BANDWIDTH GROWTH VEHICULAR ETHERNET

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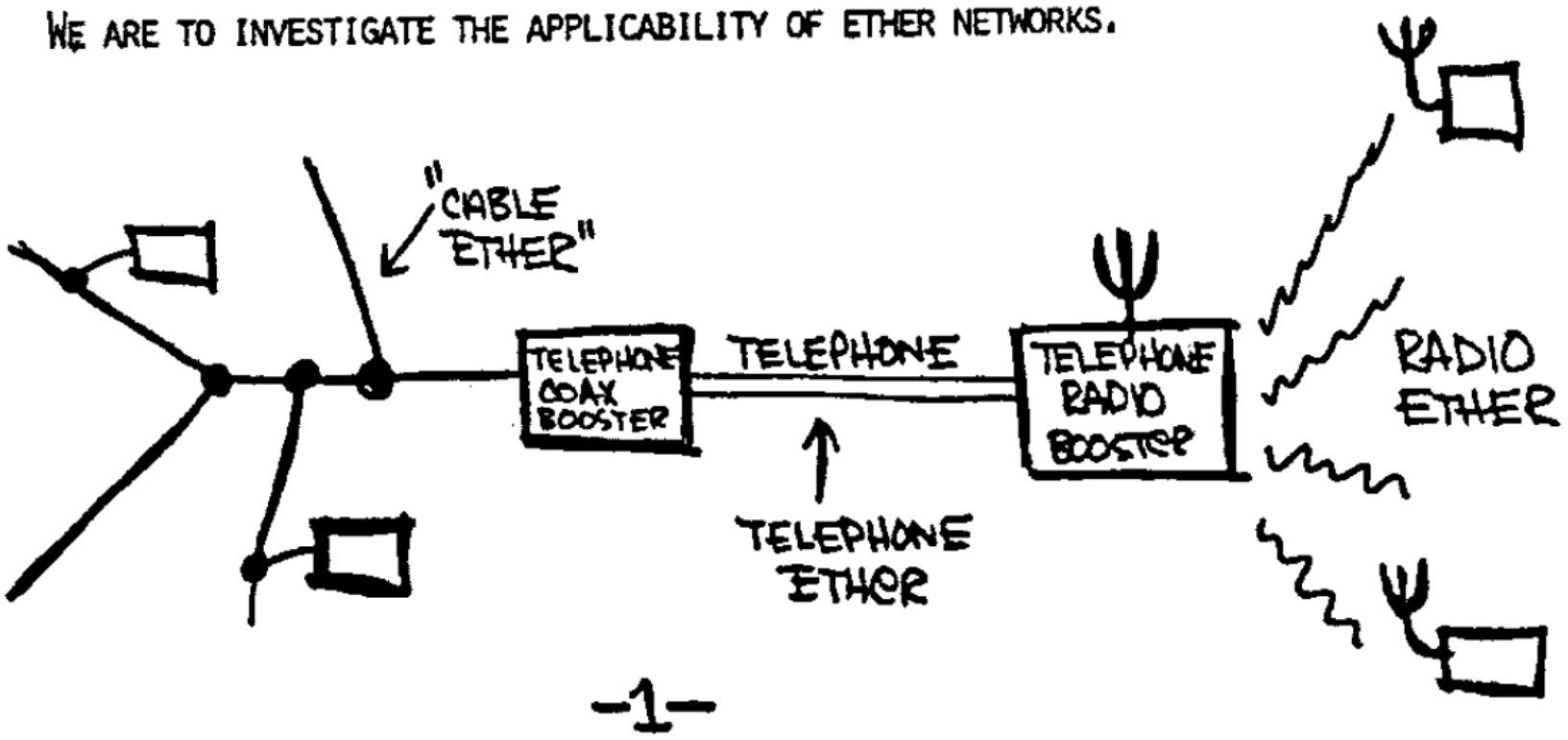
IEEE 802 Nov 2013 Plenary
Dallas, TX, USA

Introduction

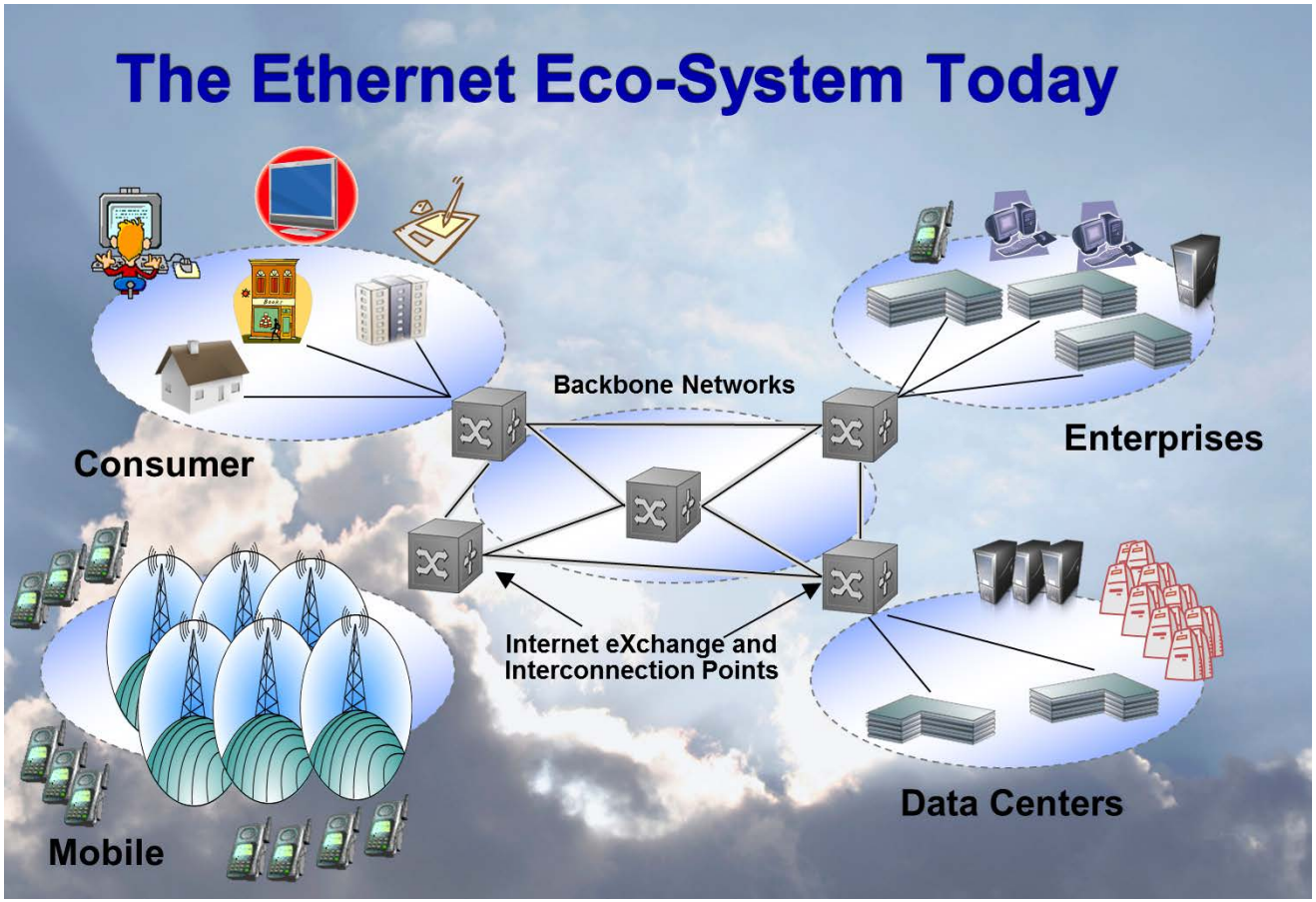
- Vehicular Ethernet
  - IEEE 802.3bp RTPGE
  - IEEE 802.3 PoDL
- People are starting to consider the networking opportunities
  - Think “Cars in the Clouds”
  - Think “The Internet of Things”
- As Bob Metcalfe put it – build it and the applications will come.

Forty Years Ago…..

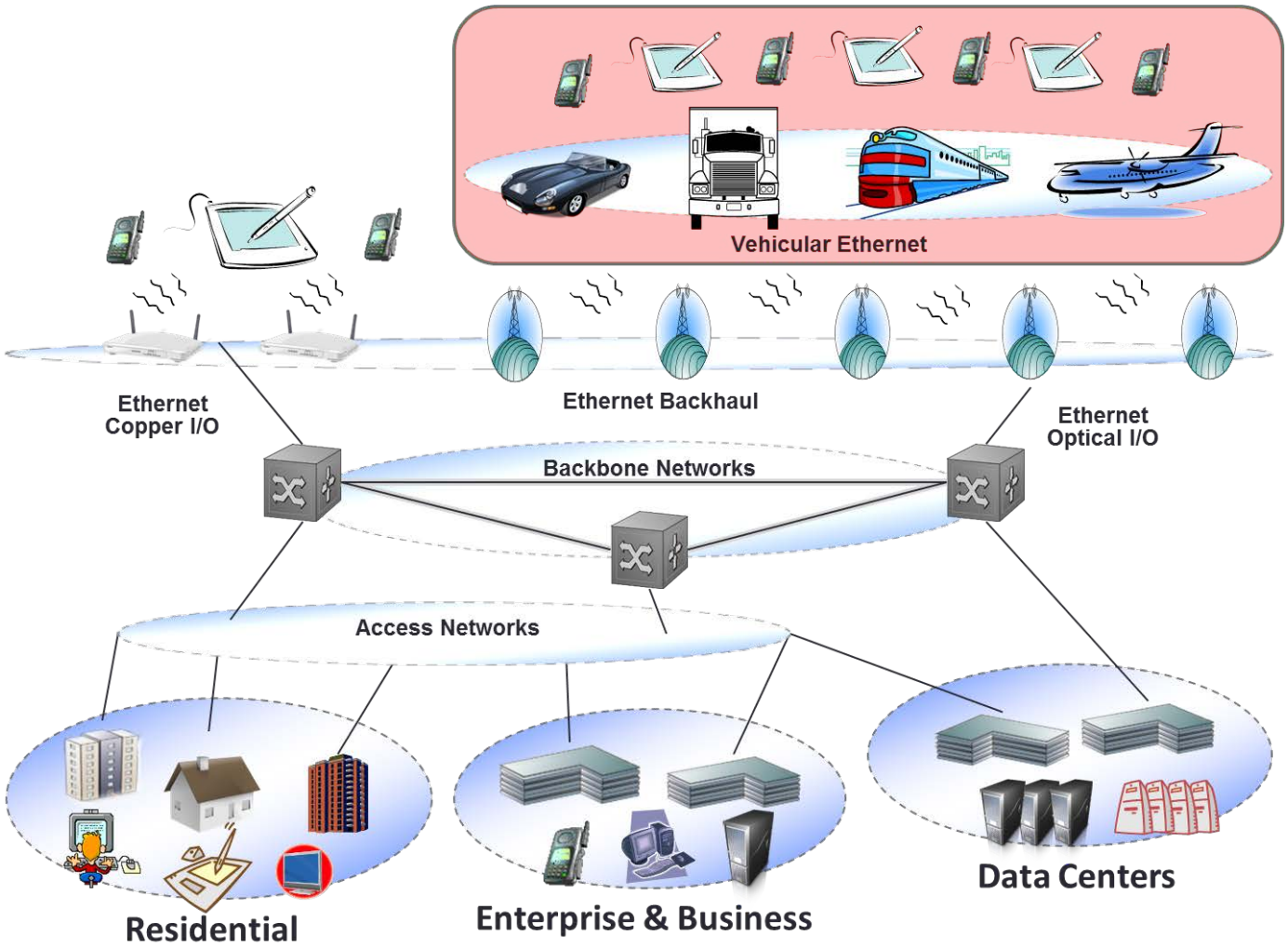


"The Ethernet Memo" by Bob Metcalfe, May 22, 1973

For the 400 GbE Call-for-Interest



The Emerging EcoSystem



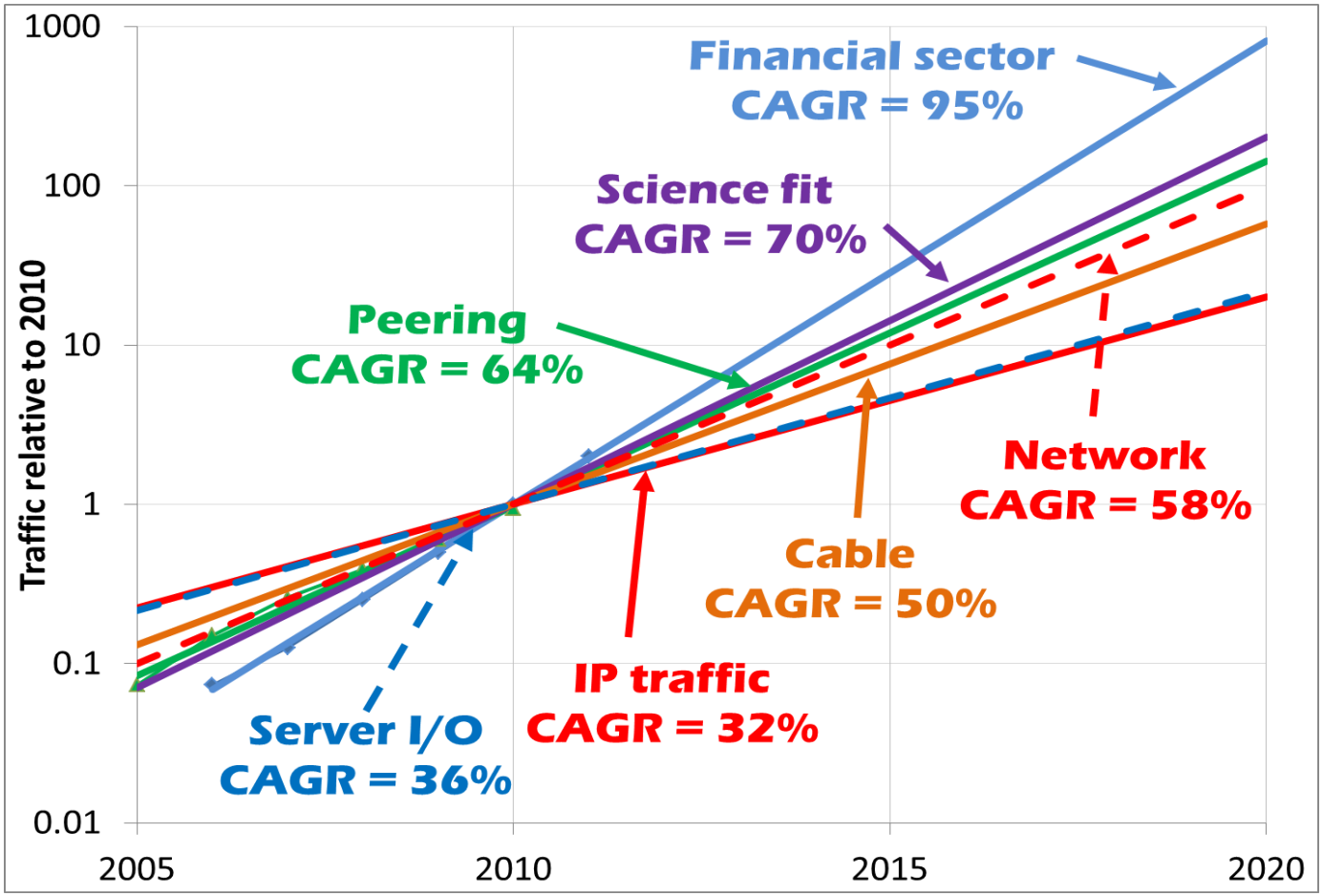
IEEE 802.3 400 Gb/s Ethernet Study Group
IEEE 802 Nov 2013 Plenary, Dallas, TX, USA.

Prior Observations – Impact of Mobile Users

- From 400 GbE Call-For-Interest
- Forecast May 30, 2012**
  - By 2016 – 1.2 million video minutes traveling Internet every second
  - "Fixed" video users: 0.792B (2011) to 1.5B (2016)
  - ***"Mobile" video users – fastest growing mobile service, 0.271B (2011) to 1.6B (2016)***
  - Desktop videoconferencing users – 26.4M (2011) to 218.9M (2016)
- Forecast Feb 2013 ***
  - ***Mobile video to represent 66% of all mobile data traffic by 2017***
- YouTube Statistics ****
  - Every minute - 72 hours of video are uploaded
  - Each month 4 billion hours of video are watched
  - ***25% of global views come from mobile devices***
  - ***Traffic from mobile devices tripled in 2011***

** May 30, Press Release, "2012, Cisco VNI Forecast," http://newsroom.cisco.com/press-release-content?articleId=888280.
*** Visual Networking Index , Cisco, http://www.cisco.com/en/US/netsol/ns827/networking_solutions_sub_solution.html#~forecast, Feb, 2013.
****Youtube Statistics, http://www.youtube.com/t/press_statistics, data obtained Feb 15, 2013.

IEEE 802.3 BWA Ad Hoc Findings



Source: http://www.ieee802.org/3/ad_hoc/bwa/BWA_Report.pdf

Application Growth 5 to 10 years

- The is a backlog of functionality for automotive systems:
  - No way to get the desired data from Point A to Point B;
  - Or the pathway between Point A and Point B is too slow
  - Once there is an Ethernet network in the car, the logjam will break
  - There will be a flood of new applications
  - Many of these apps will send and receive a lot of data via the car's cellular connection

Application Growth 5 to 10 years

- Cellular Data to the Car
  - There are several models, all with pros and cons:
    - Embedded modem single SIM - Car company has a contract with a carrier, customer pays some annual subscription
    - Embedded modem dual SIM - Car company has a contract for one SIM, customer can add their own. Services split between
    - Embedded modem, Phone connectivity - Car company has contract for one SIM, customer uses their phone for some services
    - Phone only
    - Cellular handsets are not designed or tested for operation at vehicle speeds---hence the use of an in-car cellular radio
    - Handset antennas are no match for a roof-mount system with a control unit that is optimized for vehicle use
  - Currently the car is bound to a carrier network, but this will loosen with Softsim technologies

Application Growth 5 to 10 years

- Sensor fusion
  - In-car data is sent via cellular to the “cloud”
    - Road conditions
    - Parking availability
    - Real-time traffic navigation
    - Vehicle telemetry (including video upload)
    - Emergency assist (crash notifications)
    - ***And so on…***
- Infotainment
  - In-car Wi-Fi hotspot
  - Audio streaming services
  - Video streaming services
  - Web browsing
  - ***And so on…***
- Human Interface Systems
  - In-dash system becomes an HTML5 browser front end
  - New functions are added via the cloud
  - Firmware updates
  - ***And so on…***

Why do we care?

- More and more cellular data uses Ethernet backhaul networks and this trend is increasing
- It's a lot more traffic on the network, hence it's traffic that 802.3 will carry at other places besides backhaul, e.g. data centers, Internet X-changes, etc.
- Assume 80 million cars on the road in North America with this functionality by 2023, each using, on average, 3Mb/s: **240 Terabits per second**
- **The above is simply an example---it could be much worse!**
- **Remember smartphones**
- **Remember Facebook**
- **Remember Netflix**
- **Time is not on our side!**