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PACKAGING AS KEY TO SYSTEM EVOLUTION

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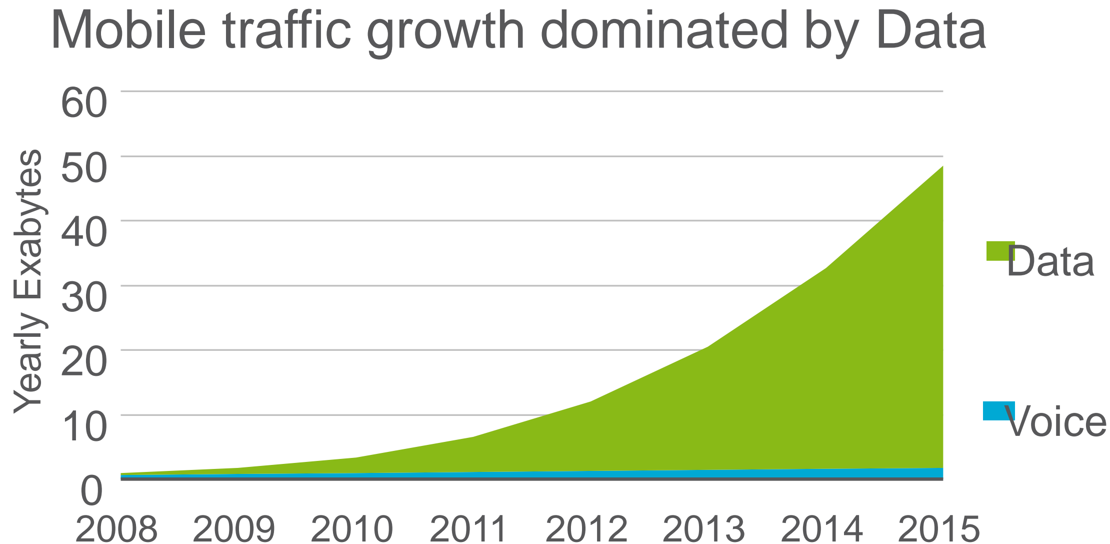
CHALLENGES

› We ship systems designed for
  - Radio (Base stations)
  - IP routing
  - Microwave backhaul
  - Optical backhaul and Transport

› What are we most pressed for ?
  - Power consumption + Thermal
  - Cost
  - Capacity and scalability
  - Footprint + BW densification
  - Cloudification



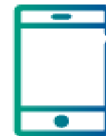
THE NETWORKED SOCIETY- Y2018 FORECAST

60% annual video & traffic growth

12X greater mobile data traffic

9.1 billion mobile subscriptions

7 billion mobile broadband subscriptions
1.7 billion in 2013



4.5 billion smartphone subscriptions
1.2 billion in 2012

WCDMA/HSPA to cover 85% of world's population
55% in 2012

850 million subs. for PCs, mobile routers, and tablets
300 million in 2012

11 GB/month mobile PC traffic
2.5 GB/month in 2012

LTE to cover 60% of the world's population
10% in 2012

50 BILLION CONNECTED DEVICES EXPECTED BY 2020

WHAT IT MEANS…

- Densification of cell coverage with LTE pushes footprint, power consumption to their limit
  - ARPU is quite flat! Still, we need to evolve systems and keep prices flat.
  - Energy costs are higher: In some cases, the entire CAPEX of a router is paid in electricity in 15 months!
  - Cooling in building practices is also at an inflexion point; liquid cooling isn't practical in many cases
- Copper is now at inflexion point: moving to 25G involves costs and power (e.g. Megtron-6 laminate, CDRs, etc…)
  - Copper also limits rethinking of system architectures
  - Going electrical outside of package is expensive: densify!
- We can't fit enough MSA's (e.g. SFPs) on faceplate to follow processing needs!

PACKAGING AS A SOLUTION?

- Yes! : Combining functions, potentially coming from various vendors, can be done through packaging
  - Chip scale packages
  - Multi-Chip Modules
  - SoC

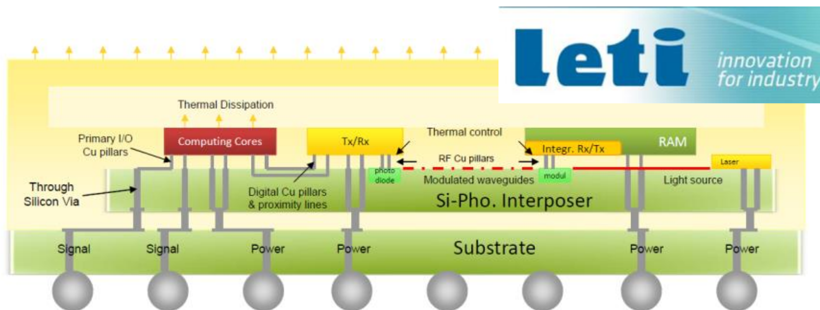
- I/O is an issue; power, density etc… can be solved through silicon photonics
  - This is a natural evolution, along ecosystem ways of working, if packaging is used to e.g. exploit silicon photonics to solve I/O

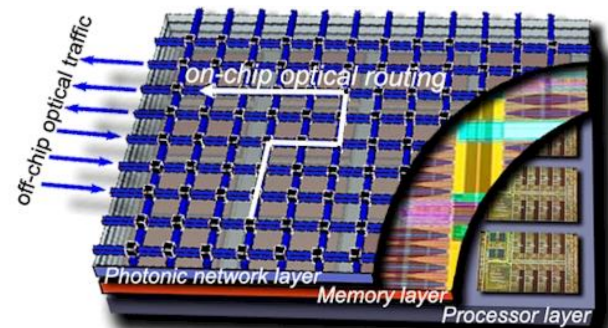
- Still: Thermal is an issue in all scenarios

USE CASE: OPTICAL I/O

- Silicon photonics is a prime candidate
  - But we don’t want to lock ourselves to 130nm, 90nm or 65nm!
  - We want to enable dual source for sourcing of I/O’s: can’t assume all foundries will support photonics.

- The solution lies in packaging
  - Commoditizes silicon photonics as I/O blocks
  - Dual source easier to setup (in most cases)
  - Fully benefits from electrical 2.5D and 3D ecosystem: silicon photonics blends right in as an E-O function





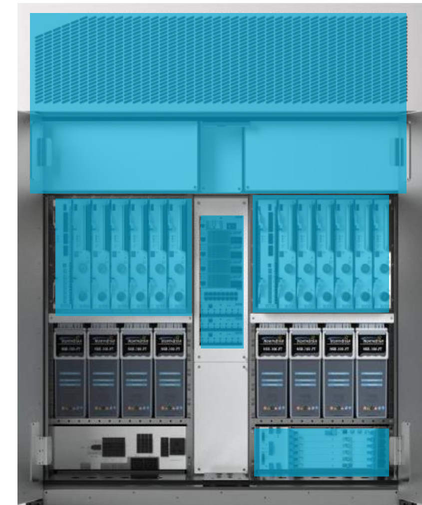
SOME IMPACTED SYSTEMS

Routers

Microwave backhaul

Radio Base Stations

- Radio Units GSM/WCDMA/LTE
- Transmission Module
- Site Power
- Cooling



TAKE AWAYS

- Industry will need to keep high speed signal inside package as long as possible to cope with
  - Cost, power and density
  - Processing complexity
- Packaging ecosystem will have to align
  - For photonics interfaces E.g.: An “optical equivalent of BGA”; something providing a standard physical interface
  - Capabilities to design interposers (Si, organic) in house
- Thermal is critical: telco has many systems without “active” cooling.
  - What’s good for a server isn’t viable for a top-of-mast radio system!

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