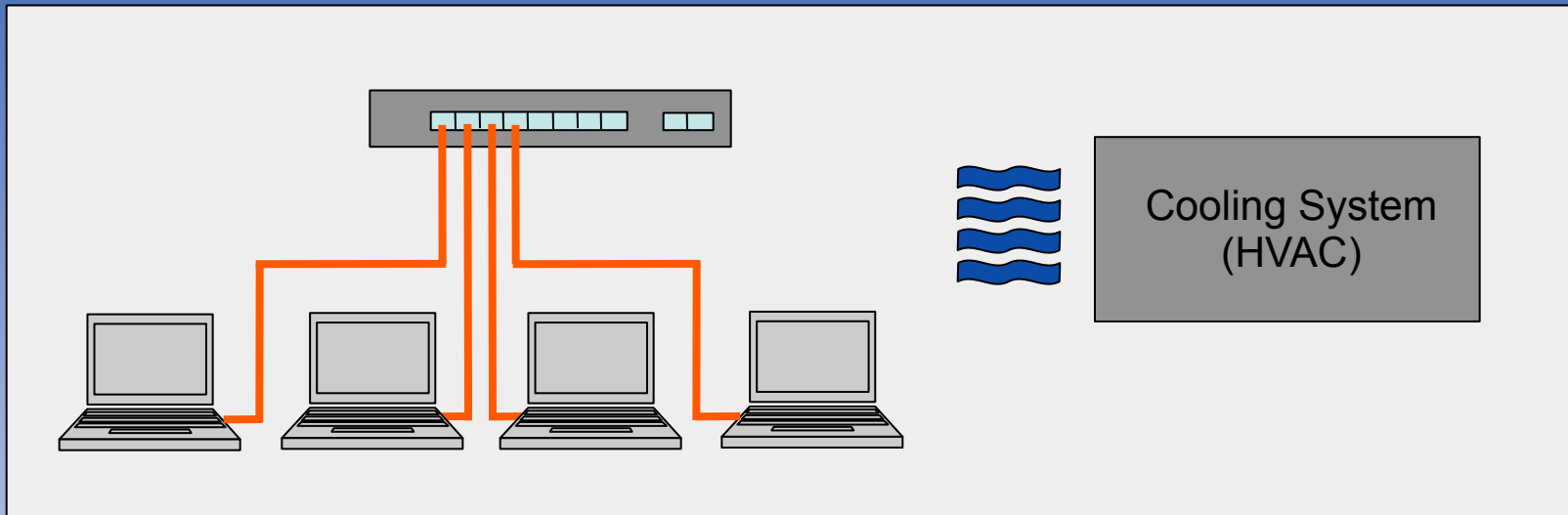
The Always-On Ethernet Fallacy



- With today's switches (without EEE), energy use is relatively constant regardless of the amount of data traffic
- Even unused ports use energy because of auto-negotiation

During idling periods these switches are consuming unnecessary energy!

The 3X Energy Fallacy



- **Going back to the energy calculation...**
 - One key energy consumption element was not accounted for
 - Power cooling a large component to an Ethernet network architecture
 - Two watts to cool one watt of power dissipation
 - Why two watts? Cooling systems are generally 50% efficient
- **Networking 4 devices with an Ethernet Switch & HVAC factored in:**
 - $E_T = 3 \times (E_1 + E_2 + E_3 + E_4 + E_{\text{Switch}})$

The Ethernet Transceiver Fallacy

- **10, 100, 1G & 10GBASE-T PHYs ...**
 - Are required to transmit & receive at 100 meters, regardless of actual cable length
 - Cannot idle when no traffic is present (except 10BT)

- **The auto-negotiation feature within PHYs ...**
 - Is great for auto-detecting link speed
 - However, unused ports will continuously transmit link pulses & constantly listen for a link partner to respond

These fallacies cause inefficiencies in energy use!

What's Being Done Today

■ Design Innovation

- New PHYs with active-shutoff ports, cable reach scaling, and short range modes
- New Ethernet switches and SoCs with idling enhancements

■ Standardization Efforts

- 10GBASE-T Short reach mode
- IEEE's 802.3az Energy Efficient Ethernet

■ Certifications and Gov't Policies

- EnergyStar adopted by several countries
- Japan's Top Runner program



Rethinking a Design's Power Calculation

- **Traditionally, a design's power calculation includes:**
 - Summing up the ICs' power based on the specific supplies used
 - An estimate of the number of passives being statically powered
 - Factoring in power supplies inefficiencies
 - Adding in cooling devices

- **For a design to become energy efficient, one must...**
 - Analyze ICs' energy use with various traffic & activity performance
 - Design local power supplies with the ability to actively thrift supply output
 - Rethink use of devices that consume static power

Power calculation no longer just estimating max power!

Summary

- The growth in Ethernet creates an increasing demand for energy
- Ethernet with energy inefficient features such as “always-on” continuous signaling exacerbates the problem
- Steps are being taken to curb Ethernet energy use
- As a result, system-level designers will be able to build energy-efficient Ethernet solutions to meet the latest market trends

Thank You

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