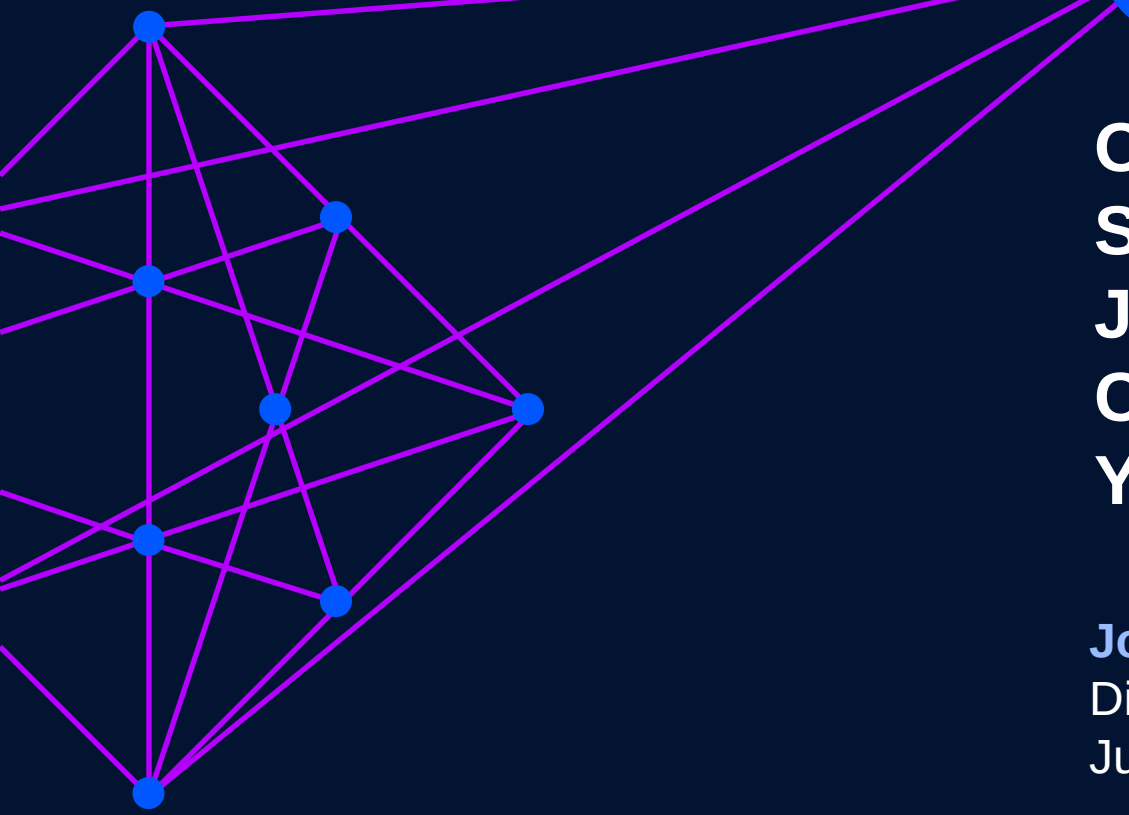


ECI THE ELASTIC NETWORK

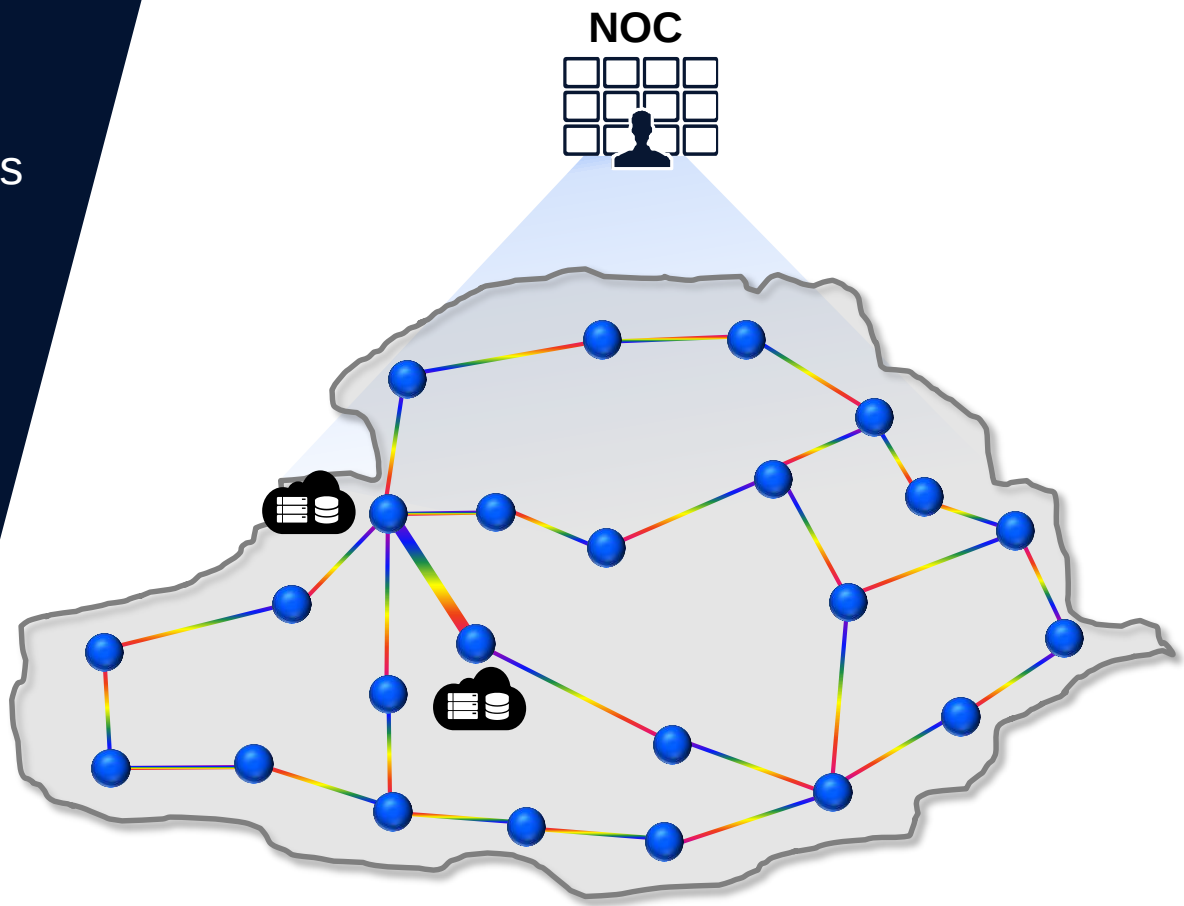
OPEN OPTICAL SYSTEMS: JUST BECAUSE YOU CAN, DOES IT MEAN YOU SHOULD?

Jonathan Homa
Director Portfolio Marketing
June 2018

MISSION

Deploy an NREN/REN optical backbone network that supports innovative ICT applications for researchers, educators, and their institutions.

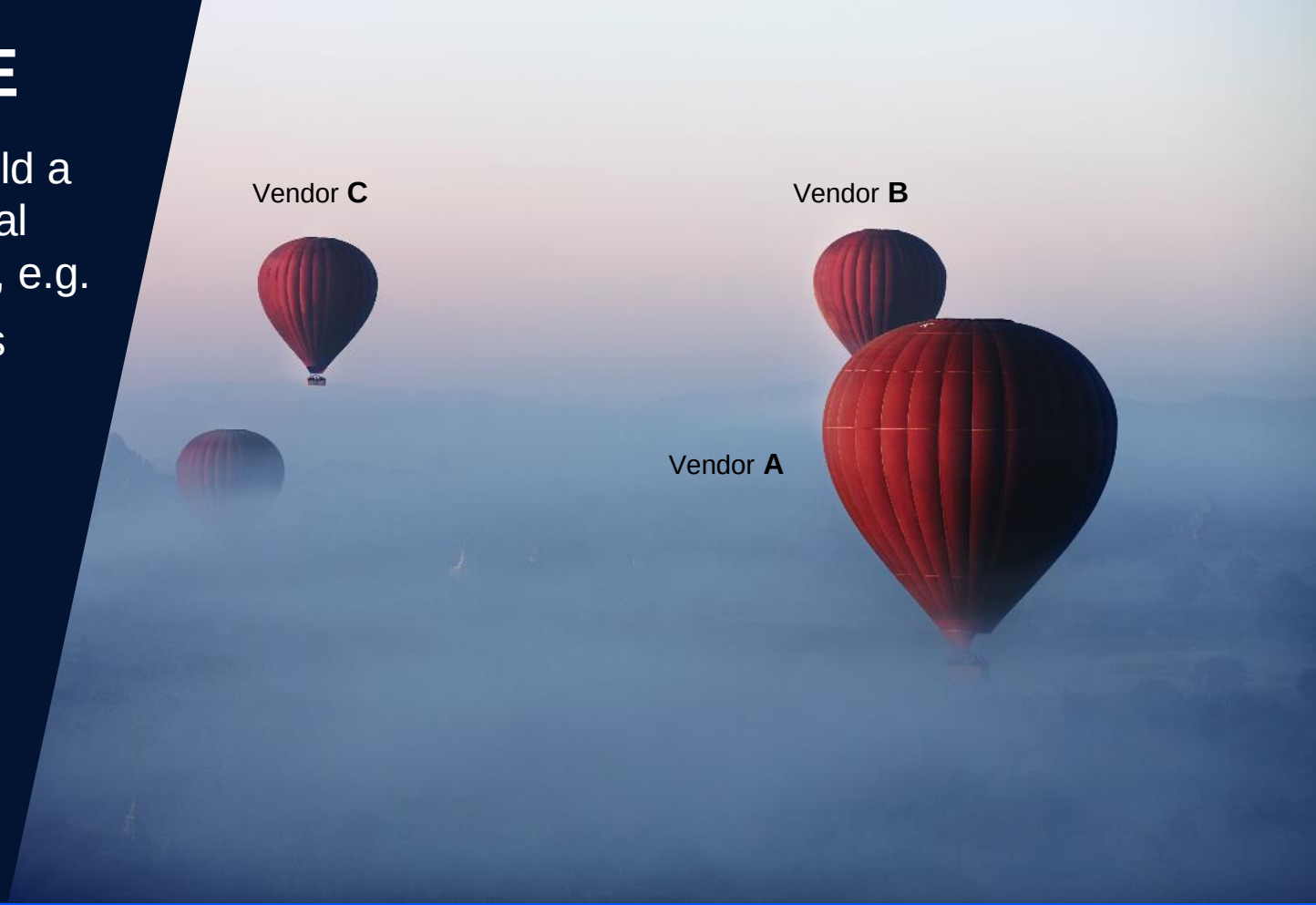
- Dozens of nodes
- Hundreds of links
- Needs
  - *Performance*
  - *Flexibility*
  - *Control*
  - *Availability*
  - *Budget*



CHALLENGE

To what extent should a disaggregated optical solution be pursued, e.g.

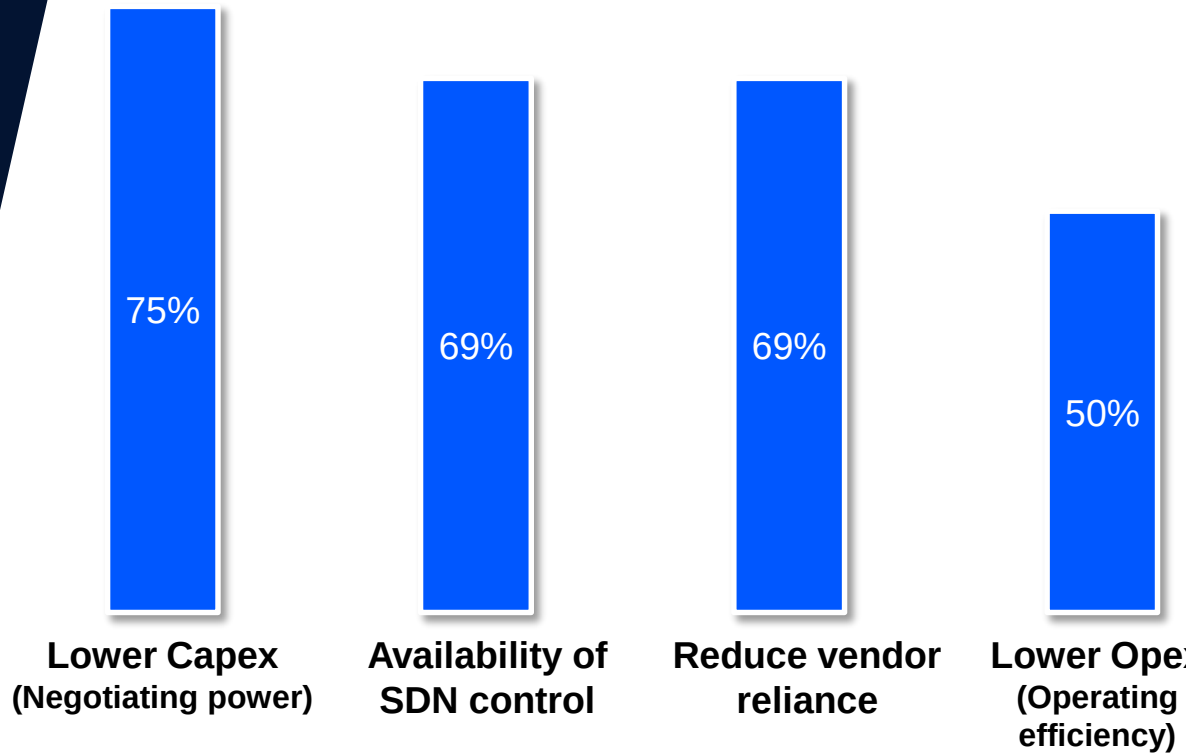
- Open line systems
- DCI pizza boxes
- White boxes



MOTIVATION

Boils down to:

- Avoid vendor lock-in
- Flexibility and control



Source: IHS Markit service provider survey, 2017

MAIN PIECES OF THE PUZZLE

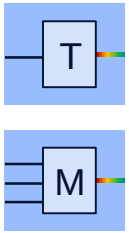
Support

OSS/BSS, Orchestration

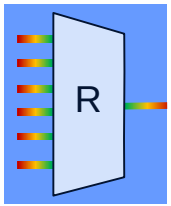
- Services (e.g. BWoD)
- Multilayer operations

Network Control
(EMS/NMS -> SDN)

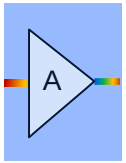
- Resource management
- Service provisioning
- Monitoring, restoration, assurance, alarms/fault handling



Transponders and Muxponders



ROADMs
(and passive mux/demux)

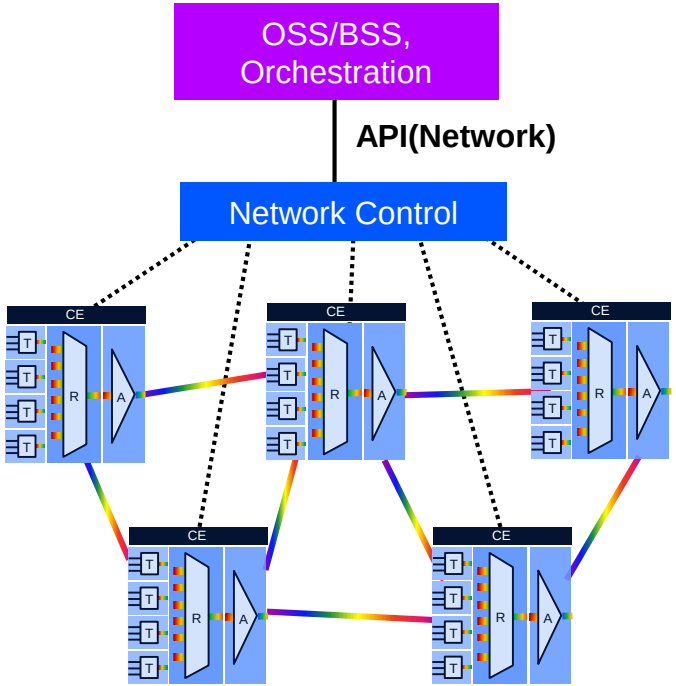


Amplifiers

NO DISAGGREGATION – OPEN NETWORK

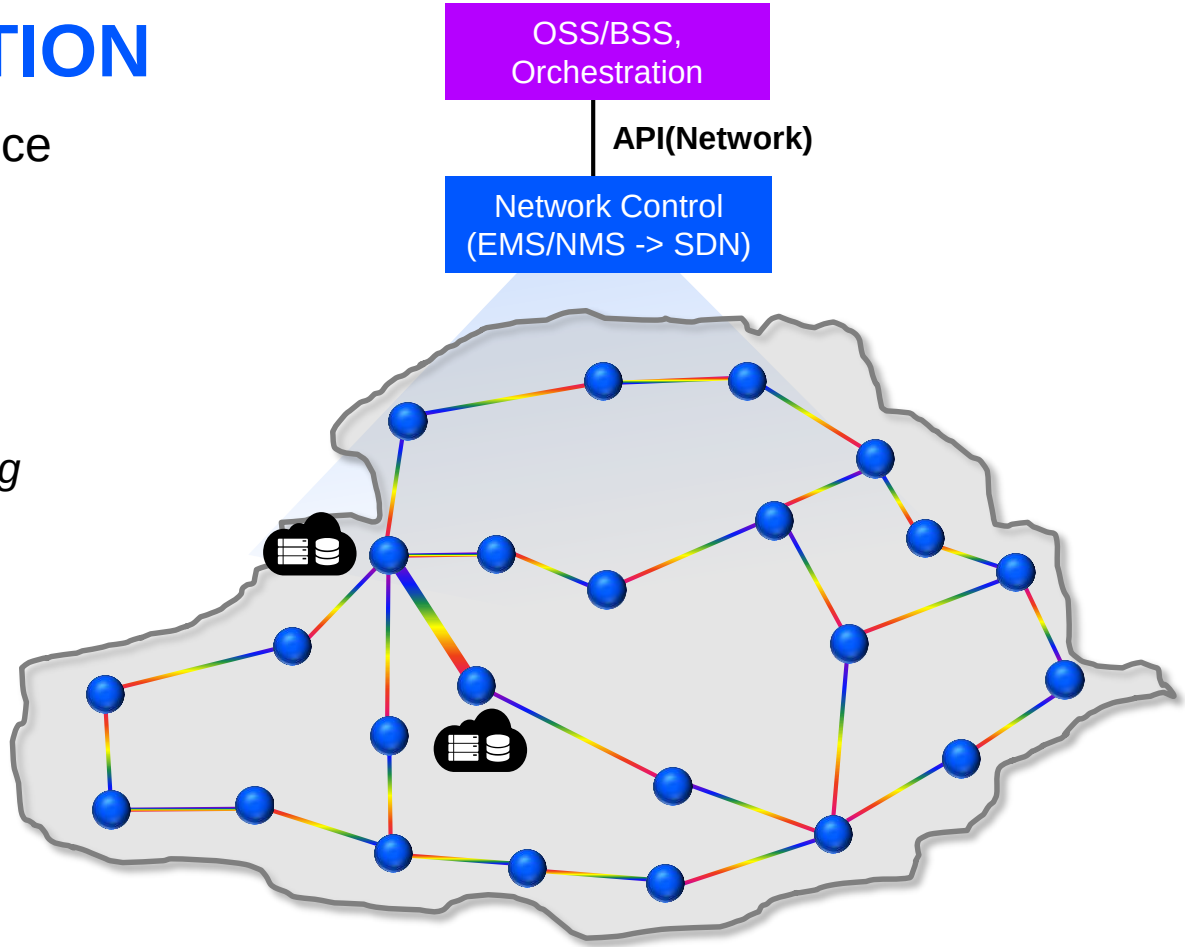
Support

- Single vendor supplies entire network including network control and ongoing support
- Presents Network APIs to higher level OSS/BSS or orchestrators
- Predominant REN situation today



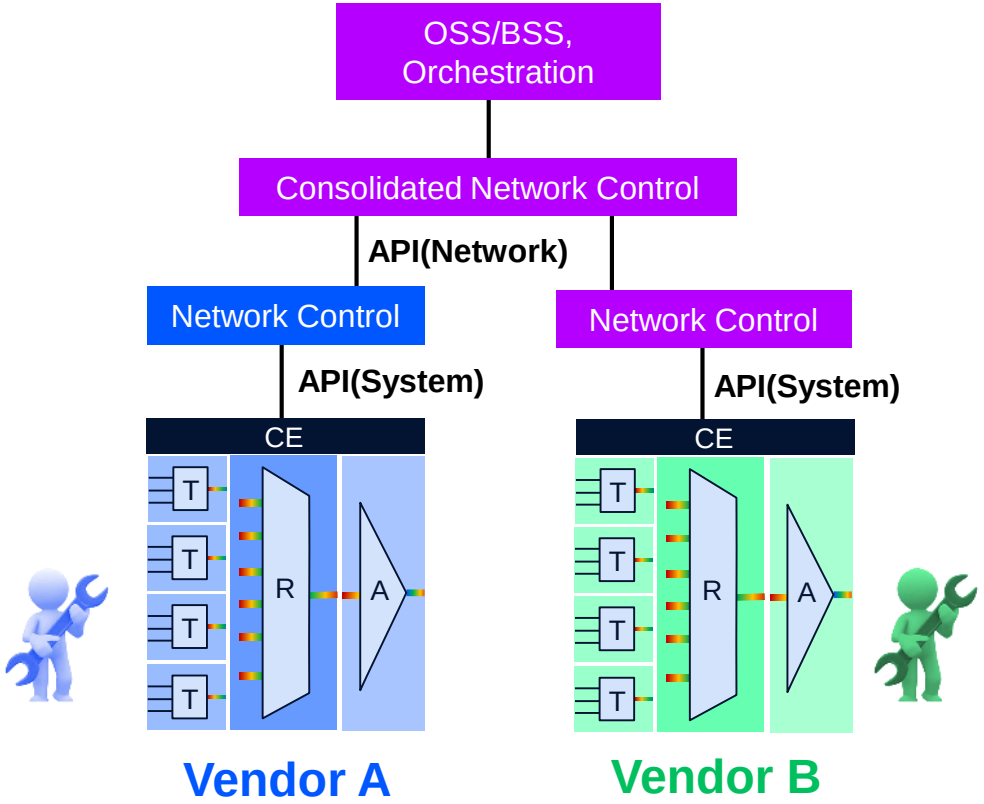
NO DISAGGREGATION

- Optimized system performance
  - *Amplifier auto-balancing*
  - *ROADM equalization*
  - *Proprietary FEC*
- Optimized maintenance
  - *Integrated OSNR monitoring*
  - *Integrated OTDR*
- Optimized restoration
  - ASON
  - WSON
- Better network intelligence and proprietary features



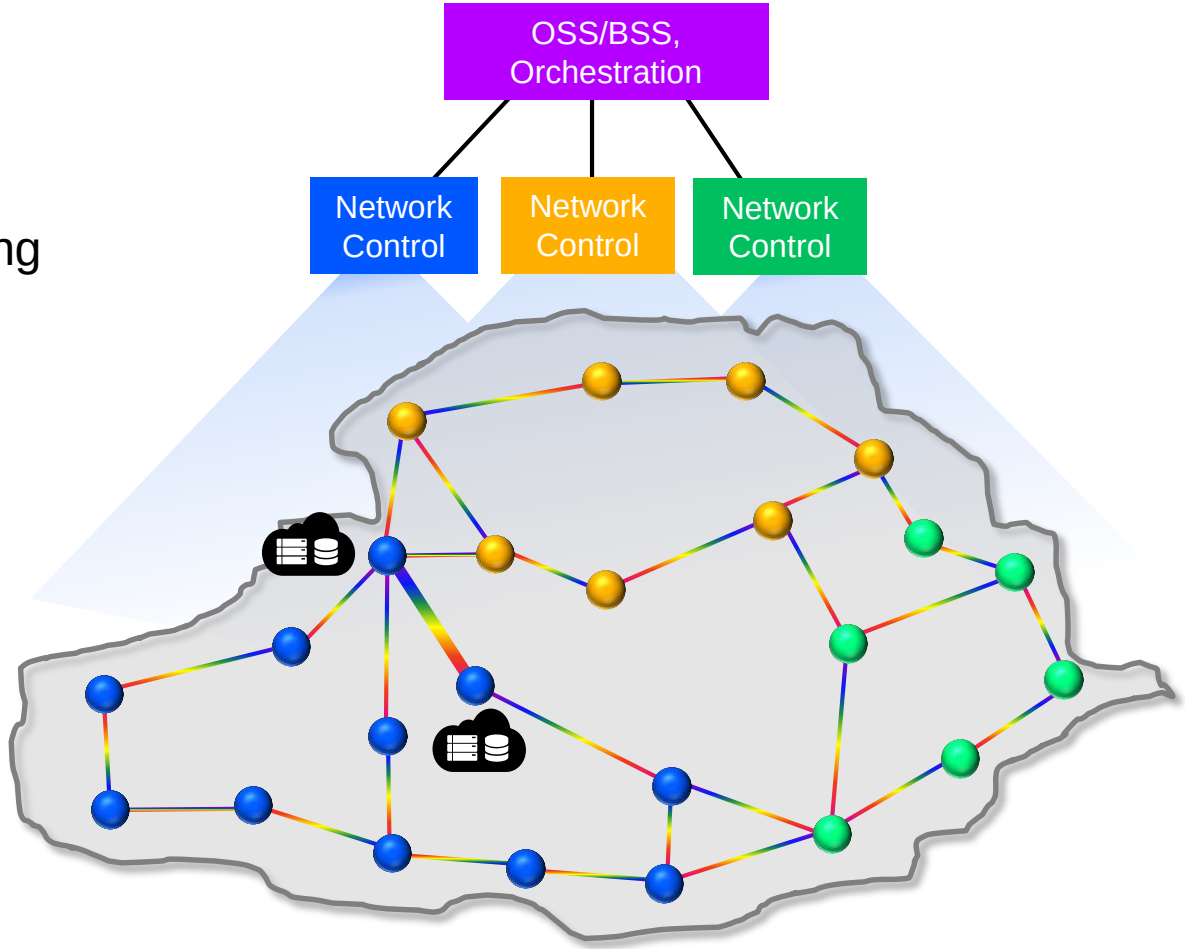
NE DISAGGREGATION – OPEN SYSTEMS

- Several vendors supply integrated network equipment (NEs)
- NEs presents System APIs (e.g. based on various Yang models) to network controllers
- Can have different divisions of responsibility between REN and vendors for implementing network control



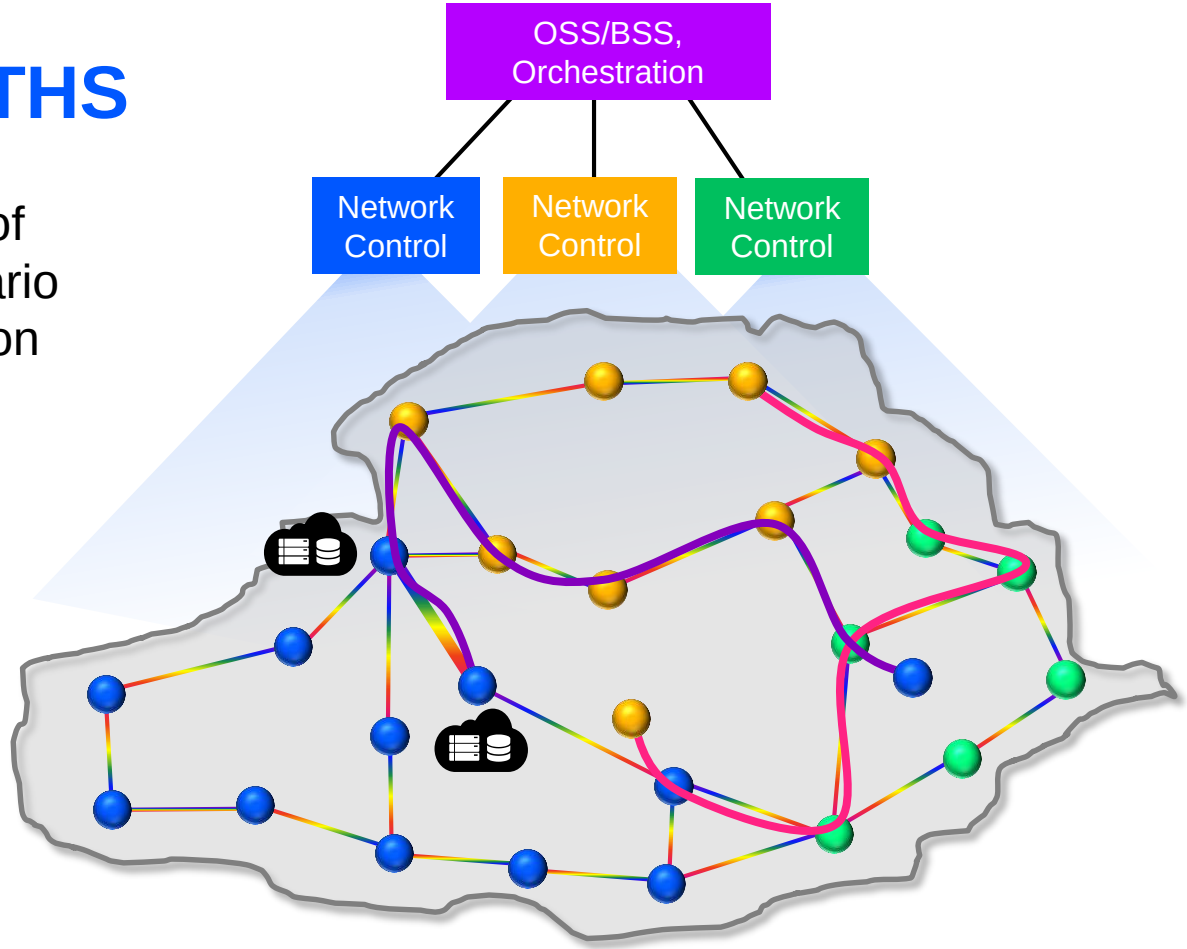
SYSTEM (NE) DISAGGREGATION

- Likely deployment is assigning vendors with sub-network domains in which they can optimize
- Requires consolidating multiple levels of network control



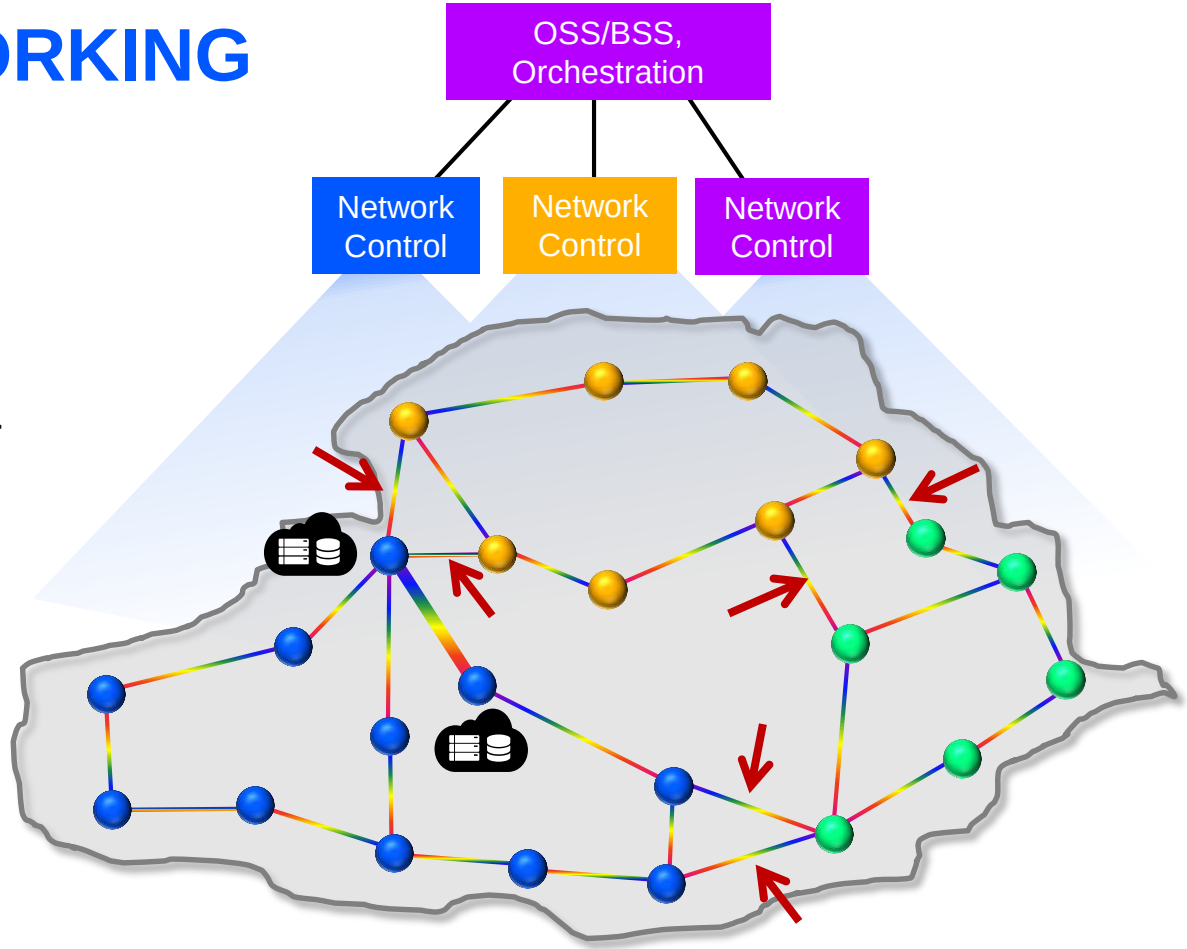
ALIEN WAVELENGTHS

Will likely see increased used of alien wavelengths in this scenario which is a type of disaggregation



OPTICAL INTERWORKING ISSUE

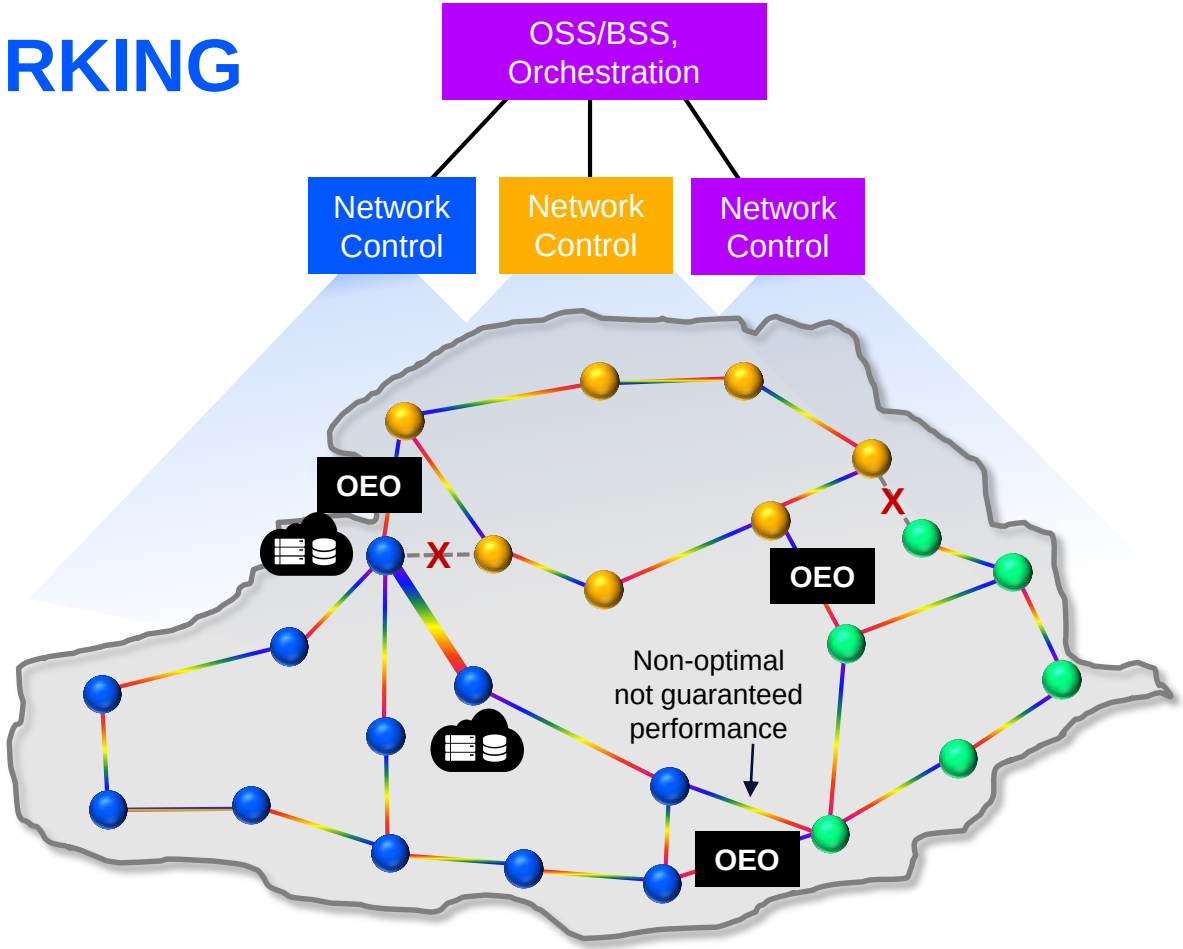
- Who guarantees and troubleshoots
- Lowest common denominator FEC and performance



OPTICAL INTERWORKING ISSUE (CONT'D)

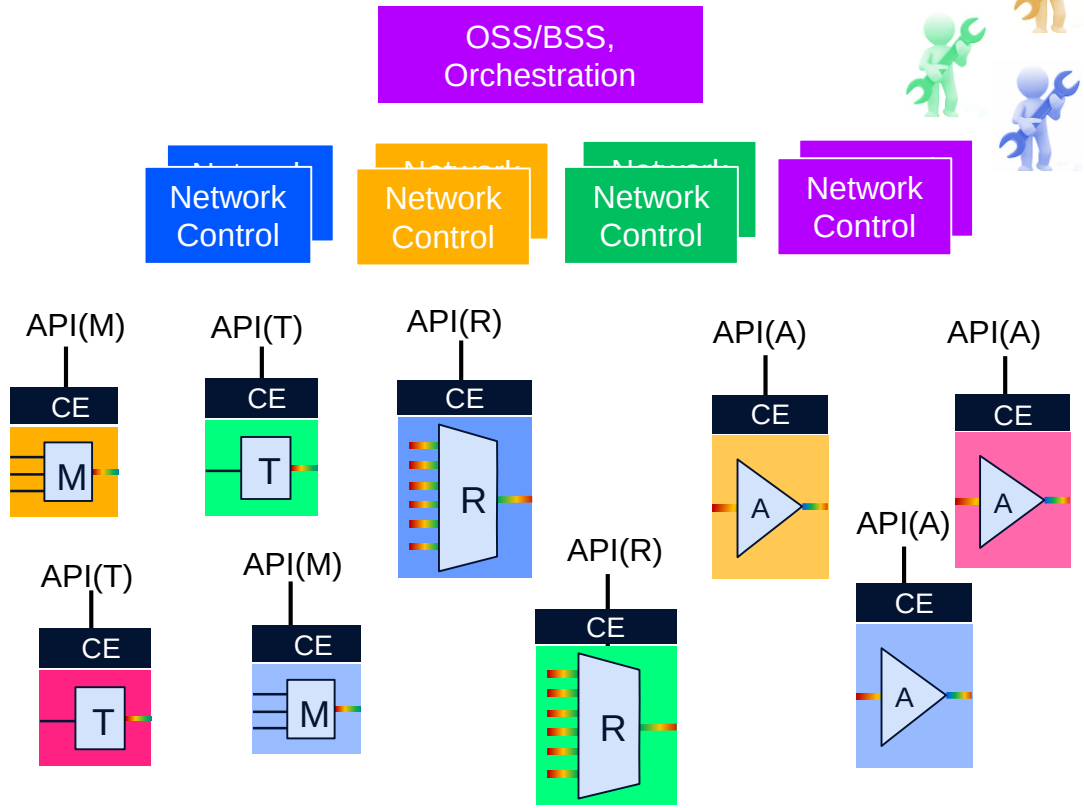
Interworking between vendor domains will devolve to sub-optimal non-guaranteed links, or will require:

- Some re-architecting (e.g. eliminating links)
- Introduction of OEO such as OTN switching



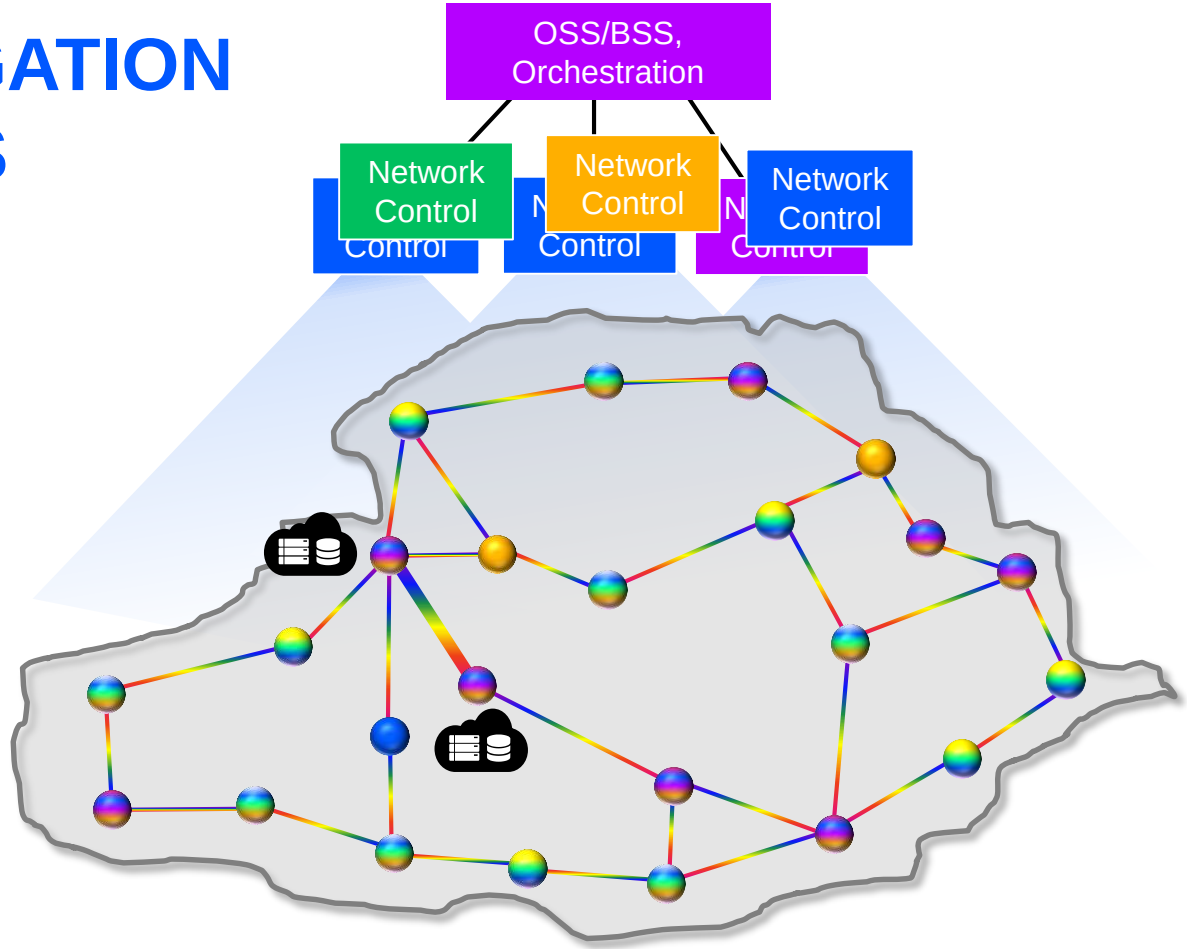
FULL DISAGGREGATION – OPEN MODULES

- Multiple vendors supply disaggregated modules
- Modules present module-specific APIs to different levels of network controllers (e.g. OpenROADM MSAs)
- Many ways to “re-aggregate” functionality
- Still need to maintain transponder or muxponder “pairs” for anything but basic performance



FULL DISAGGREGATION – OPEN MODULES

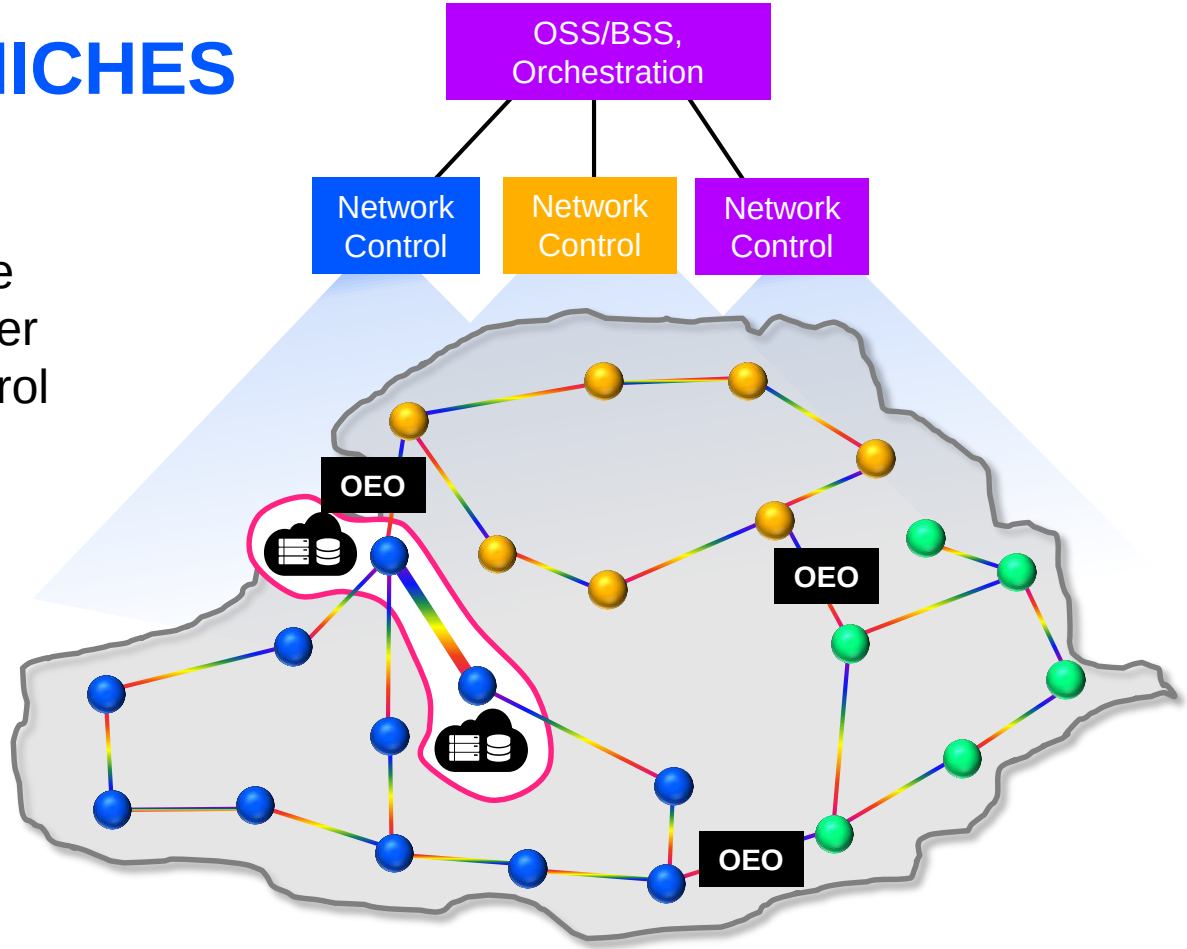
- AT&T experience
  - *Forced three vendors together*
  - *Limited deployment*
  - *Significant AT&T SW dev and system integration*
- Too complex for RENs to implement on a network wide basis (for foreseeable future)



OPEN MODULES NICHES

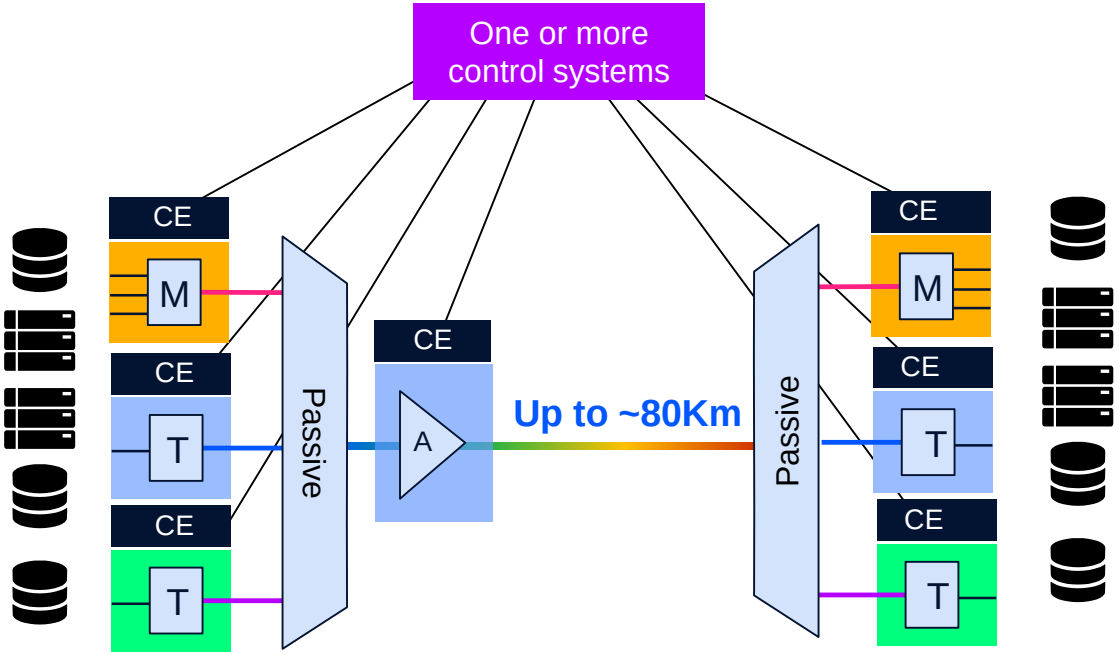
Open modules can make sense for niche applications that deliver significant performance or control benefits, with low system integration obstacles.

- Point-to-point data center interconnection
- ROADM hubs



OPEN MODULES DATA CENTER INTERCONNECT

- High performance very low latency links for real-time data replication
- Many channels can make cost a key factor
- No ROADMs or mid-span amplifiers simplifies transmission engineering
- With open modules can continuously rotate vendors optimize cost-performance

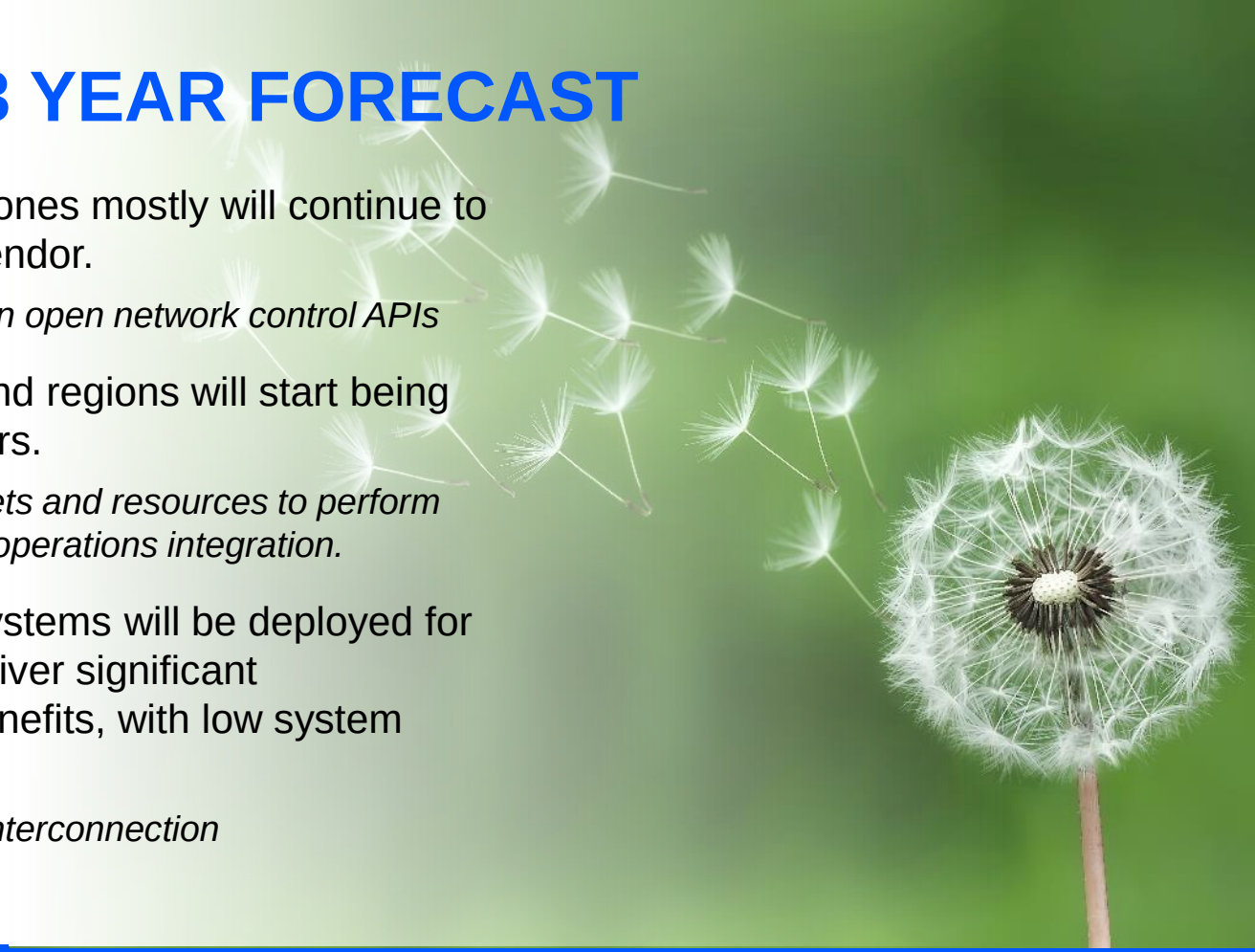


PROS AND CONS SUMMARY

	Single Network Vendor	Several NE Vendors	Multiple Module Vendors for Niche Applications
Vendor Independence	Low	Medium	High
Initial Cost	Good – based on competitive bidding and single vendor economies of scale.	Better in theory – more competition, but economies of scale diminished.	Unclear – modules have common equipment overhead, and no economies of scale.
Benefits of Vendor Innovation	High for network-wide and some specific functions	Similar to single vendor, but for smaller domain	High for specific functionality
NREN/REN System Integration effort	None	Moderate	Moderate (more complex but on smaller scale)
Other	Can run alien wavelengths over other vendor network, which achieves some goals of disaggregation.		

CONCLUSION: 3 YEAR FORECAST

1. NREN/REN optical backbones mostly will continue to be provided by a single vendor.
   - *With increased emphasis on open network control APIs*
2. Some geographically bound regions will start being awarded to second vendors.
   - *By NREN/RENs with skillsets and resources to perform the necessary system and operations integration.*
3. Fully disaggregated subsystems will be deployed for niche applications that deliver significant performance or control benefits, with low system integration obstacles.
   - *Point-to-point data center interconnection*
   - *ROADM hubs*



THE ELASTIC NETWORK

THANK YOU!

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