

# The Journey to “Higher Speed”

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# Some Bandwidth Trends

## Users

- Internet Users: 3B > 4.1B \*
- Networked Devices: 16.3B > 26.3B \*
- Wi-Fi Hot Spots: 48M > 340 M \*\*

## Access Rates

- Avg Fixed Broadband: 24.7M > 47.7M \*
- Next Gen Wi-Fi: 802.11ac
- 2.5GbE / 5GbE BASE-T
- 5G

## Applications

- IP Video – 82% of all traffic by 2020 \*
- Build it and they will come....

\* - Cisco VNI (2015 – 2020), <http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html#~completeforecast>

\*\* - Grand View Research (2015 – 2022) - <http://www.grandviewresearch.com/industry-analysis/wi-fi-hotspot-market>.

# Scaling to Meet Bandwidth Demand

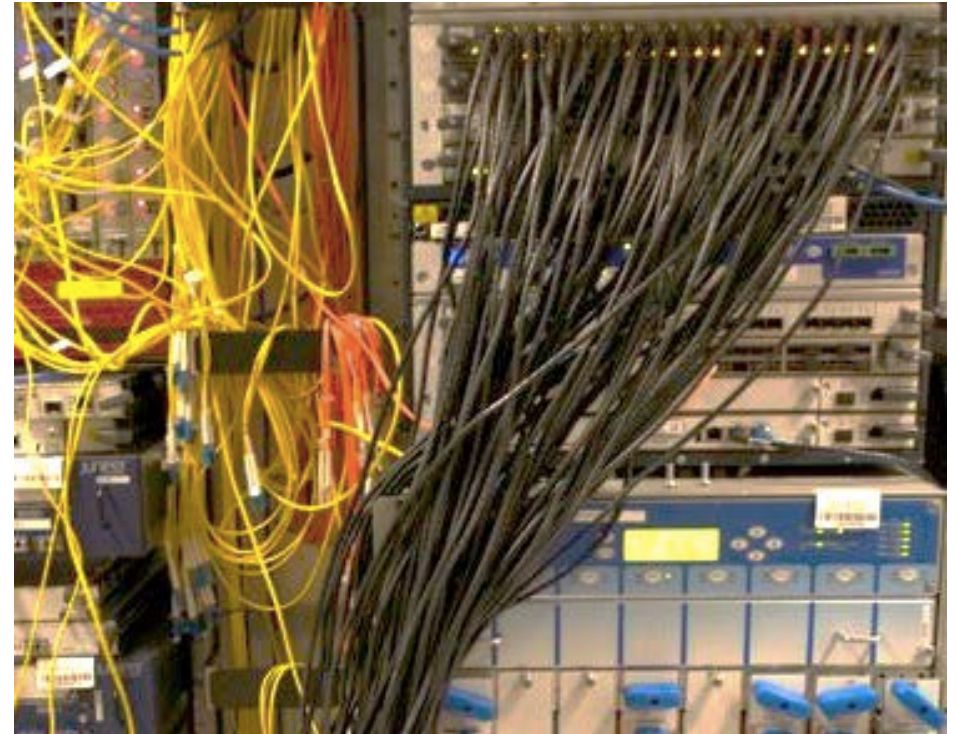
## Creating a “Fatter” Pipe

- Option #1 – Link Aggregation
  - Non-deterministic performance
  - Fastest flow limited to individual link speed
- Option #2 – Flex Ethernet
  - “LAG done right!”

## Challenges

- Number of links
- Operational & management issues
- Doesn't scale forever.

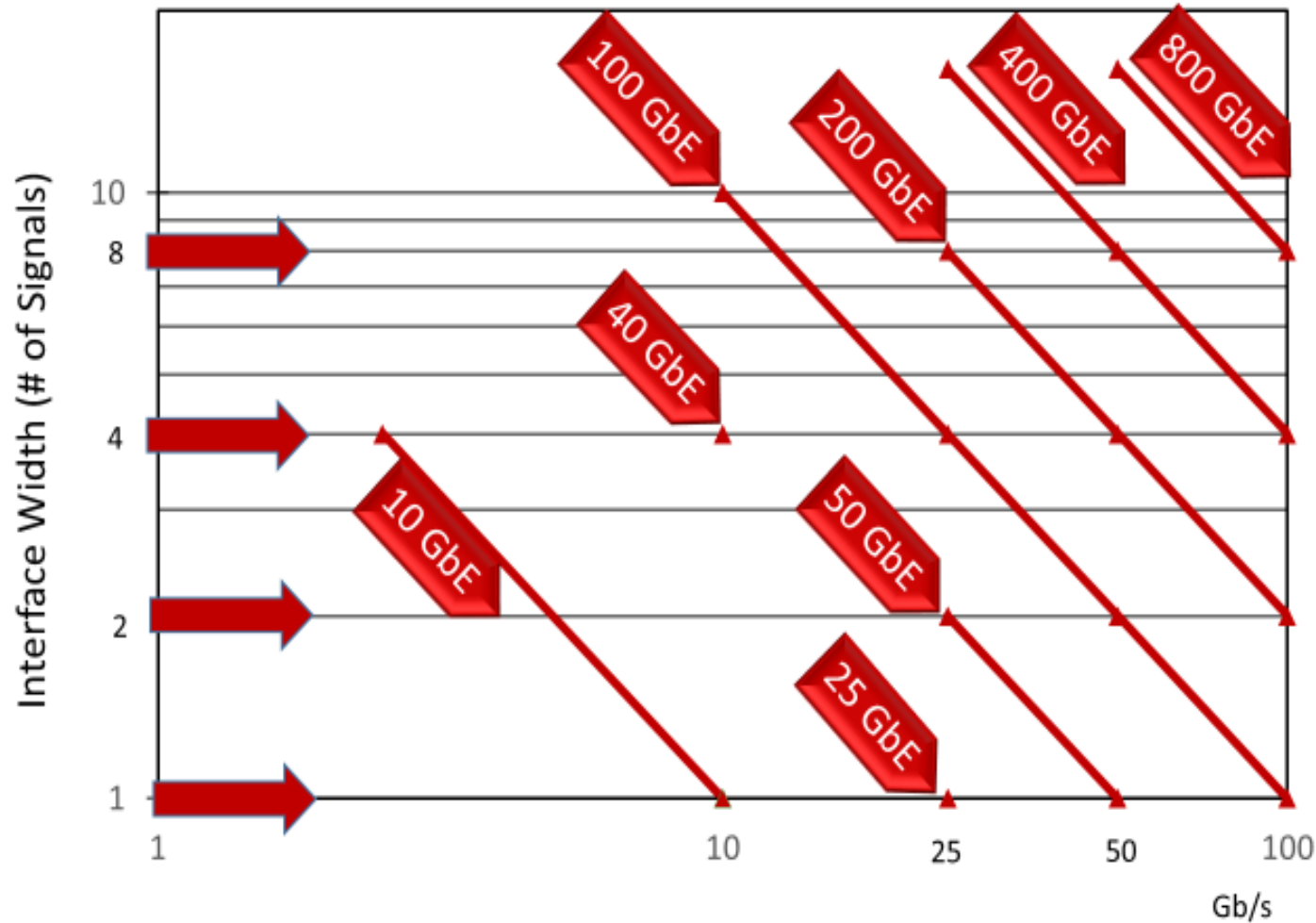
**Need for a faster solution  
is inevitable**



Courtesy, David Ofelt, Juniper.

**Physical Mockup: “80xN” LAG using 80 links (Used 25% of all front panel ports for single “LAG”)**

# Higher Speed Families



- Key: Lane signaling
- Families created
  - By lane rate
  - By lane width
  - By media
  - By reach
  - By form factor

**Universal Ports**

# Market Idea #1 - Breakout

- Common industry form factors, backwards compatible solutions from 50Gb/s to 10 Gb/s
  - SFP (x1)
  - QSFP (x4)
- Breakout by physical media enables higher density, lower cost for x1 (or x2) solutions
- 32 ports of QSFP represents 128 x1 ports
- Deployment in today's data centers

**Upgrade path  
based on family**



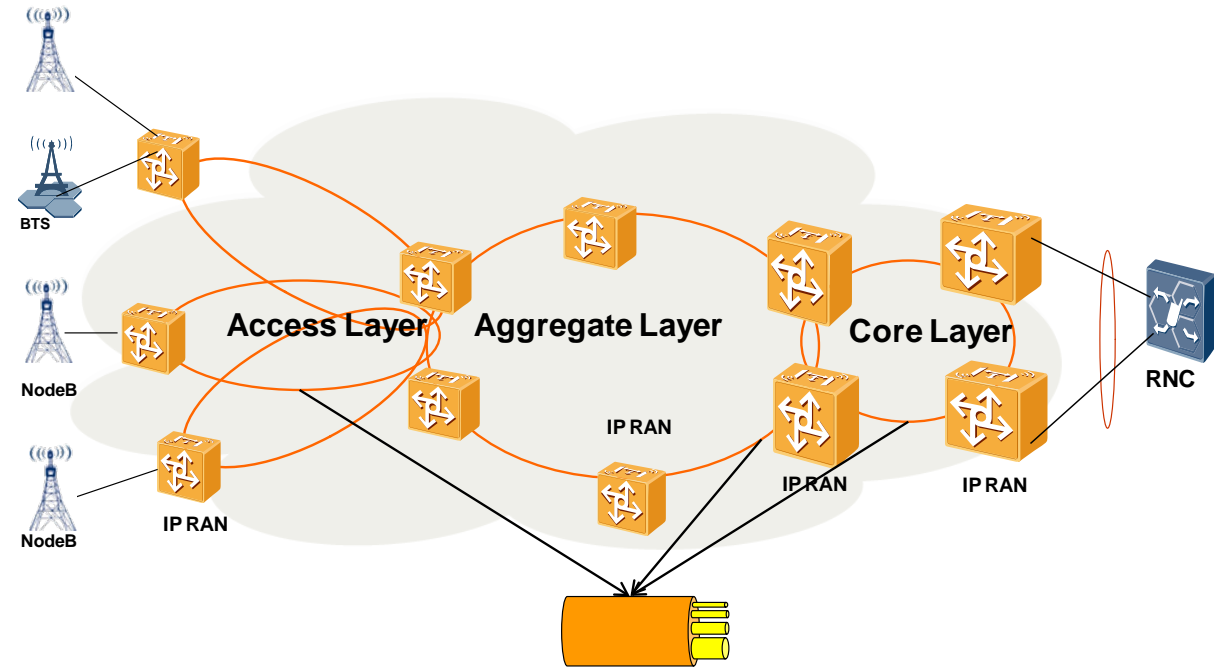
Source: Nathan Tracy, TE Connectivity

- Various configurations based on x1, x2, and x4

# Market Idea #2 – Channelization

- Channelization – create a link within a PHY or a group of bonded PHYs
- Consider its use in large networks
  - On-demand bandwidth configurability
  - Dedicated individual channels for guaranteed deterministic performance, QoS, and security
  - Low Latency Networks
  - Leverage SDN

**Just getting started ...**



IP/Ethernet based Mobile Backhaul

Some carriers exploring / expected to implement strict traffic isolation via FlexE in their networks based on bandwidth requirement from their customers

# Looking to the Future

- “Higher Speed” is relative
- Faster solutions will be necessary to keep pace with demand
- The market will leverage the solutions provided
- New applications emerging
- New applications will demand higher speeds and / or longer reaches

