Society of Cable Telecommunications Engineers
30TH ANNIVERSARY
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OPTIMIZING MULTI-LAYER NETWORKS WITH TRANSPORT SDN

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Agenda

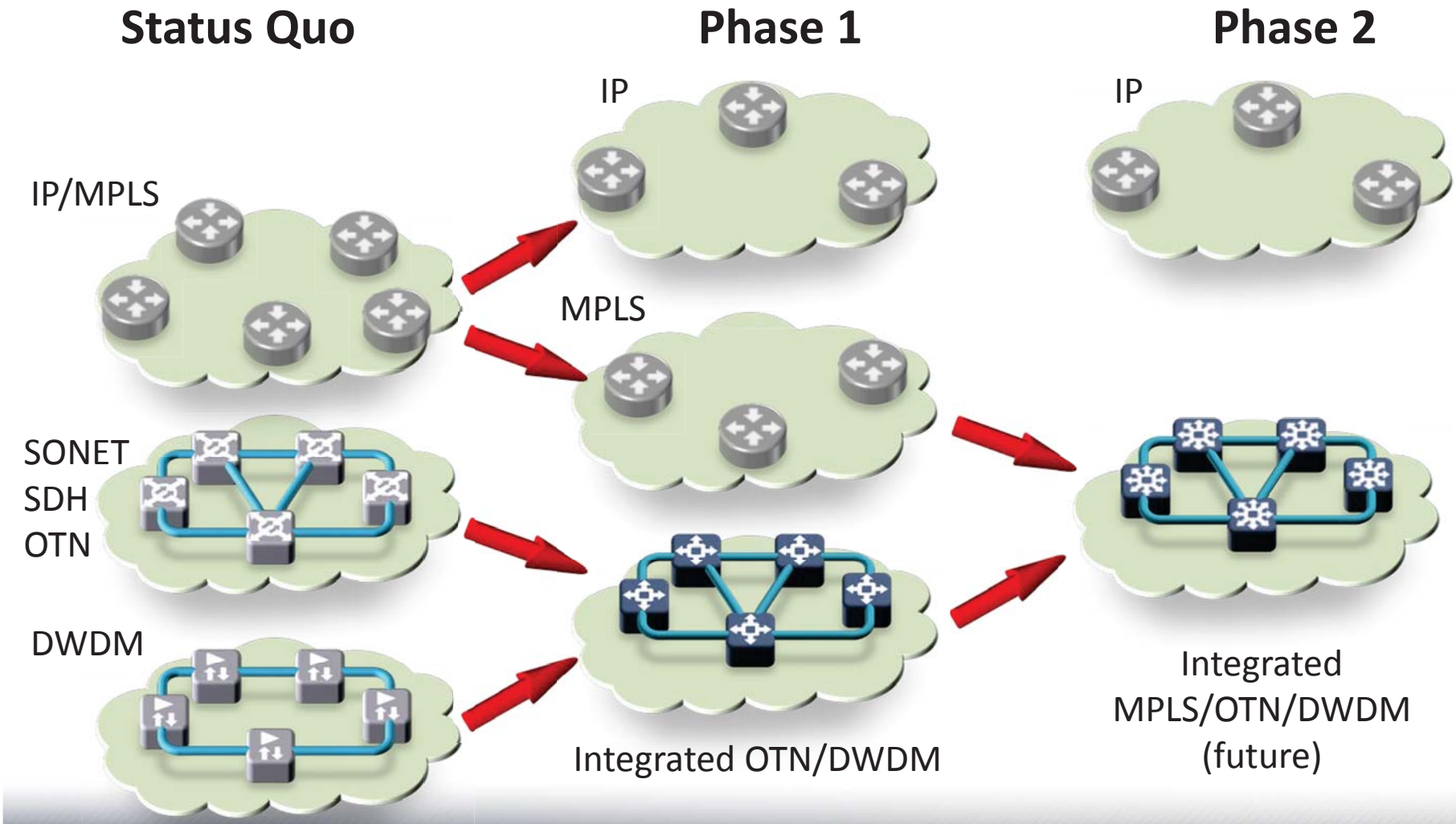
- Emergence of the Terabit Optical Core
- Transport SDN: What is it?
- Applying Transport SDN to Multi-layer Networking
- Closing remarks

The Evolving WAN Landscape

Fiber Capacity	• 100Gb coherent technology • Optical Super-channels on the horizon • Bandwidth service needs vary broadly
Transport Convergence	• WDM + OTN + Packet transport = **Flexibility** • Intelligent traffic management & switching • Router offload & bypass
Data & Content Networking	• Dynamic traffic patterns & profiles • Demand for adaptive and agile transport • Integration of Network & IT

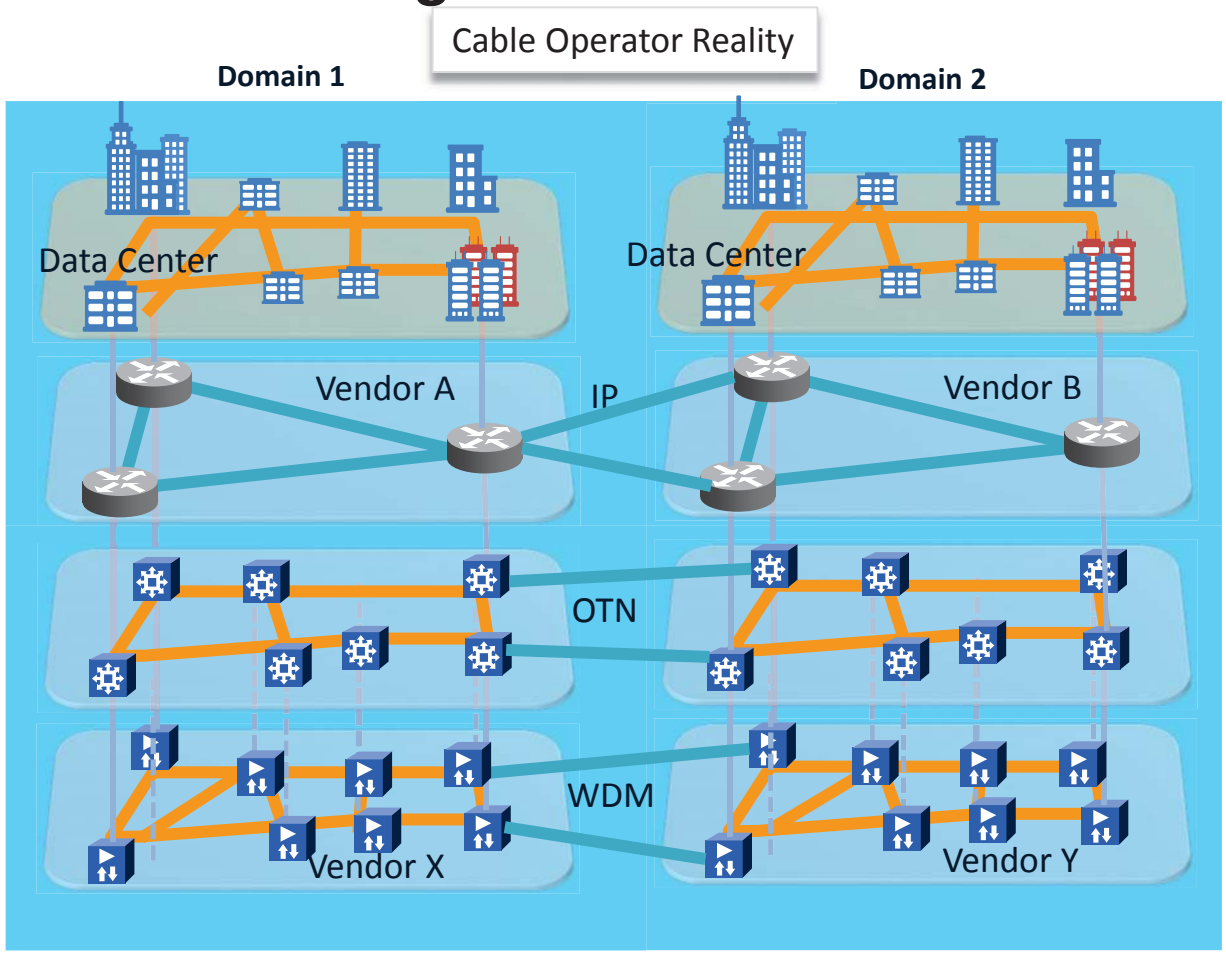
Core Network Evolution

Convergence is Essential



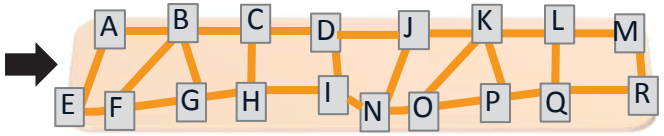
Transport SDN Vision

Integrated Multi-layer, Multi-Domain, Multi-Vendor Networking



Applications see simple, flat virtual network

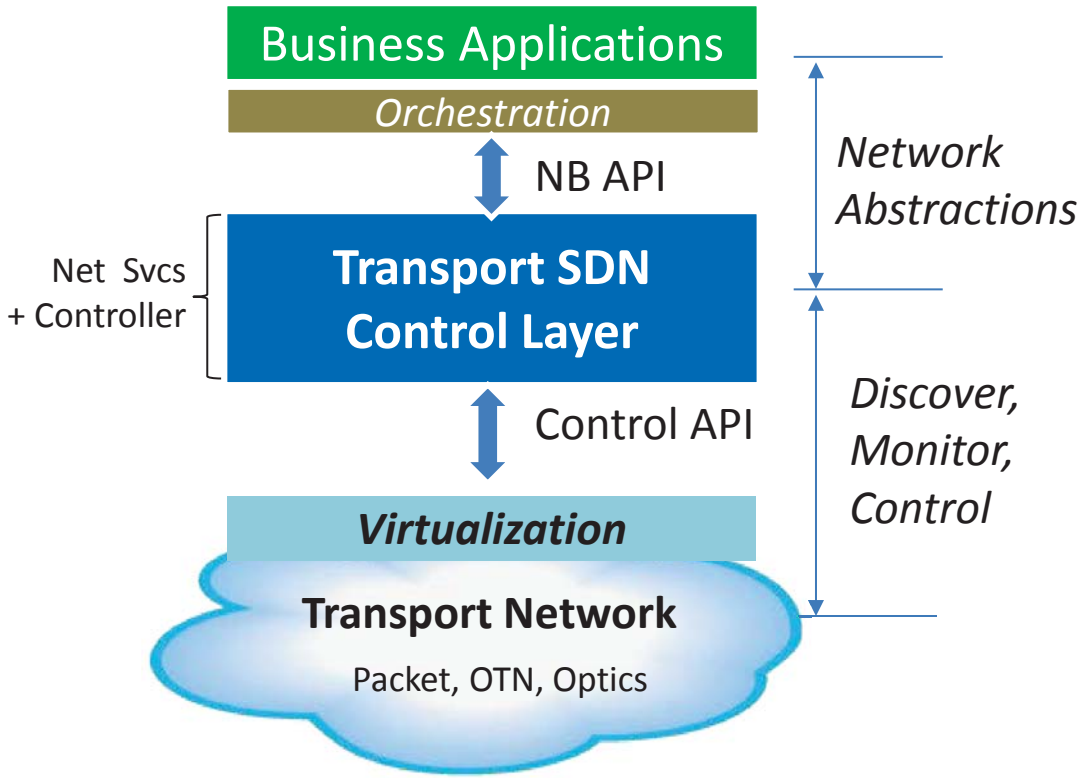
Centralized SDN controller



- Multi-layer integration & Optimization
- Virtual Network Slicing (NaaS)
- Application driven Bandwidth
- Inter-Domain connection management

Extending SDN to Transport

Open & Programmable Networking



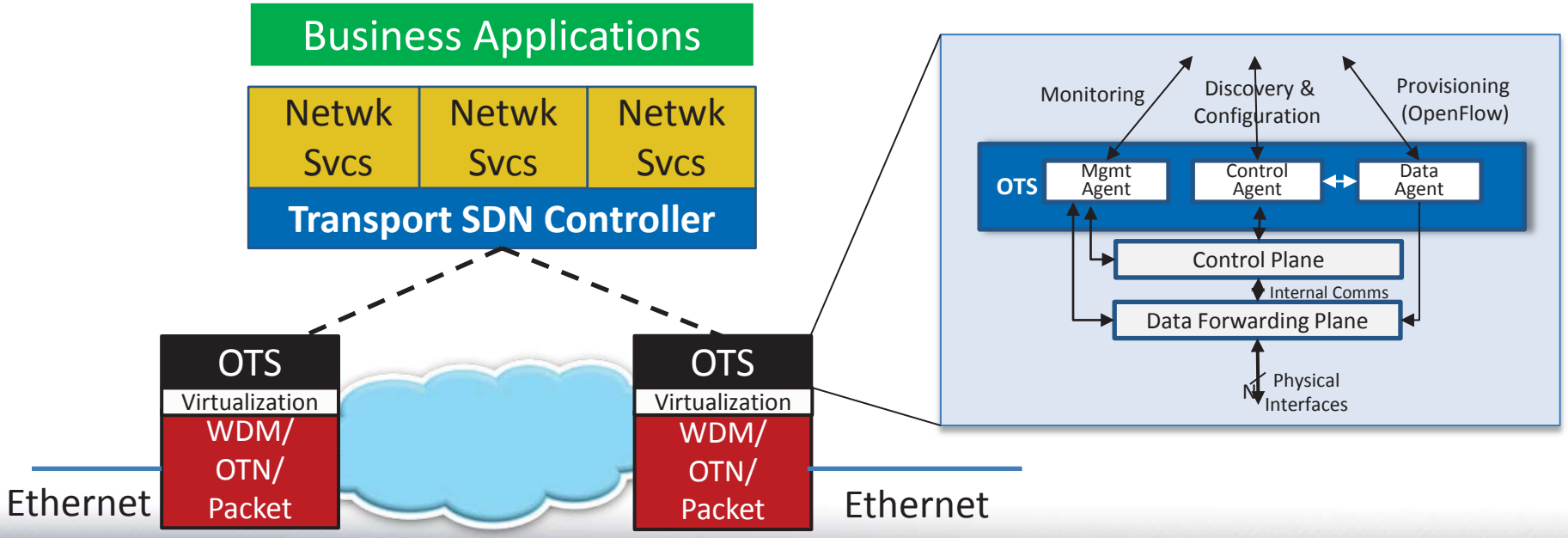
- Multi-layer
- Multi-vendor
- Multi-domain

- P-OTN convergence enables flexibility & agility
- SDN unifies control over multi-layer, multi-vendor network
- Abstraction simplifies network representation
- Benefits:
  - Rapid & Flexible Bandwidth
  - Simplify/Automate Operations
  - Global resource optimization
  - Speed New Service Deployment

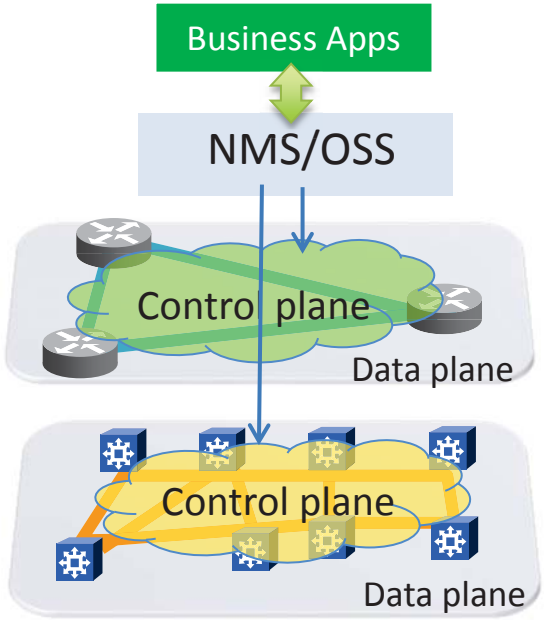
Supporting Network Virtualization

Open Transport Switch

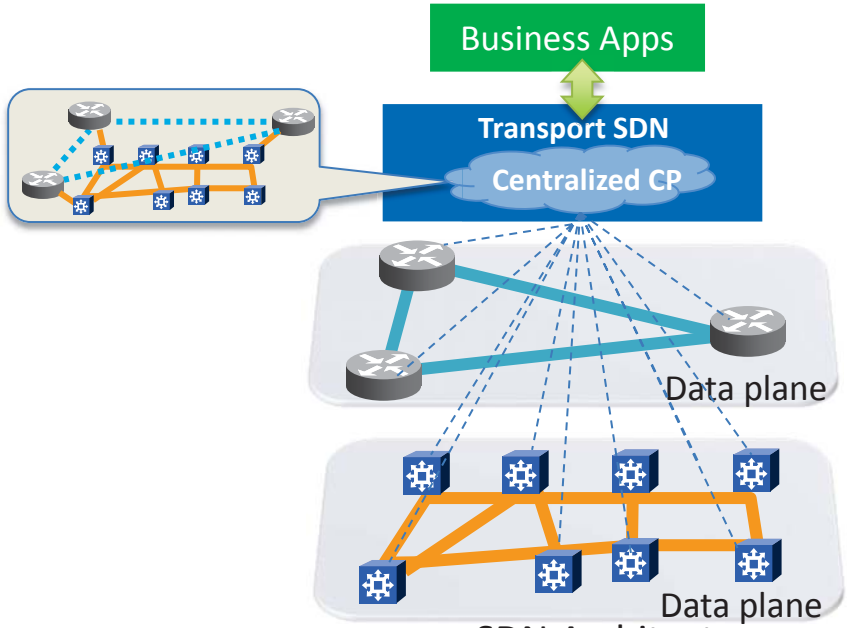
- Light-weight virtual switch employed in SDN architectures for facilitating discovery, monitoring and provisioning
- Extends OpenFlow for transport functions, adds other required protocols
- Runs on top of programmable packet/optical transport platforms



SDN Enables Global Optimization



Distributed Control Planes

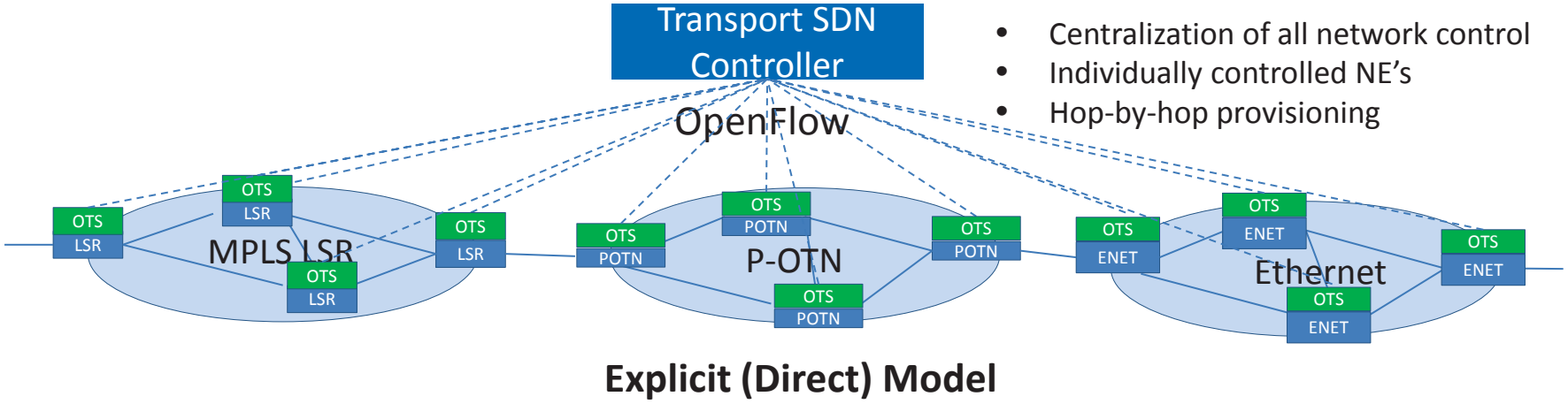


SDN Architecture

- Per-layer intelligence for incremental flows
- Lack of inter-layer intelligence
- Optimization limited to local domain & current network state
- Incapable of optimizing *global* set of demands

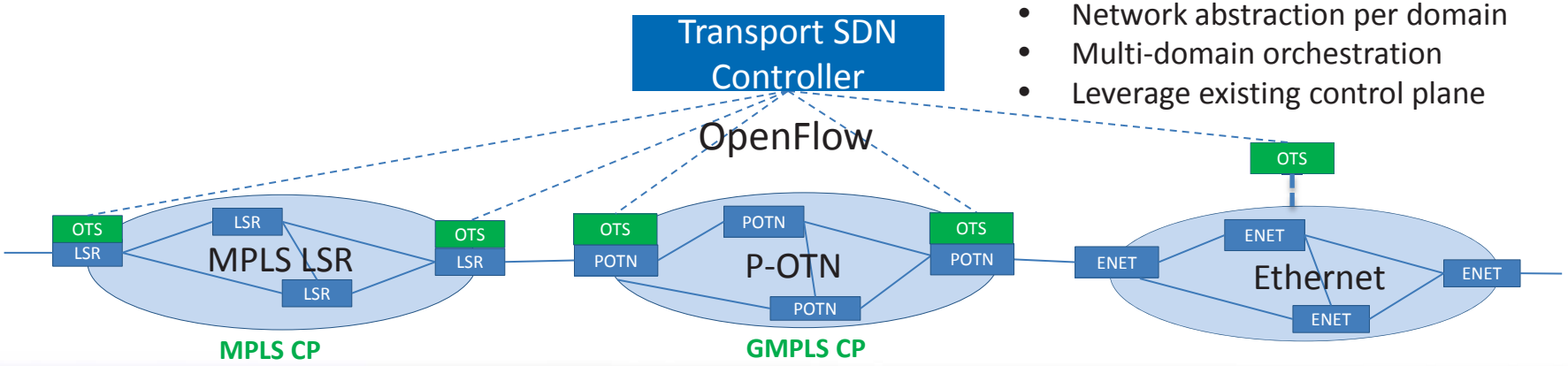
- Centralized & integrated multi-layer topology presents global view
- Abstraction important for multi-layer, multi-domain, multi-vendor support
- Facilitates global optimization and cross-layer efficiency

OTS Provisioning Modes



- Centralization of all network control
- Individually controlled NE's
- Hop-by-hop provisioning

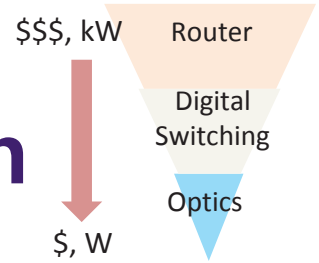
Explicit (Direct) Model

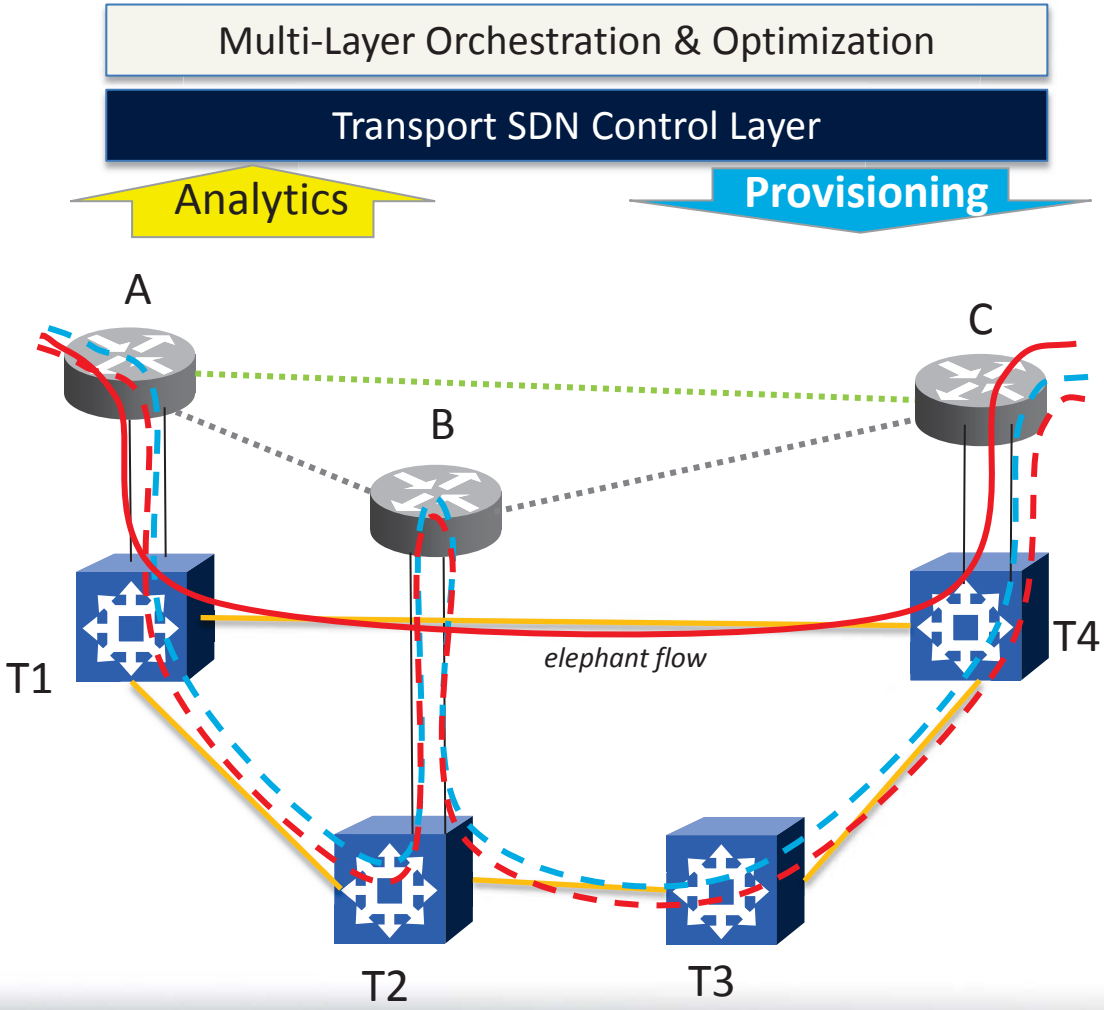


- Network abstraction per domain
- Multi-domain orchestration
- Leverage existing control plane

Implicit (Indirect) Model

Facilitating Multi-Layer Optimization





- Network Analytics
  - Pre-planned & real-time
- Multi-Layer Traffic Engineering
  - Application-centric bandwidth
  - Multi-constraint routing intelligence
  - Packet/optical coordination
- Multi-layer Control & Orchestration
  - Integrated global topology & demands
  - Unified control & APIs
  - Common abstraction for vendor agnosticism

Closing Remarks

- Optical bandwidth model is changing!
  - P-OTN convergence → flexibility, agility, elasticity
  - Super-channels driving need for sub-λ granularity
  - Mesh L0/L1 networking + shared mesh protection
- Transport SDN enabling new alternatives to status quo
  - Centralized control-plane model
  - Facilitates automation & application-driven networking
  - Multi-vendor, multi-domain, multi-layer
- Multi-layer optimization improves Total Network Cost
  - Leverage most suitable network layers & resources
  - Centralization of topology essential

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what THE NETWORK will be