Ethernet Alliance
Technology Exploration Forum 2013
"The Future of Ethernet"

Technology Exploration Forum

Synergy Between IEEE 802 Wired and Wireless Technologies: Meeting in the Ether

October 15, 2013

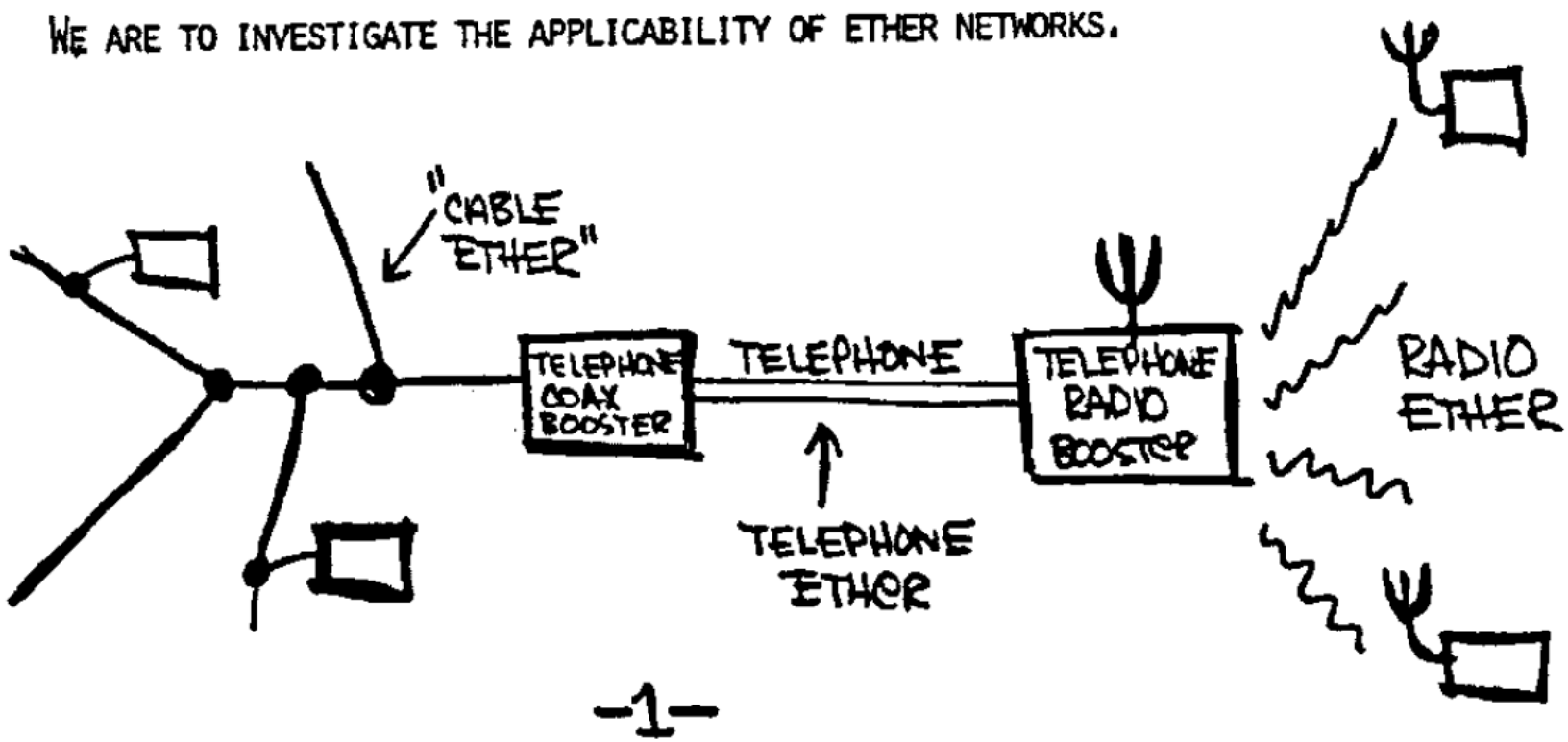
This presentation has been developed within the Ethernet Alliance, and is intended to educate and promote the exchange of information. Opinions expressed during this presentation are the views of the presenters, and should not be considered the views or positions of the Ethernet Alliance

The Panel

- Moderator, John D'Ambrosia, Dell
  (Chairman, Ethernet Alliance)

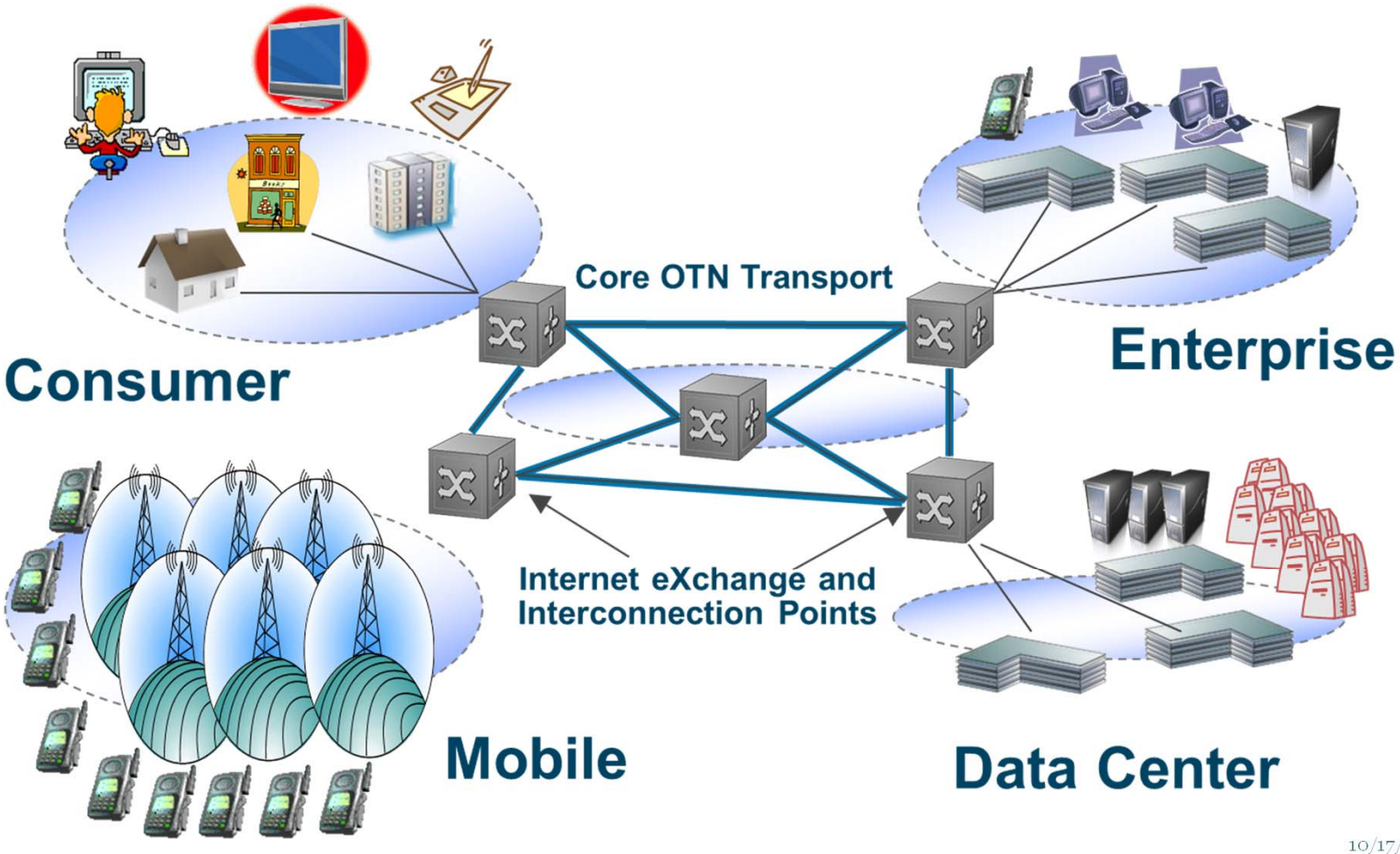
- Panelists
  - Bruce Kraemer, Marvell
  - David Law, HP
  - Dave Dwelley, Linear Technology
  - Pat Thaler, Broadcom

Forty Years Ago…..



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

The Ethernet Ecosystem



Questions to Ponder

- How is "cellular offload" being handled?
- What are the future bandwidth demands that wireless applications will impose on Ethernet?
  - With co-existence with cellular technology?
- What is happening with wireless spectrum allocation?
- For Ethernet to support Wireless Access points –
  - Wireline reaches?
  - Optical?
  - Power?
- What is the state of the IEEE 802.1 / 802.11 Bridging Project?
- Delivery of new services?

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Emerging Wireless Applications

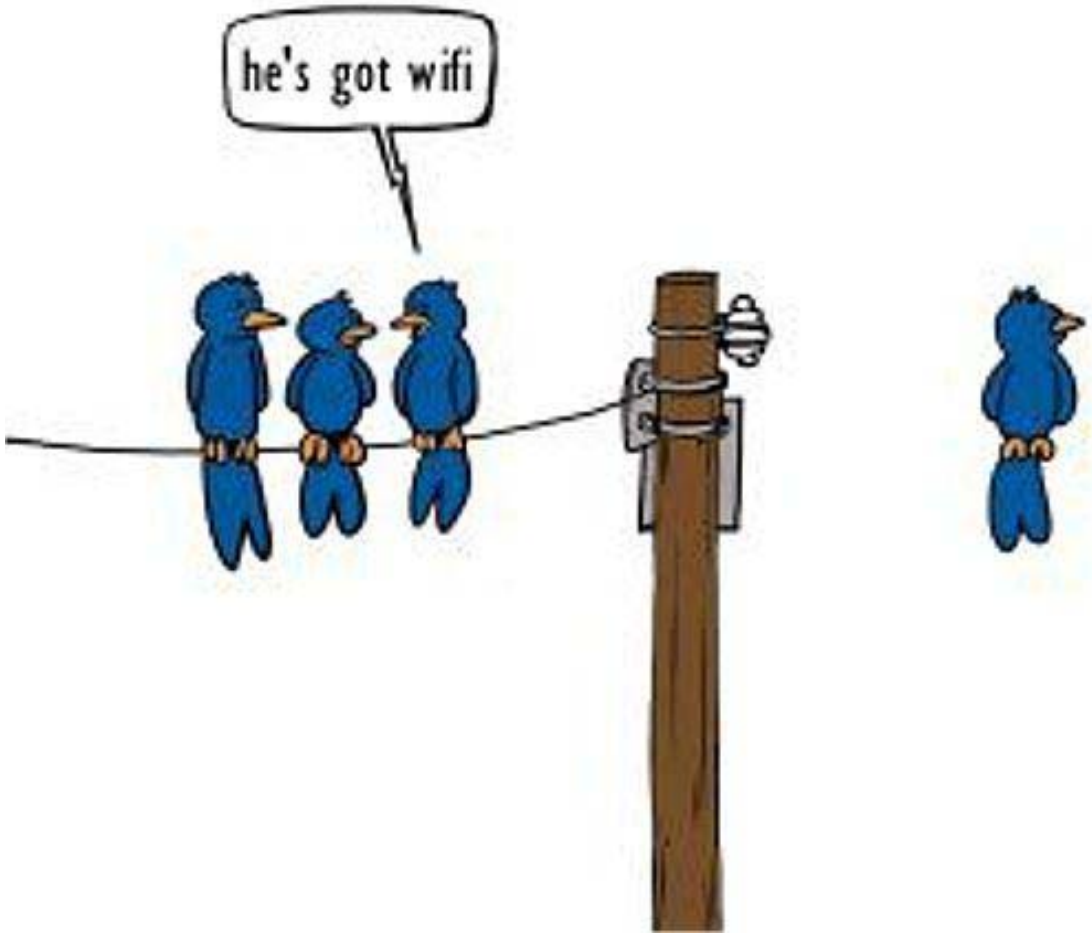
Bruce Kraemer, Marvell

Before we Share Our Views…

"At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE."

IEEE-SA Standards Board Operation Manual (subclause 5.9.3)

Birds of a Feather

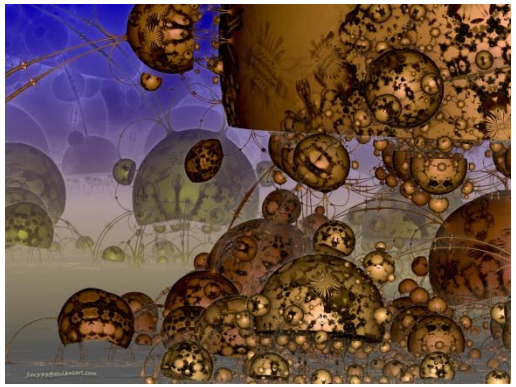


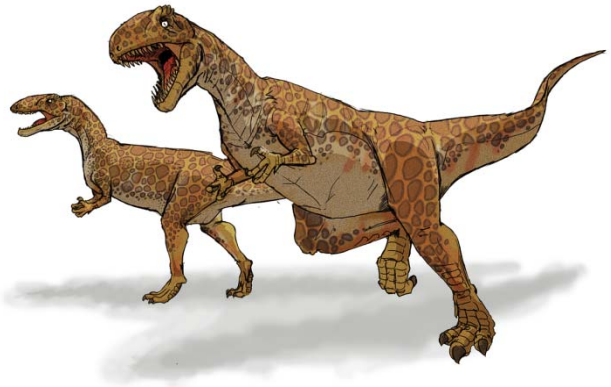
Standards that Define Future

IEEE 802.11™, "Wi-Fi"

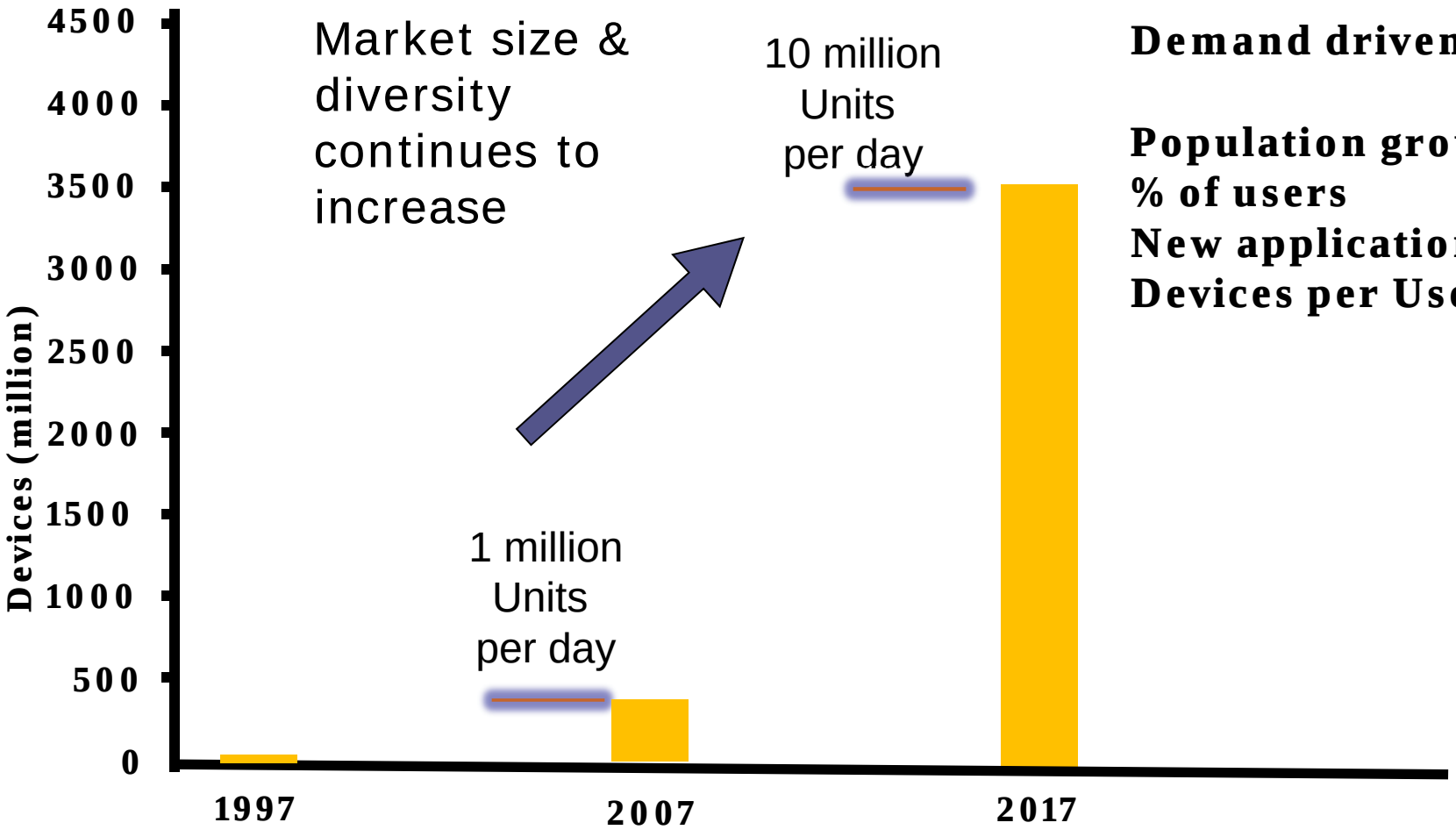
- Originally conceived to link wireless cash registers
- Today underpins revolutionary mobile devices and ever-growing range of applications

Brief History of 802.11 (Wi-Fi)





802.11 Market Grows and Evolves



Demand driven by:

Population growth
% of users
New applications
Devices per User

Source ABI

Mariah Carey Demands 802.11n

Mariah Carey Demands 802.11n
February , 2008
In Mariah Carey's latest video titled "Touch My Body"
CompuNerd shows up at Carey's house to fix her "all-in-one."

Carey tells CompuNerd: "The download speed was killing me. Please tell me you updated to 802 dot 11 N."

Check out the full video here.

http://www.mtv.com/videos/mariah-carey/212381/touch-my-body.jhtml

Wi-Fi in Taxis

Mobile phone company NTT Docomo recently installed free Wi-Fi in about 820 taxis in Tokyo.

モバイル Wi-Fi ルーターがあれば、FOMA エリアならタクシーでの移動中さえもWi-Fiエリアに。Wi-Fiのベンリさを、皆さんに体験して欲しくて、「Wi-Fiタクシー」はできました。あなたなら、「Wi-Fiタクシー」を、どんな風に使いますか?

Wi-Fiタクシーって?

ドコモの
モバイルWi-Fiルーターを
搭載したタクシーのこと。

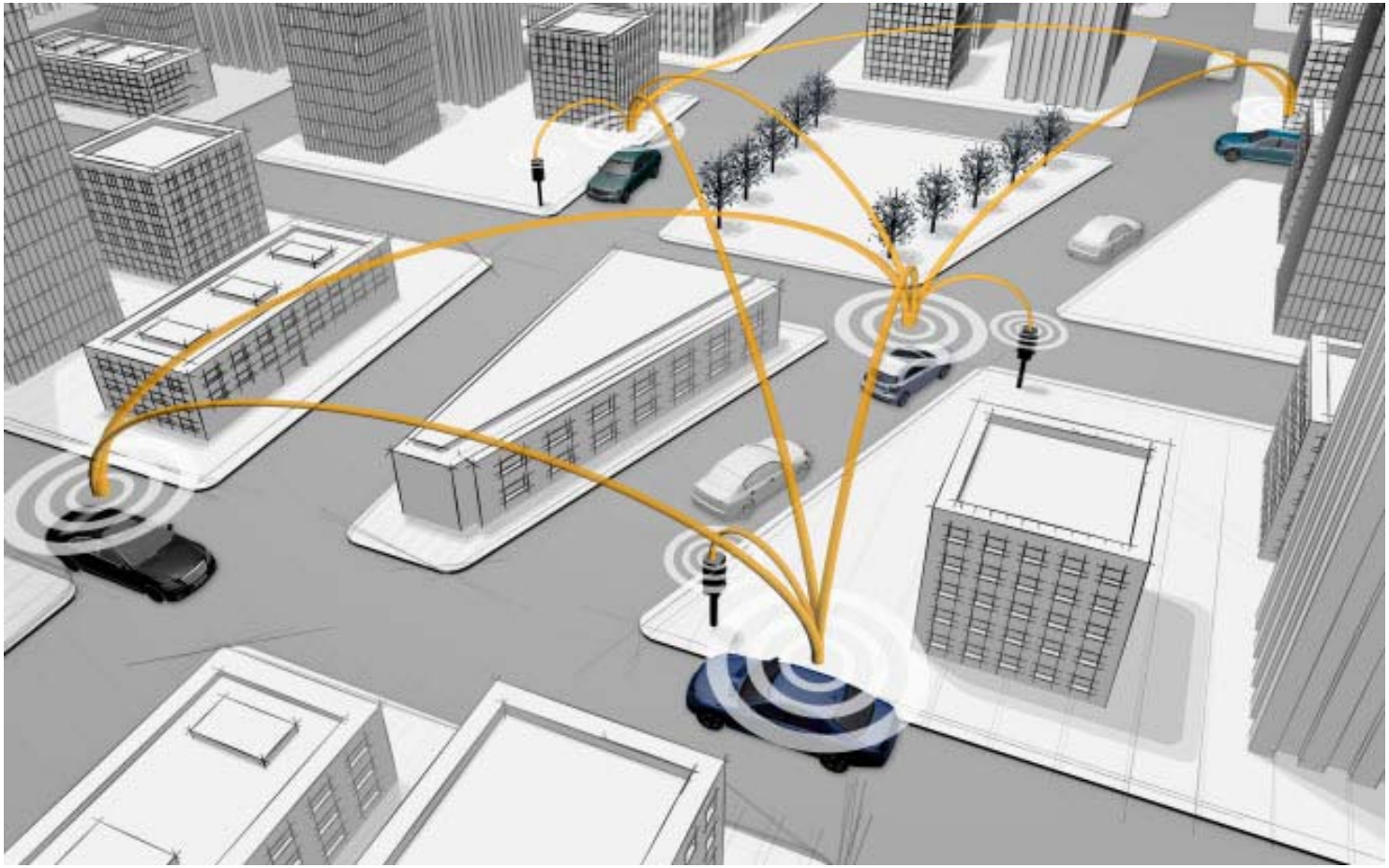
タクシーでの移動中も、無料でインターネットに接続できます。2011年3月31日まで、東京都内で、約820台のタクシーが走っています。そのうち100台には PSP® go が設置されています。

Wi-Fi in Buses

- **Broadband Internet Access Service to be Introduced to All Keikyu Limousine (Airport**

Car to Car

Traffic control



Airplane Wi-Fi

AA®

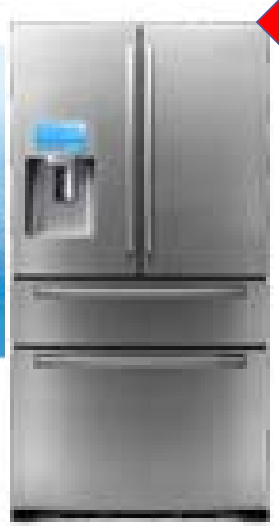
Virgin atlantic

Alaska Airlines®

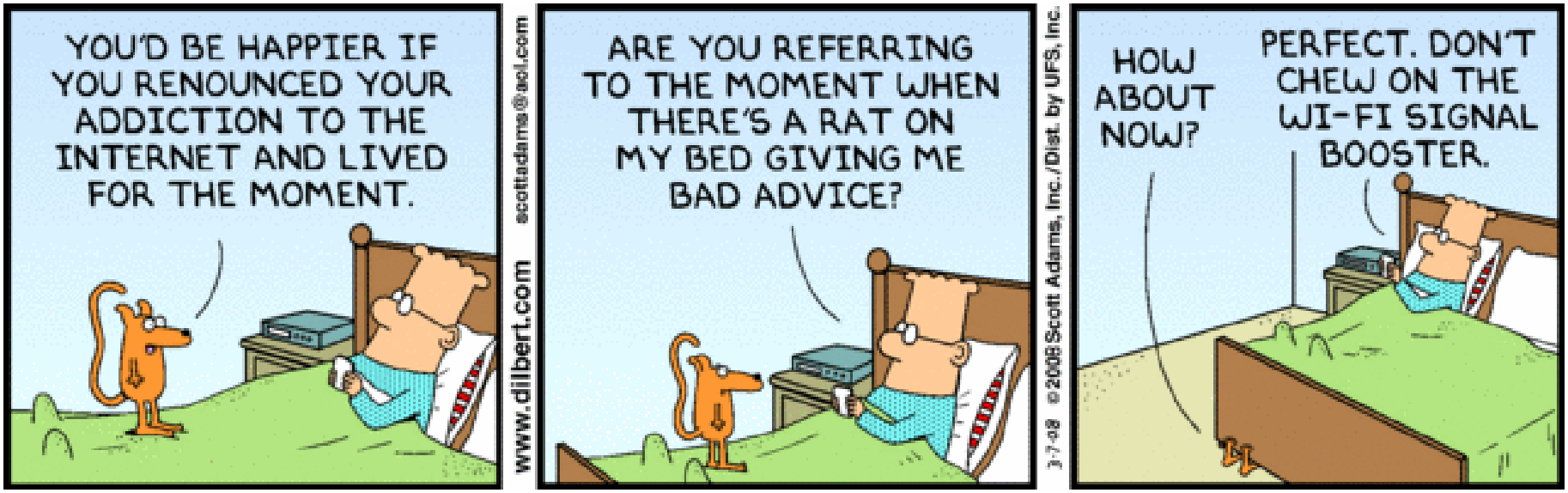
DELTA

UNITED

Wireless Product Diversity



Internet Addiction



Example, New Kindle HDX

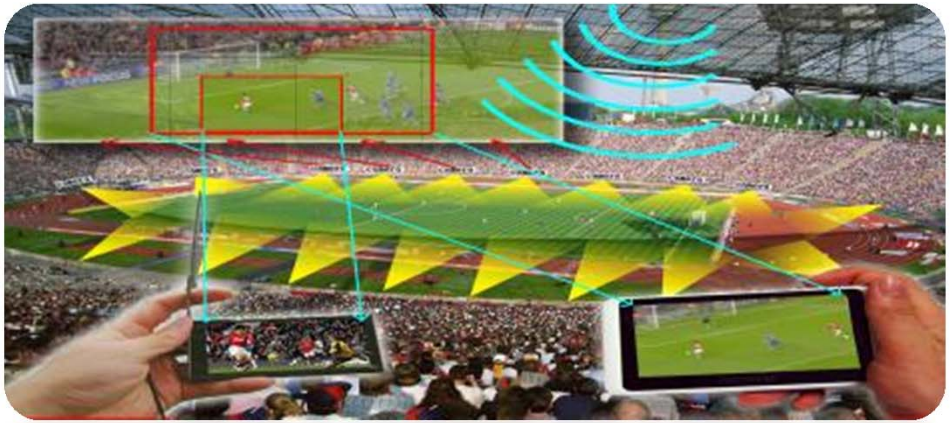
Select: 16 GB
32 GB
64 GB

Select: With Special Offers
Without Special Offers

Select: Wi-Fi Only
Wi-Fi + 4G LTE AT&T
Wi-Fi + 4G LTE Verizon

Future?

High Efficiency WLAN (HEW) Newest Initiative



Point-of-Sight in Stadium

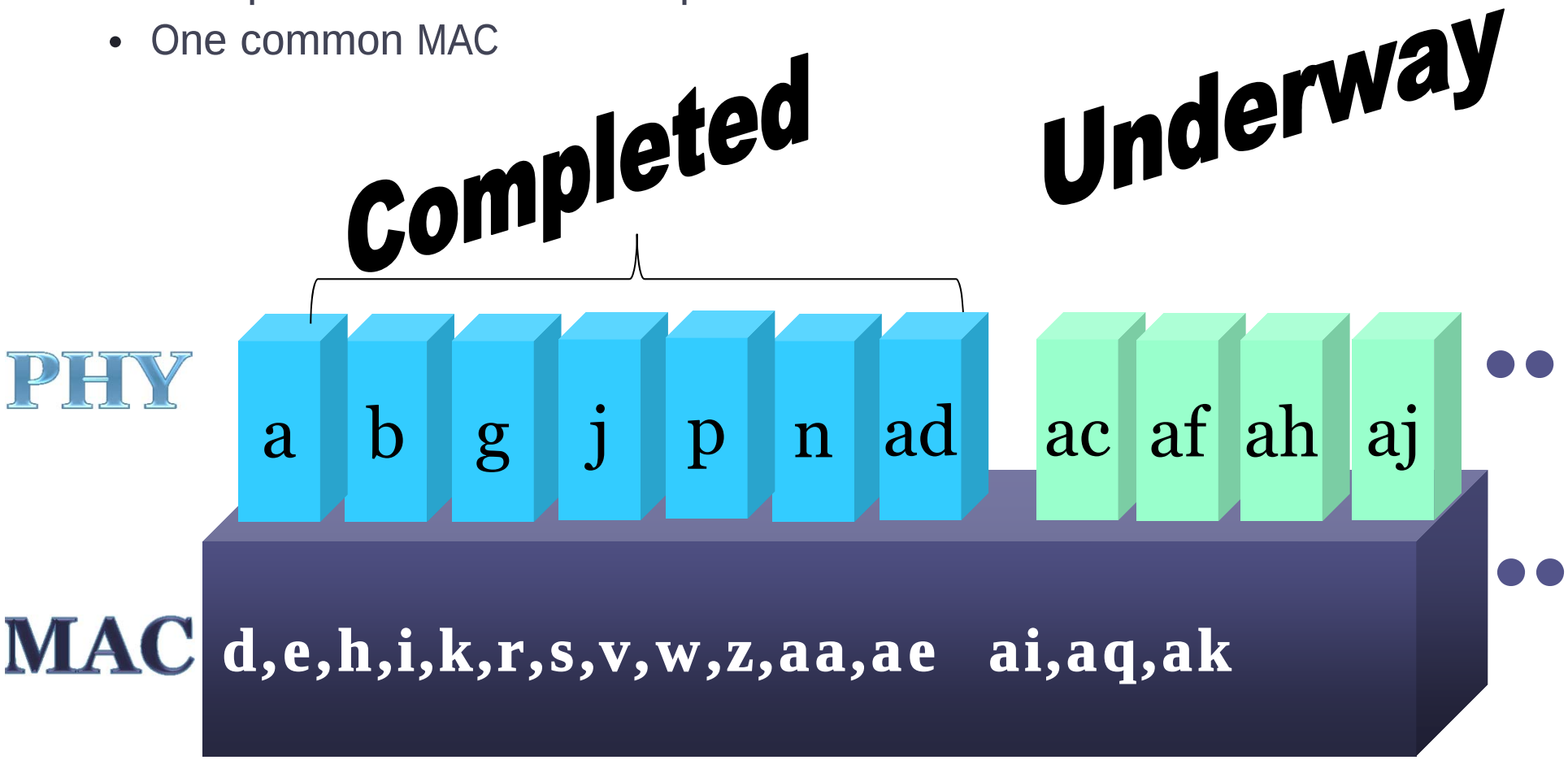
Location Services

Enhanced Video

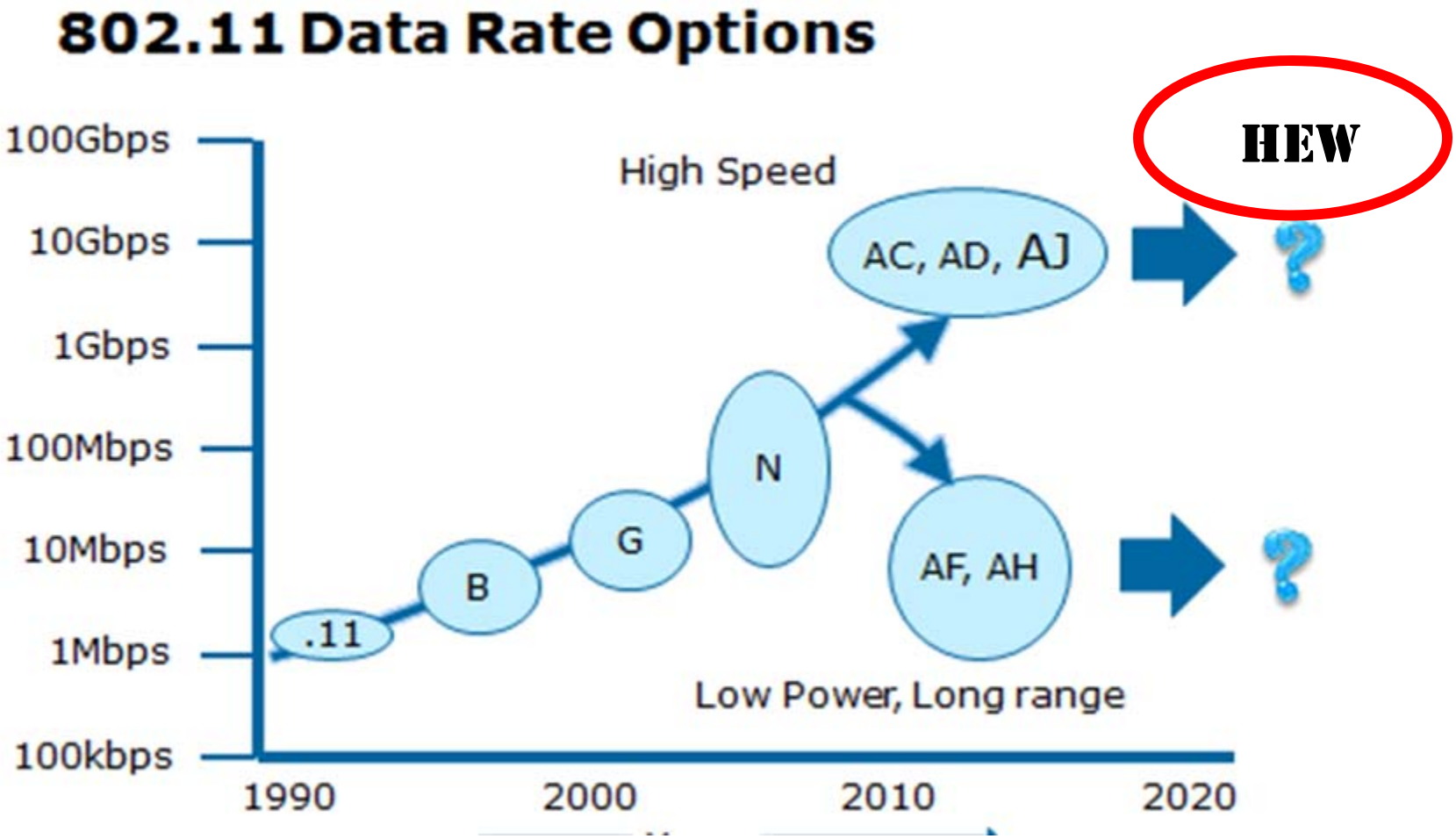
Consumer Wearable

802.11 Architecture & Amendments

- Multiple Over the Air PHY options
- One common MAC



Standards & Opportunities evolution



What about High Rate physics?

Problem: Shannon-Hartley Capacity Theorem

C=Capacity (bits/second)

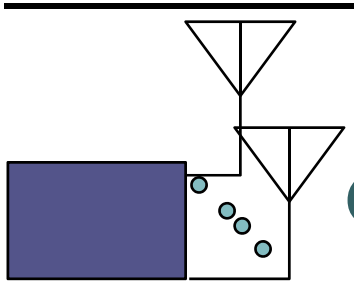
B=Bandwidth (Hz)

S= Received Signal Power

N= Noise Power

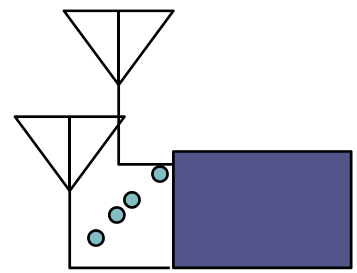
$$C = B \bullet \log_2 \left[1 + \frac{S}{N} \right]$$

Solution: Use a Multiplier



Multiple signal Transmissions

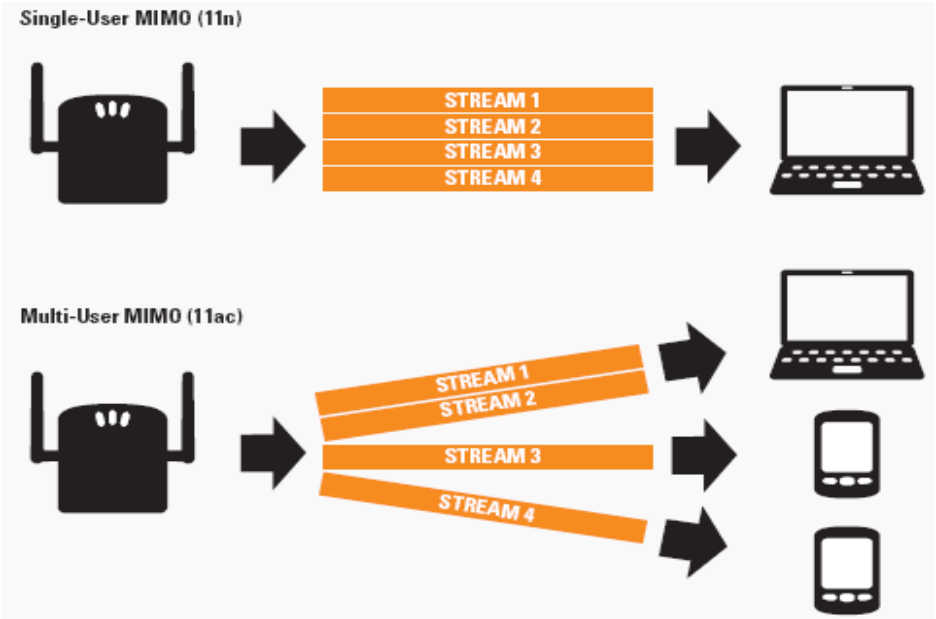
$$Cap = M \bullet B \bullet \log_2 \left(1 + \frac{N}{M} \bullet SINR\right)$$



M transmitters

N receivers

What about antennas?



http://www.motorolasolutions.com/web/Business/_Documents/White%20Paper/_Static%20files/80211ac_White_Paper_0712-web.pdf

EARLY PROTOTYPES

Success Factors

Range

Data rate

Joules/bit

Cost

Die Size

Market Acceptance

Market Acceptance

User experience

Available Spectrum

REGULATORY ACCEPTANCE

Good Engineering

Good Genes

Stable Standard

Innovation

Continuous evolution

Product Family

BACKWARD COMPATIBILITY

Good Luck

We're not Alone

Long Range Cellular

- 3GPP, 3GPP2 GSM, LTE

Medium Range WLAN

- 802.11 Wi-Fi

Short Range WPAN

- IEEE 802.15.4 Zigbee
- Bluetooth

THE END

OR

THE END OF THE BEGINNING ?

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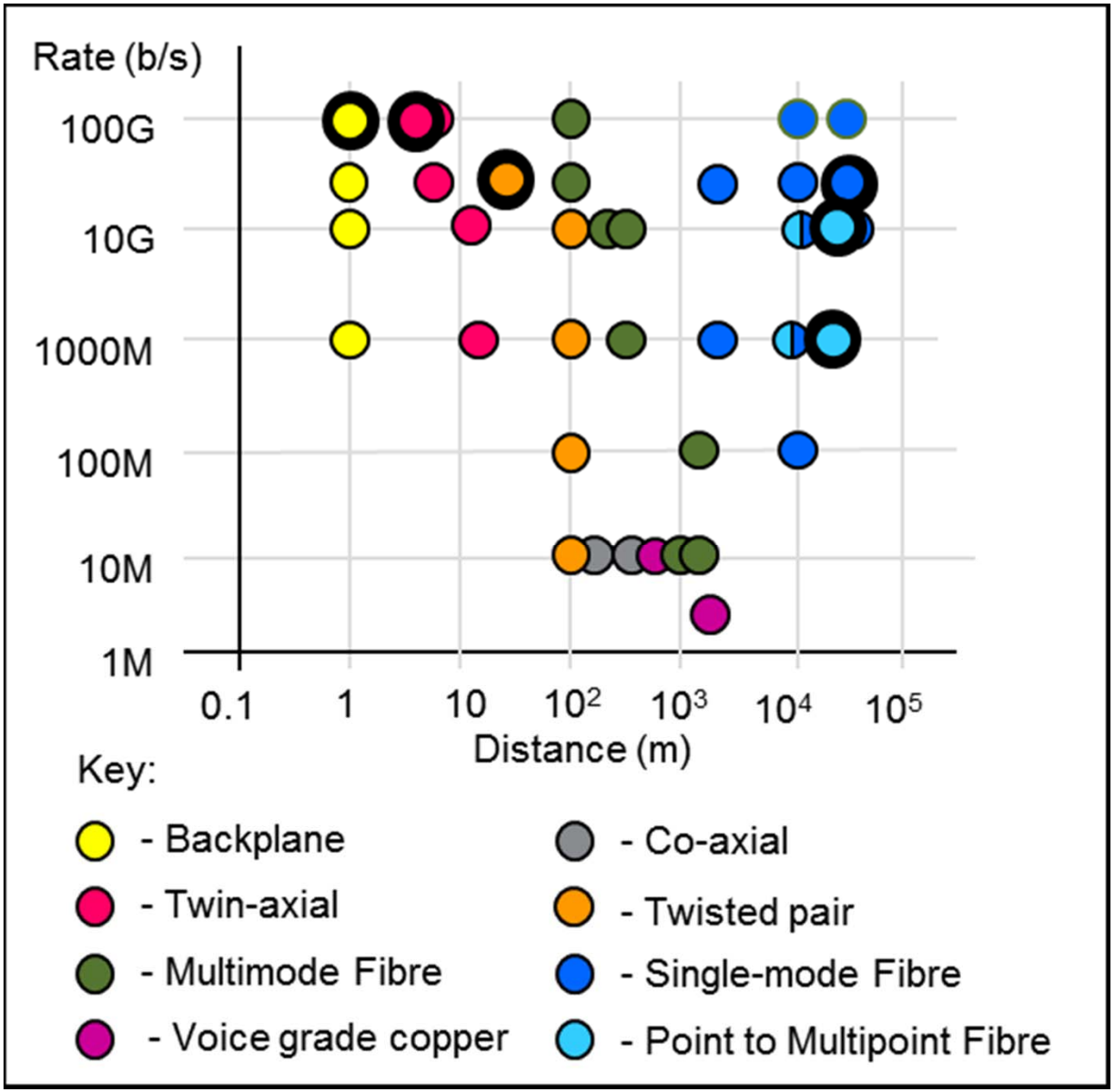
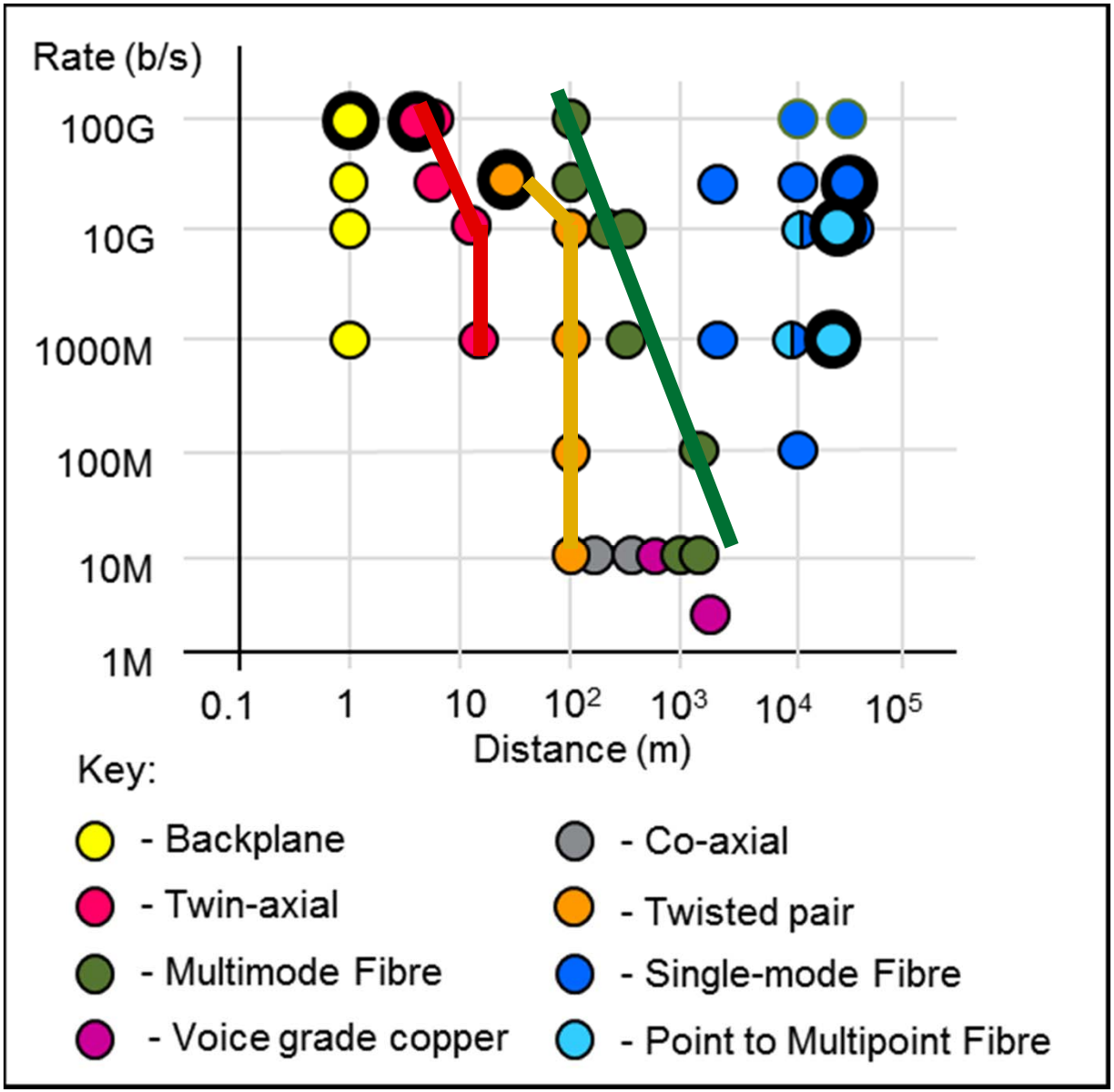
IEEE 802.3 Family

David Law, HP


Rate (b/s)
100G
10G
1000M
100M
10M
1M
0.1
1
10
10²
10³
10⁴
10⁵
Distance (m)
Key:
- Backplane
- Co-axial
- Twin-axial
- Twisted pair
- Multimode Fibre
- Single-mode Fibre
- Voice grade copper
- Point to Multipoint Fibre


Rate (b/s)
100G
10G
1000M
100M
10M
1M
0.1
1
10
10²
10³
10⁴
10⁵
Distance (m)
Key:
- Backplane
- Co-axial
- Twin-axial
- Twisted pair
- Multimode Fibre
- Single-mode Fibre
- Voice grade copper
- Point to Multipoint Fibre

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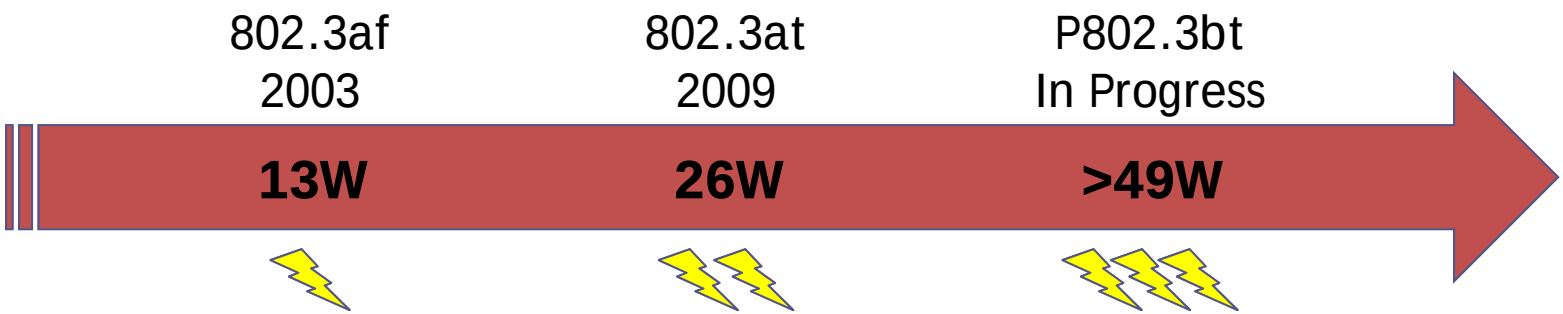
Power over Ethernet

Dave Dwelley, Linear Technology

Wireless Needs Copper

- Radio, Fiber, Coax, whatever – they all need power
- If there's twisted pair leading to the box, PoE can power it – *no new wires.*



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IEEE 802.1 Bridging

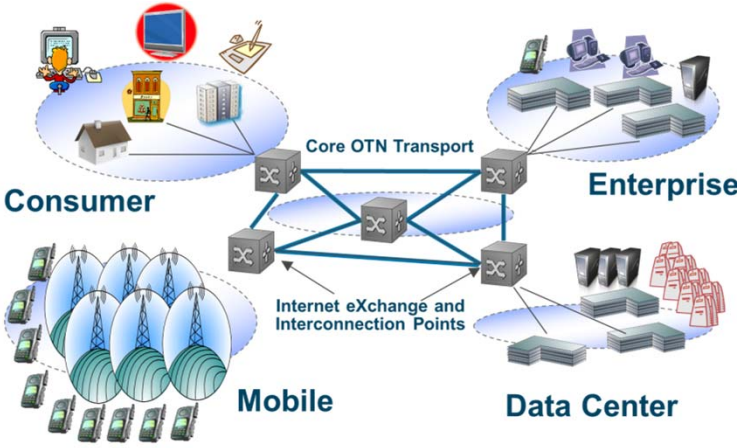
Pat Thaler, Broadcom

Enabling Wired/Wireless Synergy

- Bridging combines wired and wireless links into one network
  - Traditionally a core of wired links with wireless access points on the edge
  - IEEE 802.1 and IEEE 802.11 are colloborating on standards to allow wireless interconnects between bridges
    - IEEE P802.1Qbz and 802.11ak

Enhancing the Ecosystem

- Provider Bridging enables the core:
  - Providing tenant separation and scalability with Provider Backbone Bridging.
  - Connectivity Fault Management provides the OAM features providers need to manage the network
- Multi-pathing to cope with increasing traffic
  - Equal Cost Multi-Path
  - Path Control and Reservation
- Time Sensitive Networking
  - Delivering latency sensitive traffic streams for real time audio/video and sense/control



Thank You!