Crosswork Network Automation: The Critical Role of SDN Controller in 5G Transport Slicing

Cisco Knowledge Network (CKN) Webinar

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Presenters

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As Senior Product Manager focused on new domains, innovations and techniques, Eric manages the IP Automation solutions across Cisco's portfolio.

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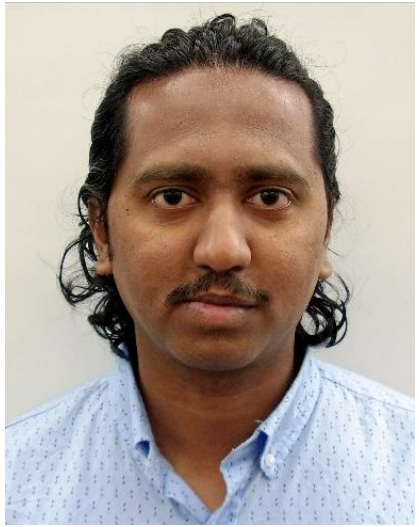


As a Technical Marketing Engineer for Service Provider Automation Products and solutions, Sujay is focused on designing and developing innovative techniques that align with customer and market requirements.

Agenda

1. Slicing: Introduction and Overview
2. Transport Slice Automation: Standards
3. SDN Controller and Transport Slice Automation
4. CNC Transport Slicing – Demo
5. Takeaways
6. Q & A

Slicing: Introduction and Overview

Introduction

- **Slicing** is developing quickly and seen as a key capability for 5G
- In 5G, **end-to-end slicing** typically covers RAN, Transport, DC and the Mobile Core
  - Different domains covered by different organizations/SDOs
- **Transport Slicing** is a key component of the E2E Slice delivery
- **Automation** is critical as slice use cases become more complex
- Cisco has a powerful and complete toolset for **Transport Slicing** including Segment Routing, FlexAlgo, QOS, L2/L3 VPNs, and more
- A powerful **SDN controller** is required to orchestrate and automate Transport Slicing

What is 5G Network Slicing?

An E2E Business Service (not just the transport)

5G Network Slicing is fundamentally an end-to-end **partitioning of the network resources and network functions** so that selected applications/services/connections may **run in isolation** from each other **for a specific business purpose and meet a business level SLA**

Its about offering:

1) **End to End Service Level Agreements (SLAs)**
2) **SLOs: Delay, jitter, loss, availability**
3) **SLEs: Disjoint paths, encrypted paths, etc.**

- **Hard slicing** refers to the provision of resources in such a way that they are dedicated to a specific slice service. (dedicated routers, Control plane, dedicated links, TDM-like, etc)
- **Soft slicing** refers to the provision of resources in such a way that whilst the slices are logically separated they share the same packet based network resources with intelligent QoS and forwarding.

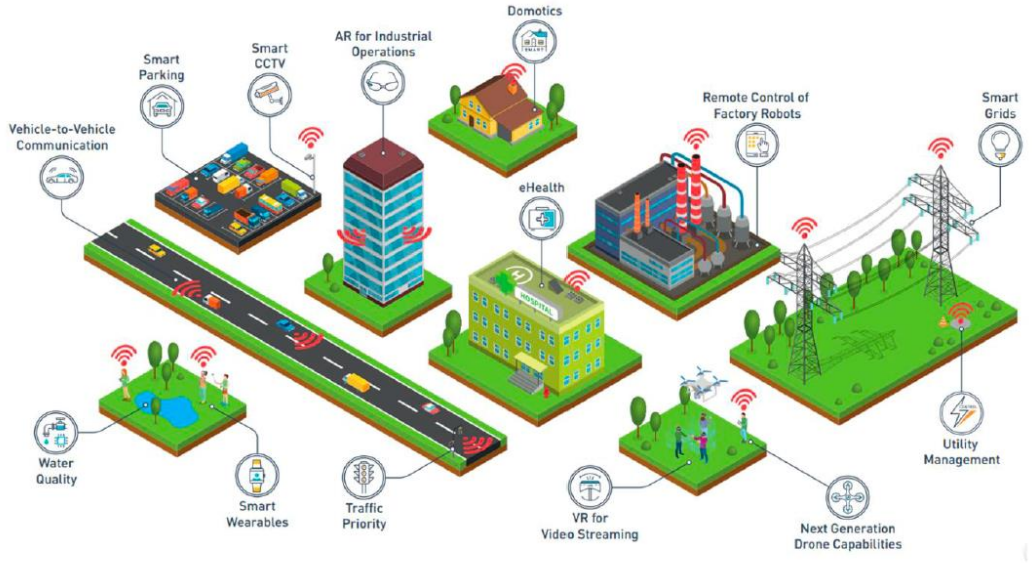
Why do you care about Network Slicing?

Deliver differentiated service and new revenue stream

New Customers
Increase adoption of 5G among Enterprises

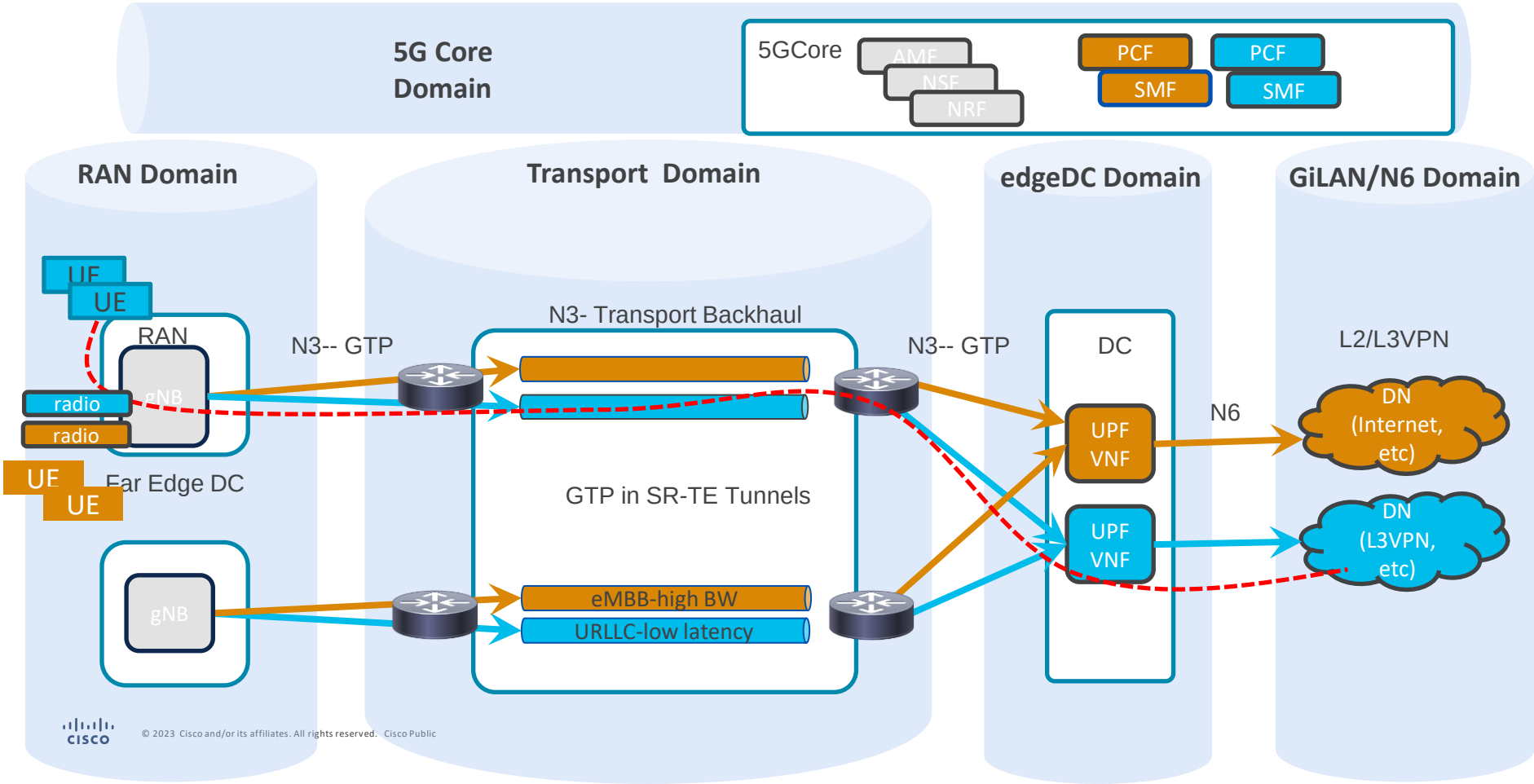
New Services
Capture a larger share of the value chain

New Business Models
Premium pricing for demanding use cases



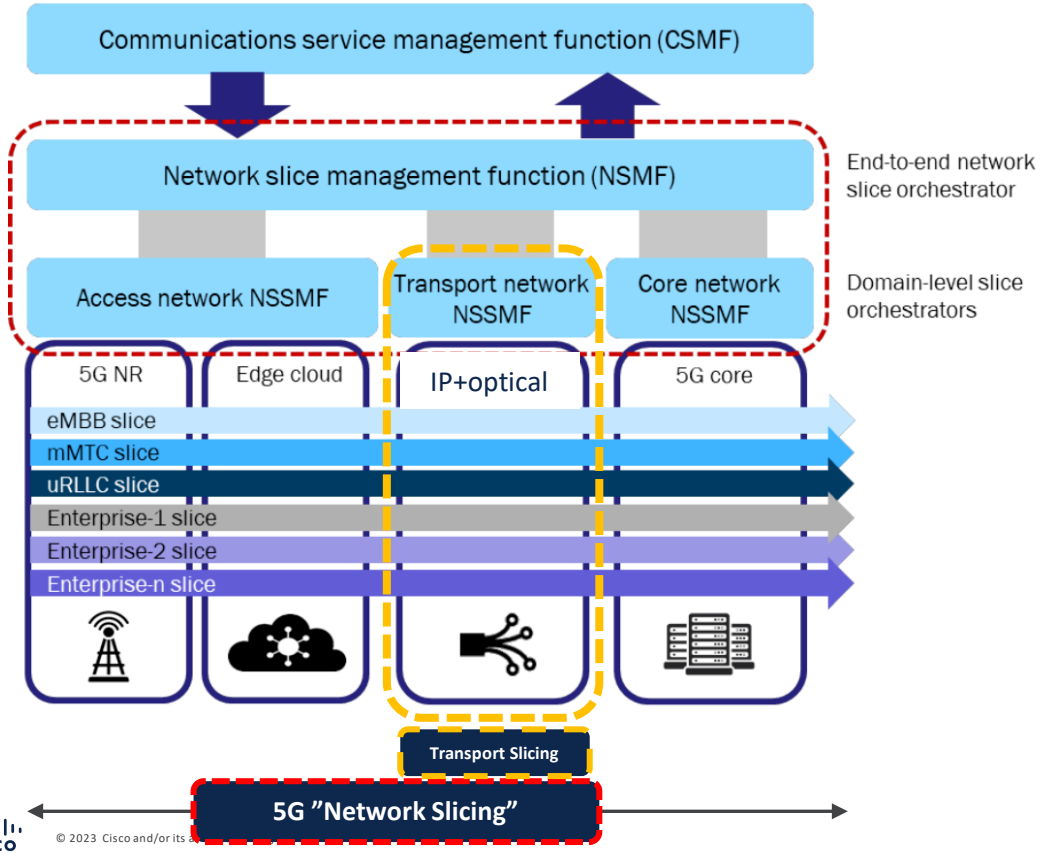
Source: Analysys Mason, 2020

A 5G Network Slice Service spans multiple “Domains”



Defining Transport Slicing Scope:

3GPP reference architecture for 5G network slicing

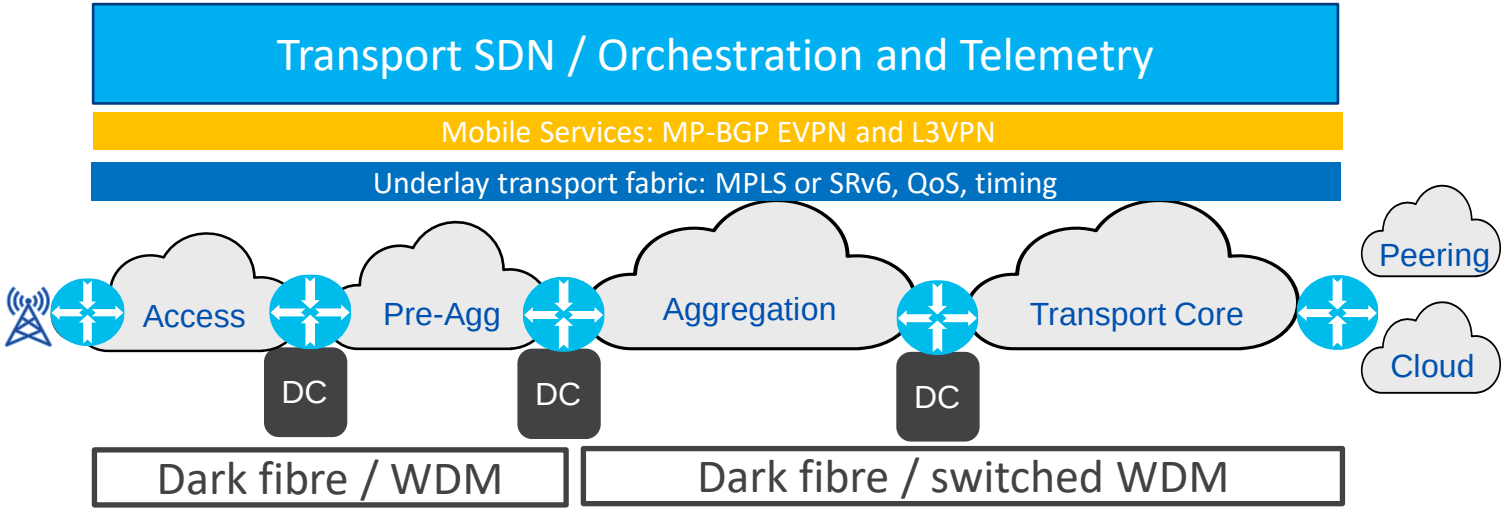


NSMF= Network Slice Mgmt. Function
NSSMF= Network Slice Subnet Mgmt. Function

Scope of 5G *Network* slice management

Scope of *Transport* slice management

Cisco Perspective: Transport Slice Machinery



- Transport Orchestration is Intent based, includes PCE, BW Optimization controller, Service Assurance Telemetry
- Underlay Transport Fabric: End to End Segment Routed with PHB QoS using routers
- Overlay Transport Fabric: MP-BGP EVPN for L3 and L2, including Private Line Emulation
- Inter-connected using point to point fibre with Ethernet presentation
- Statistical multiplexing and statistic gain from edge towards transport core
- DCs strategically at all levels

Cisco Toolset for Transport Slicing

- QoS and H-QoS: Core and edge
- Forwarding Planes: Shortest Path / SR policies (SRv6 / SR-TE / Flex-algo / Circuit-Style)
- SR underlay performance management tools

Creating and managing the forwarding plane

Combining these offer different levels of transport slice separation (ie soft or hard slice solutions)

- Virtual Private networks : L2 / L3 VPNs
- ODN and Automated traffic Steering (AS)
- VPN performance management tools

Slice isolation and mapping to slice forwarding planes.

Transport Slicing Automation Standards

Transport Slicing is Defined by Multiple SDOs…

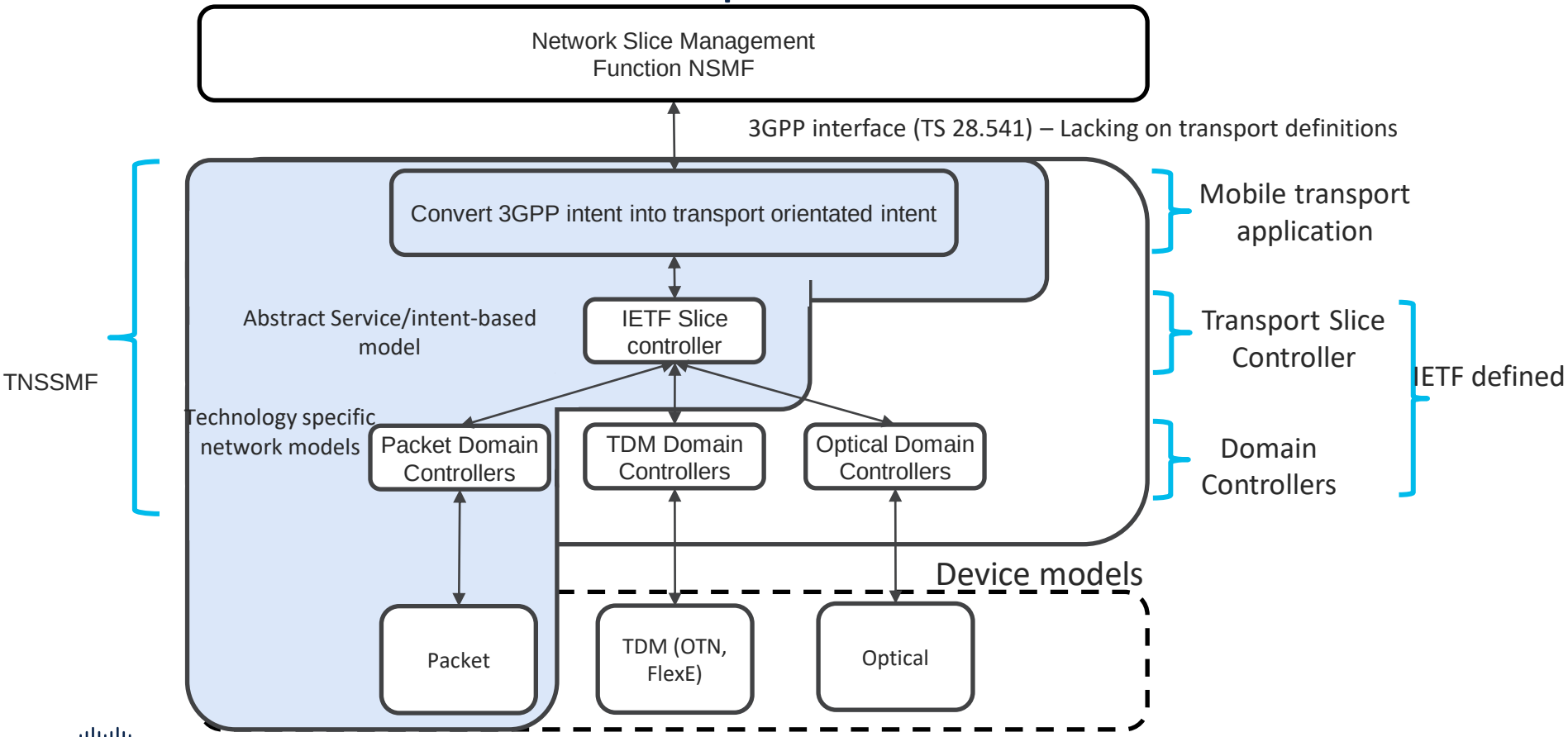
- Defines 5G slicing and 5G Slicing management end-to-end
- No real focus on Transport slicing
- Helps however to position Transport slicing management (T-NSSMF) in a larger context

- TEAS working group defines Transport slicing model and use cases
- Cisco is actively contributing to the working group and Slice Yang model definition

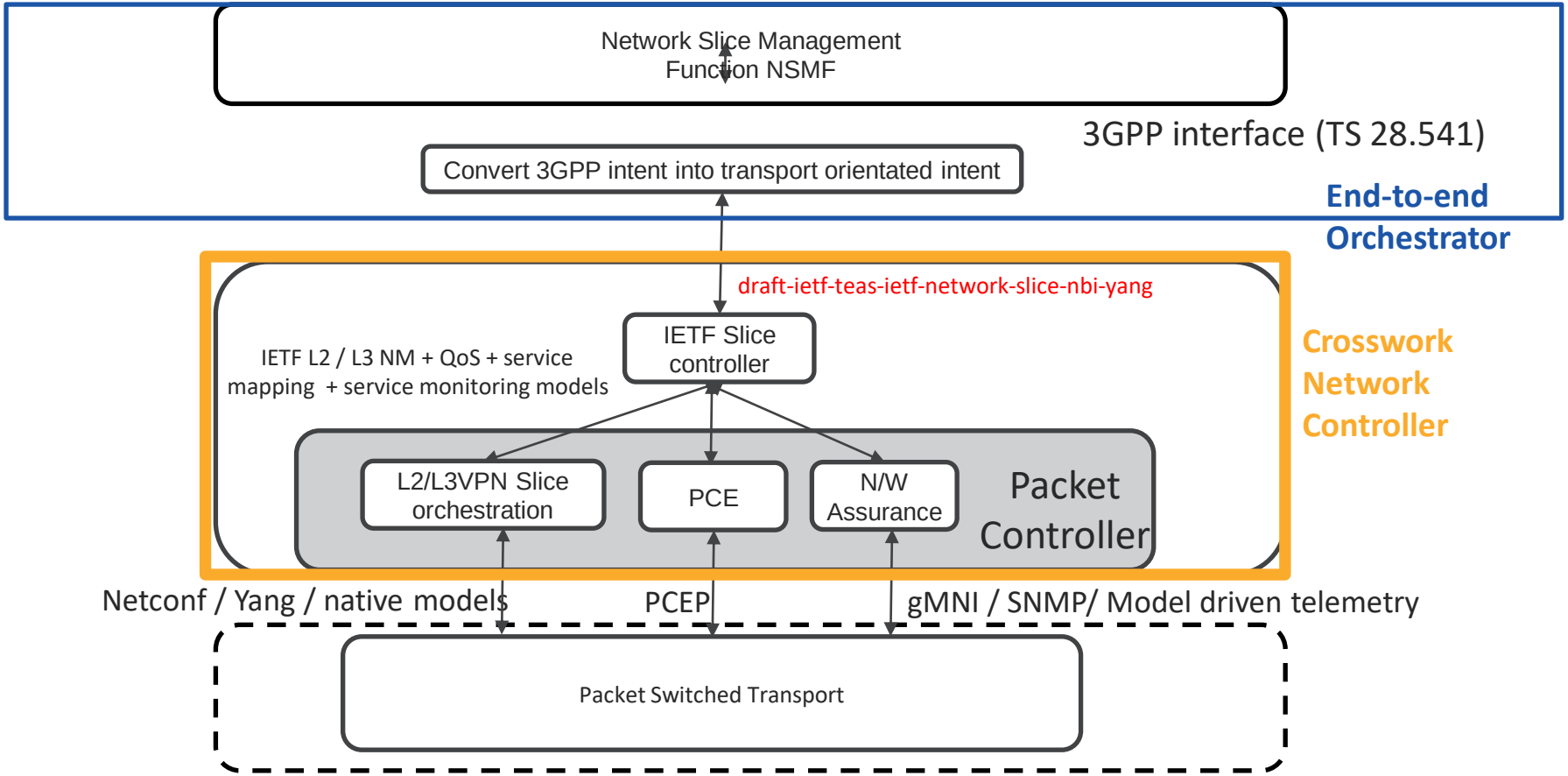
- O-RAN focuses on the RAN side of the 5G network
- And in particular the fronthaul portion of Transport slicing
- Cisco is actively contributing at defining the Transport architecture in this context

And many others… Broadband Forum, MEF,

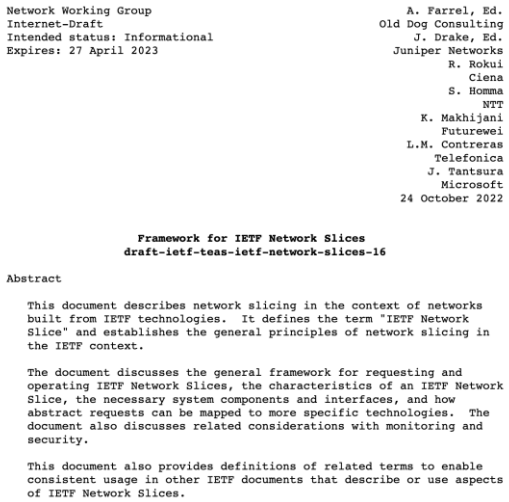
From 3GPP to IETF: Transport NSSMF



Transport NSSMF and Crosswork Network Controller



Cisco Slicing Directionally Following IETF Slicing Drafts



Network Working Group
Internet-Draft
Intended status: Informational
Expires: 27 April 2023

A. Farrel, Ed.
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24 October 2022

Framework for IETF Network Slices
draft-ietf-teas-ietf-network-slices-16

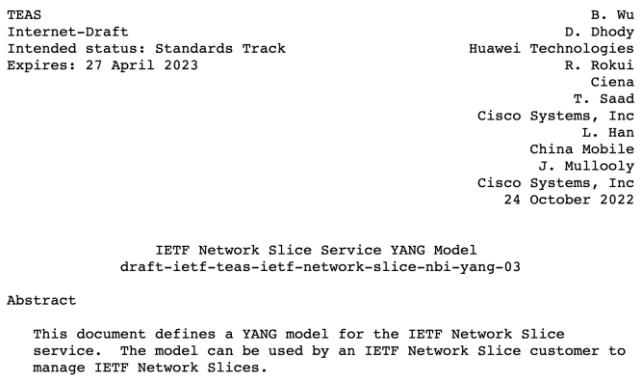
Abstract

This document describes network slicing in the context of networks built from IETF technologies. It defines the term "IETF Network Slice" and establishes the general principles of network slicing in the IETF context.

The document discusses the general framework for requesting and operating IETF Network Slices, the characteristics of an IETF Network Slice, the necessary system components and interfaces, and how abstract requests can be mapped to more specific technologies. The document also discusses related considerations with monitoring and security.

This document also provides definitions of related terms to enable consistent usage in other IETF documents that describe or use aspects of IETF Network Slices.

- IETF TEAS working group is defining Transport/Network Slices: Framework, Use Cases, Models…
  - draft-ietf-teas-ietf-network-slices-16
  - draft-ietf-teas-ietf-network-slice-use-cases-01
  - draft-ietf-teas-ietf-network-slice-nbi-yang-03
- Cisco is actively contributing to those drafts
- CNC will implement the Slice Service Yang models and follow IETF guidelines in general



TEAS
Internet-Draft
Intended status: Standards Track
Expires: 27 April 2023

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IETF Network Slice Service YANG Model
draft-ietf-teas-ietf-network-slice-nbi-yang-03

Abstract

This document defines a YANG model for the IETF Network Slice service. The model can be used by an IETF Network Slice customer to manage IETF Network Slices.

SDN Controller and Transport Slicing Automation

SLA: Service Level Agreement
SLE: Service Level Expectations

Transport Slice Lifecycle and Automation

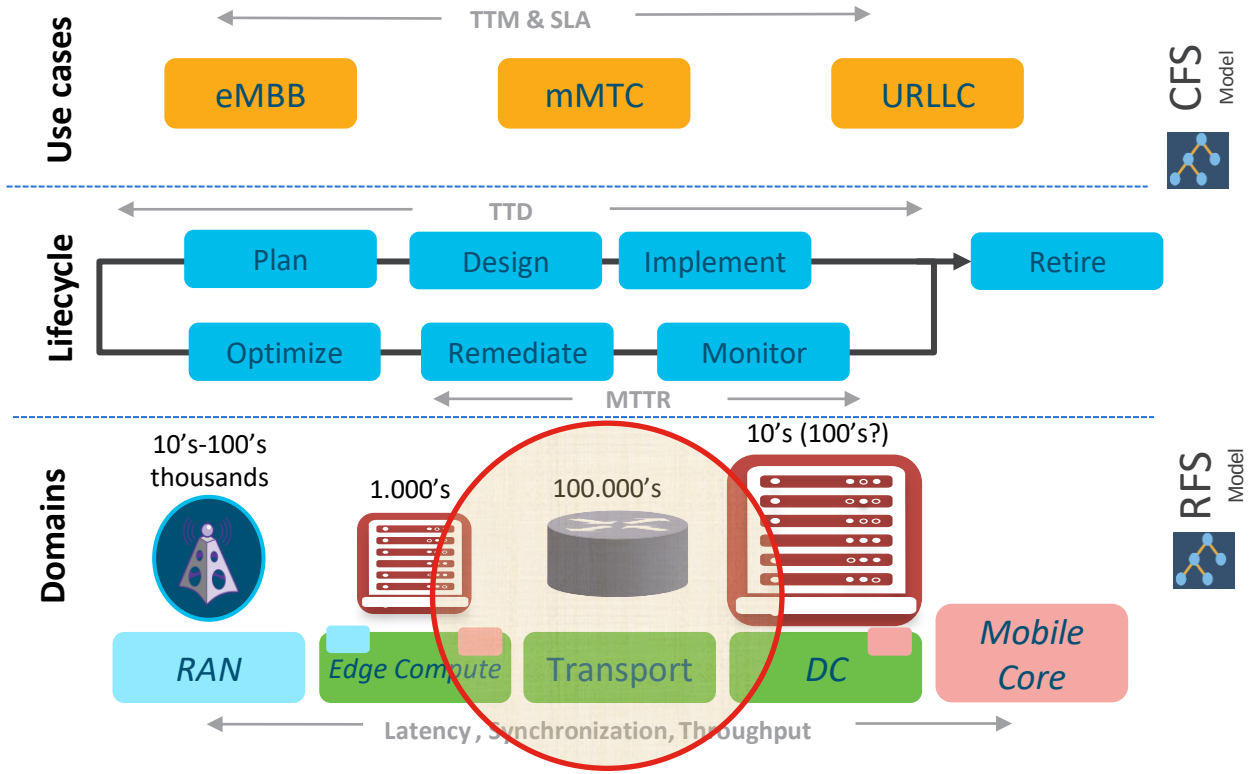
Challenges and Requirements

Transport Slice Automation Challenges

- Multiple building blocks: L2/L3 VPNs, SR, FlexAlgo, QOS…
- Powerful yet complex toolset
- Slices to offer different level of SLA/Constraints

Transport Slice Automation Expectations

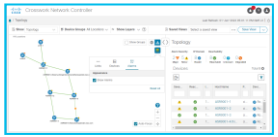
- Need for Transport Slice Abstraction to hide the toolset complexity
- Need for a complete lifecycle management
- SLA/SLE(*) monitoring and management
- Integrated with a larger cross-domain orchestration architecture



Transport Slicing Automation Made Easy

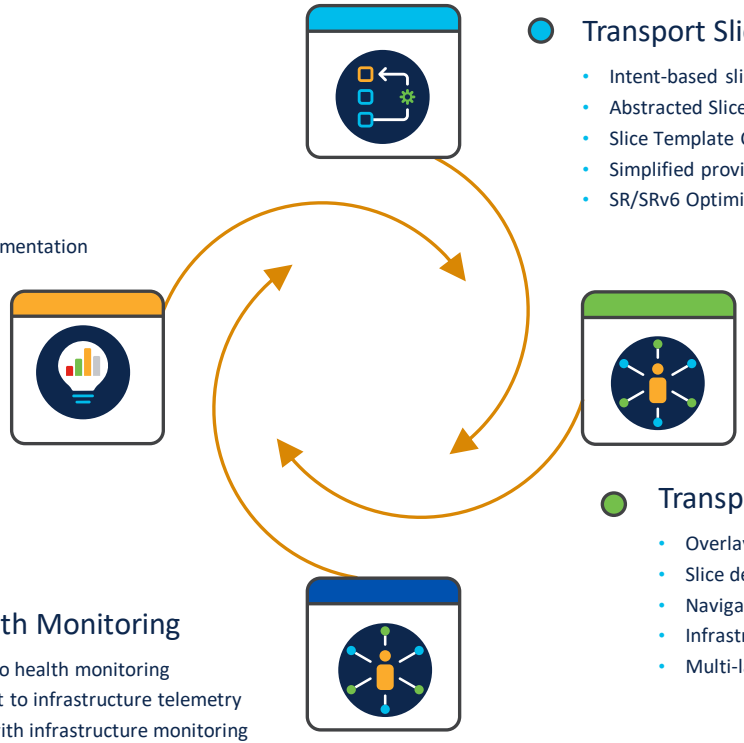
Transport Slice SLA Monitoring

- Proactive SLA monitoring per Slice
- Leveraging Cisco (SR-PM) or Accedian instrumentation
- SLA breach notification
- SLA reporting



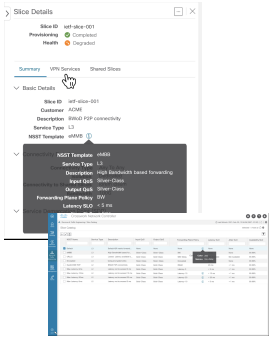
Transport Slice Health Monitoring

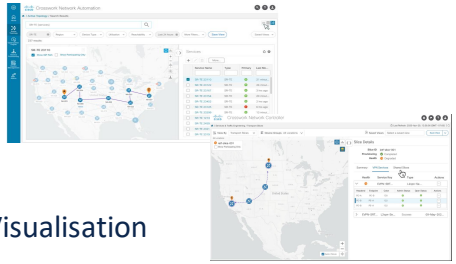
- Service Centric approach to health monitoring
- Dynamically tie Slice Intent to infrastructure telemetry
- Correlate active probing with infrastructure monitoring



Transport Slice Orchestration

- Intent-based slice definition
- Abstracted Slice model based on IETF model
- Slice Template Catalog
- Simplified provisioning User Interface
- SR/SRv6 Optimisation

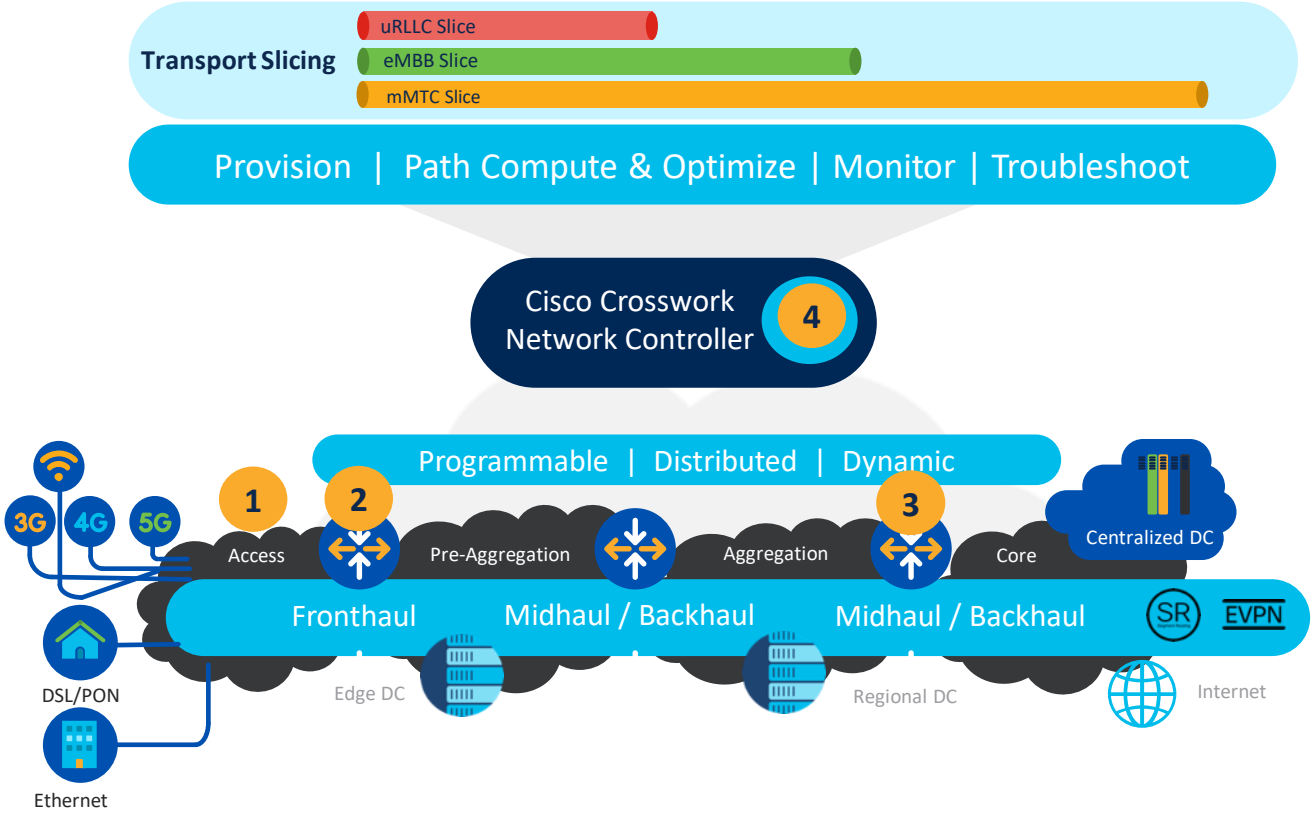




Transport Slice Visualisation

- Overlay maps
- Slice details: Type, Template, VPNs, Transport
- Navigation between Slice components
- Infrastructure visibility
- Multi-layer view and analysis of the slice

Crosswork Network Controller: A Solution for Transport Slicing Automation



Challenges

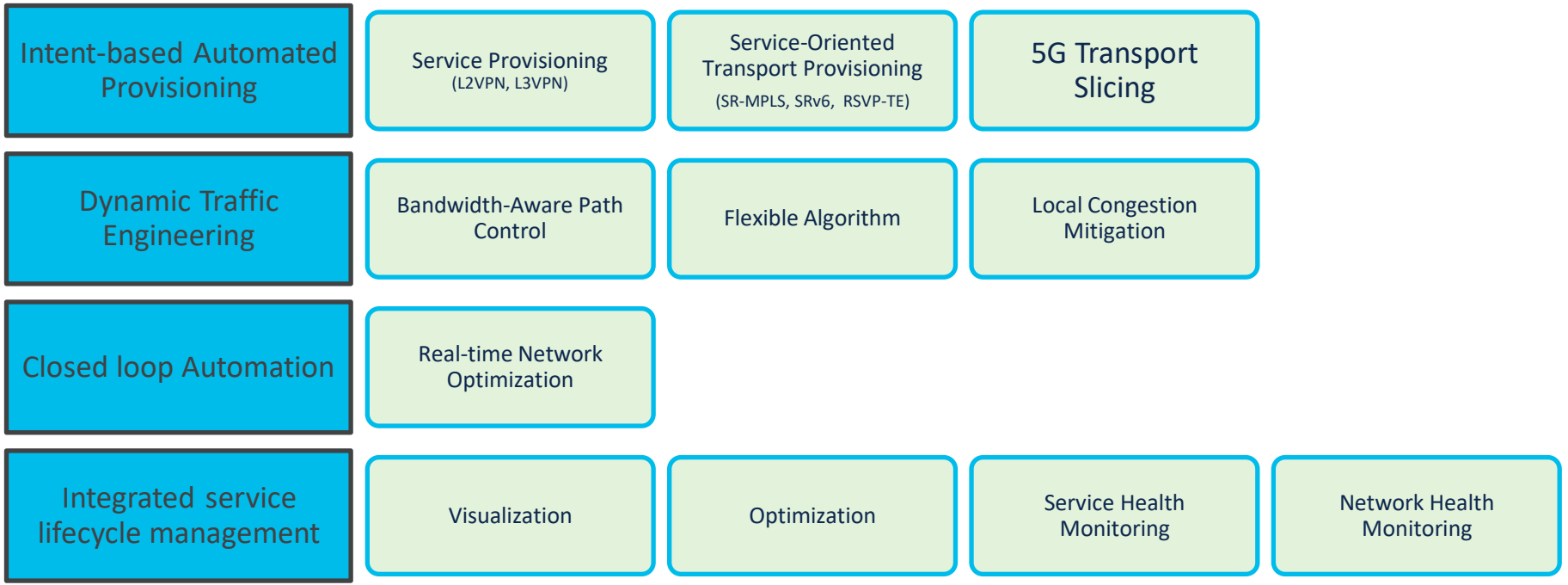
1. Cumbersome Service Provisioning
2. Bandwidth swings, Congestion and Over capacity
3. Maintaining SLA
4. Siloed tools, fragmented visibility

Outcomes

- Intent-based Automated Provisioning
- Dynamic Traffic Engineering
- Closed loop Automation
- Integrated service lifecycle management

Crosswork Network Controller

Automation solution for Deploying and Operating IP Transport networks



Transport Slicing Health and SLA Visibility

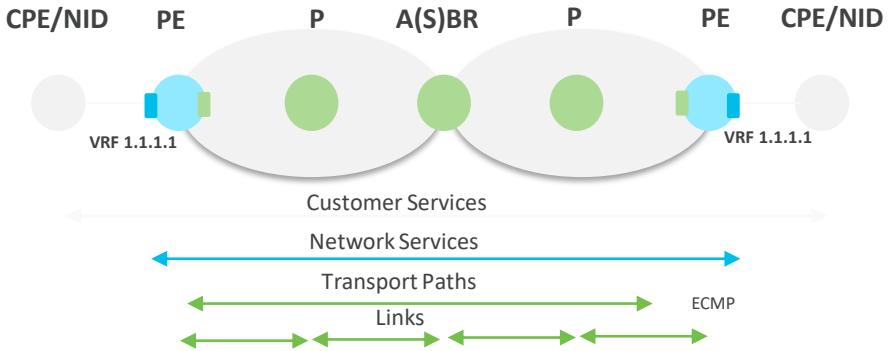
Key KPIs monitoring

Customer Experience

Network Health

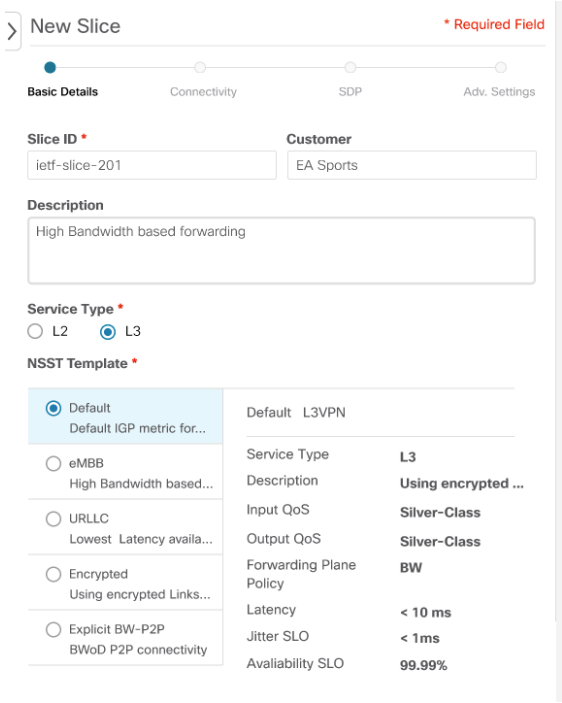
Layer	From ..To	Scale	Probes	Type	Metrics
Customer service	*CPE/NID/HOST*	*Per VPN scale*	***In CPE/NID and high priority***	*OTT Probes*	
Transport Network Services (L2 VPN/L3 VPN)	PE/VRF to PE/VRF	Full PE mesh	Internal or External (depend of PE capability and needs/requirments)	IP probes (VRF to VRF) , L2 probes	TWAMP for– L3 VPN *(Embedded & Accedian)* • Delay/Latency • Delay Variation/Jitter • *Loss (Accedian & SR-PM Roadmap)* Y.1731 for L2 VPN *(Embedded & Accedian Roadmap)* • Delay/Latency • Delay Variation/Jitter • Loss (SD, DS)
Transport Path (Policy Monitoring)	PE to PE	Full mesh x ECMP	Internal and limited to critical policies (can't be full mesh)	SR PM (per policy)	• Delay (TWAMP Light) • Liveness (SR-Policy and end points) • Bandwidth (Interface Counter)
Transport Link	Intf-Intf	All links	**Integrated (internal) and high priority**	SR PM (per link)	• Delay (TWAMP Light) • Delay Variation/Jitter • *Bandwidth* (Interface Counter – Roadmap)* • *Packet Drop* (Interface Counter –Roadmap)* • *Synthetic Loss (Roadmap)* • *Loss per Bundle (Roadmap)*

Visibility of Transport SDN Health
Descriptive analytics via contextualized key metric data for device, link, path, L2/L3 VPN service



Customers' Requirements for a Transport Slicing Controller

- **Slice provisioning**
  - Intent-based slice definition that abstracts the underlying components:
    L2, L3, QOS, FlexAlgo, SRv6, OAM…
  - **Slice template catalog** that includes pre-defined slice templates
- Slice provisioning through **Standardized APIs** (IETF most likely)
  - IETF Slice Yang Model exposed to E2E Orchestrator
- **Slice visualization**
  - Per Transport Slice Observability that includes
    - VPN
    - SR-TE Paths / Flex-Algo Paths
- **Slice performance monitoring** in near real-time
    - Path Performance (Latency/Loss/Jitter)
    - BW statistics
    - Future: QoS statistics



Crosswork Network Controller And Transport Slicing

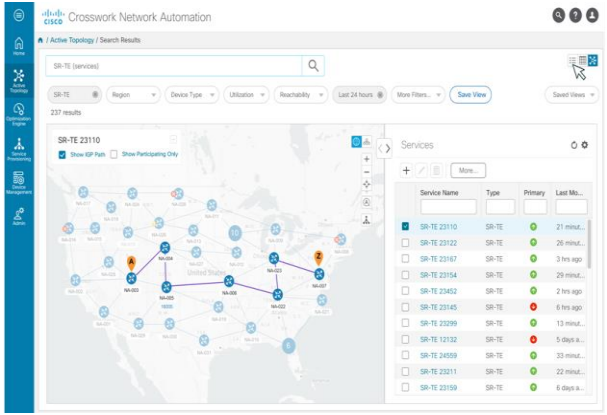
Existing Building Blocks

- FlexAlgo support
- SRv6 support
- L2VPN/L3VPN enhanced NSO Function Packs
- QOS support

NSST Name	Slice Type Value	Description	QoS Plane Profile	Forwarding Plane Policy
eMBB	1	Use High BW links	Soft-Shared-Queues	IGP
URLLC	2	Use low-delay links	Soft-Shared-Queues	min-delay
mMTC	3	Use low-delay links	Soft-Shared-Queues	min-delay
Encrypted	4	Transit MACsec encrypted links only	Soft-Shared-Queues	encrypt
Disjoint-Path-Top-Rail	5	Only transit links marked top-rail	Soft-Shared-Queues	top-rail
Disjoint-Path-Bottom-Rail	6	Only transit links marked bottom-rail	Soft-Shared-Queues	bottom-rail
20ms-max-delay	7	Delay not to exceed 20ms e2e	Soft-Shared-Queues	NTE-20ms
30ms-max-delay	9	Delay not to exceed 30ms e2e	Soft-Shared-Queues	NTE-30ms

Slice Creation Abstraction

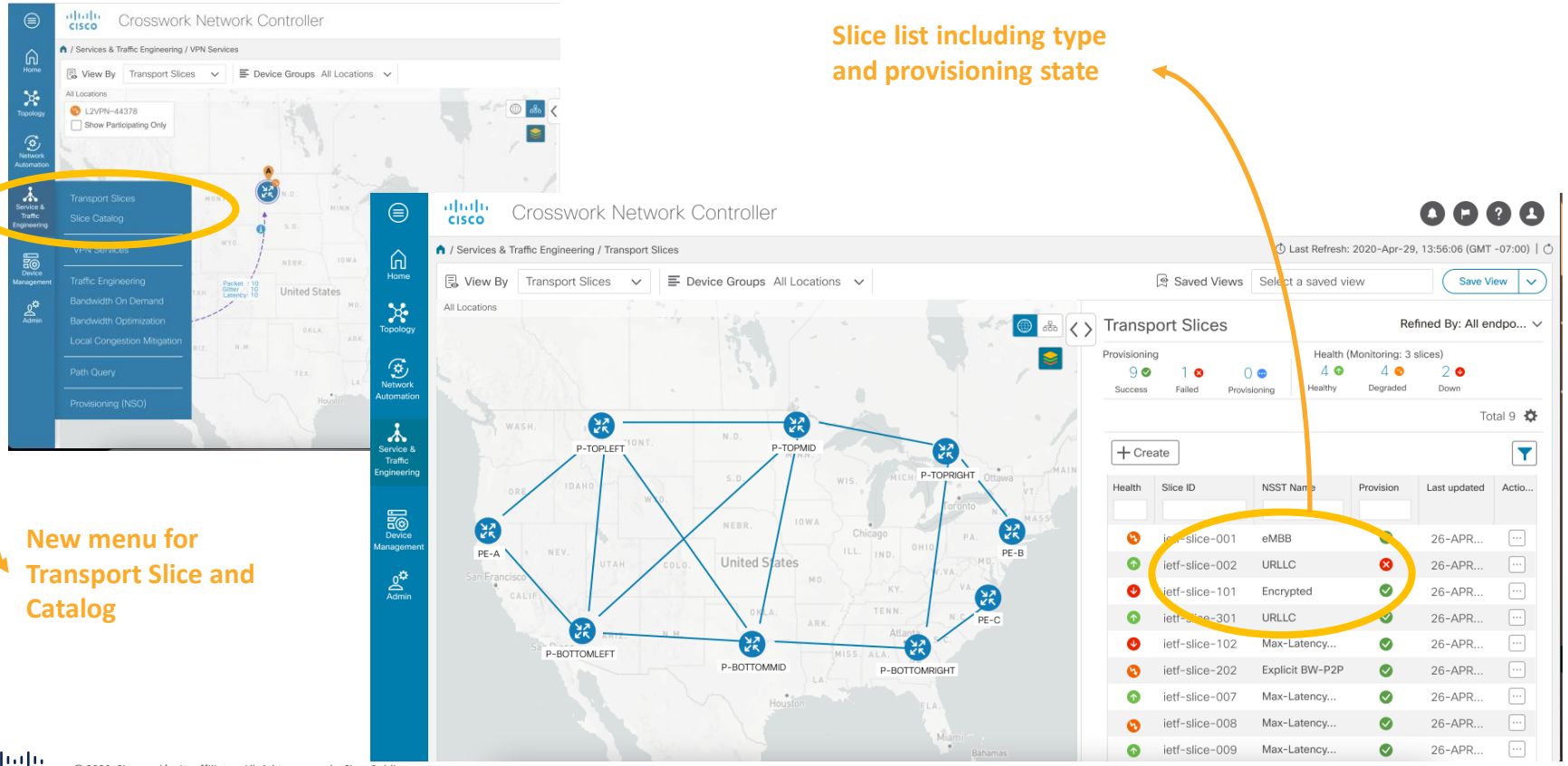
- Simplified UI to abstract the Slice components
- Slice Template Catalog



Slice Lifecycle

- Overlay maps
- KPI collection and Closed-Loop Automation
- Network Optimization

Transport Slicing in Crosswork Network Controller Visualization



Demo

CNC Transport slicing Demo

1. CNC as Transport Slicing Manager
2. Slice Catalog and Slice Details
3. Update Slice and Validate.

Key Takeaways

Slicing has become a trend with 5G Networks but can actually be applied to various contexts

Cisco offers a complete toolset to implement Transport Slicing: **Segment Routing, FlexAlgo, QOS, L2/L3 VPNs, SR-PM, OAM…**

Crosswork Network Controller is Cisco's SDN controller to **orchestrate and automate Transport Slicing**

Crosswork Network Controller will make Transport Slicing orchestration and automation even simpler by:

- **Abstracting the Cisco toolset under a Slice model**
- **Exposing an IETF API for integration with end-to-end orchestrators**

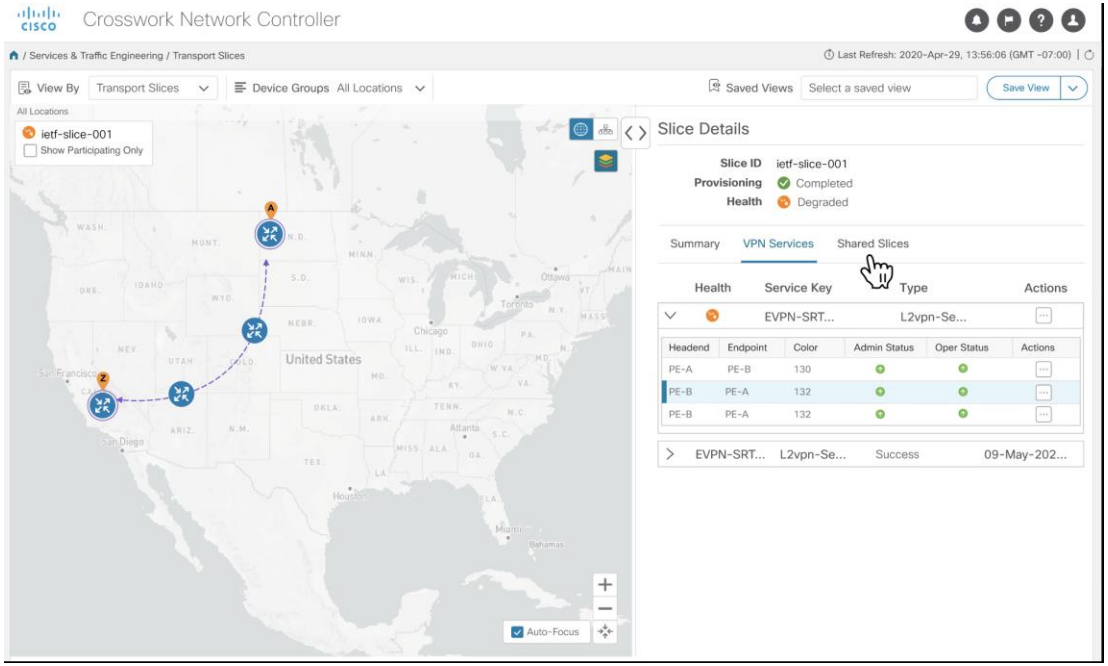
Learn more: cisco.com/go/crosswork

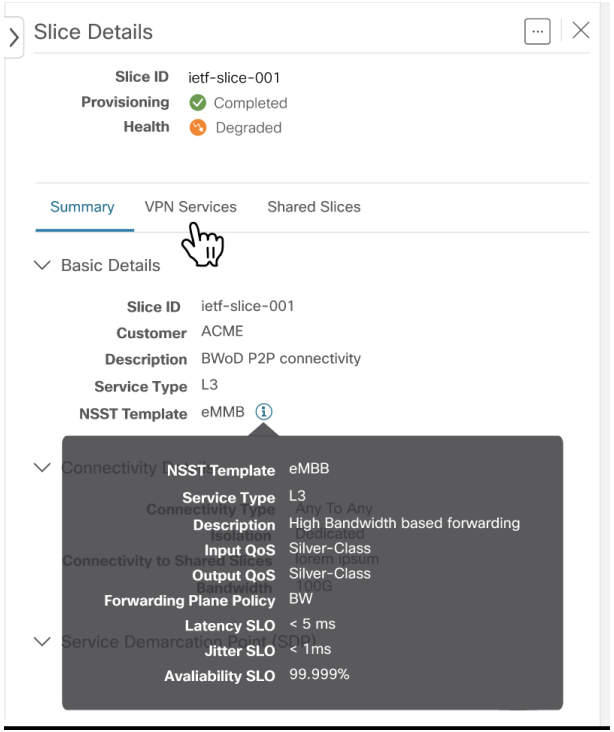
Q & A

The bridge to possible

Backup Slides

Transport Slice Details

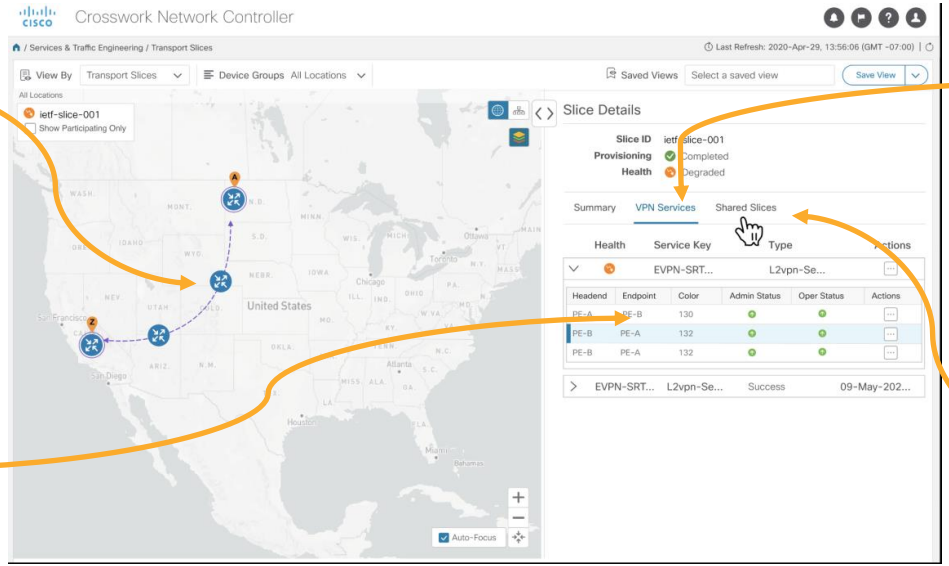




Navigate the Slice components: VPN, Transport

Display a slice on the map

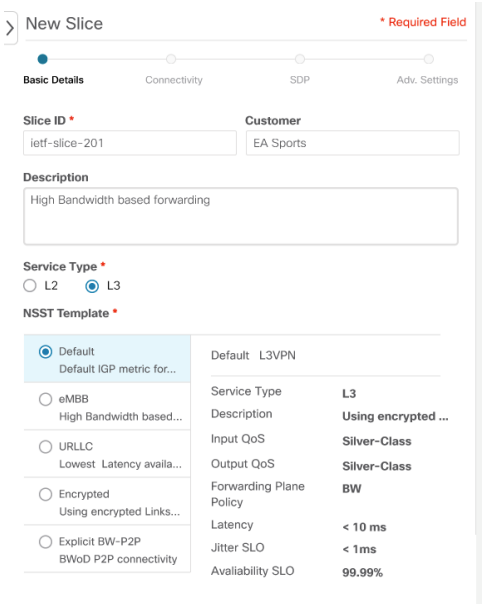
Drill-down to VPN and/or Transport details



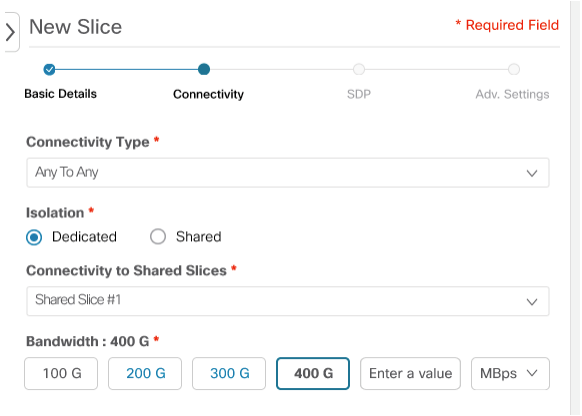
From the VPN list, display VPN details including Assurance data if monitoring is enabled

From the Transport list, display SR TE details including SR-PM data if SR-PM is enabled

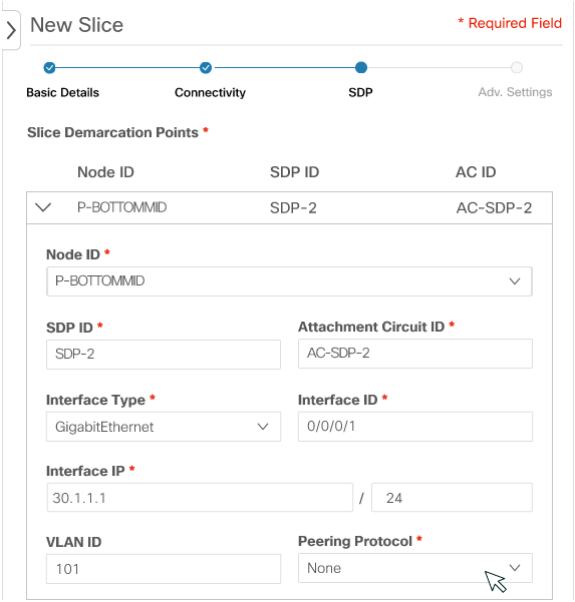
Simplified Transport Slice Creation



Specify Slice ID, Service Type, NSST Template…

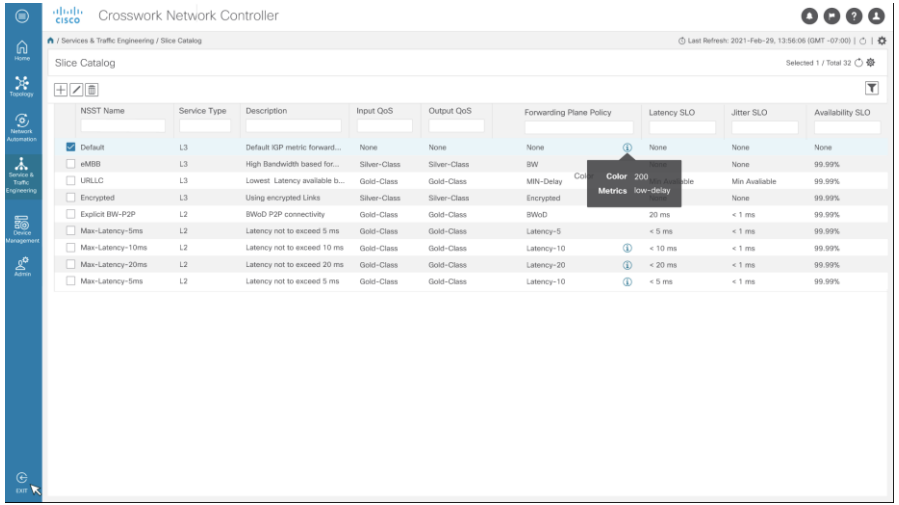


Specify Connectivity Type, Isolation, Bandwidth…



Define Service Demarcation Points

Transport Slice Template Catalog



- Pre-defined and User-defined slice templates
- Template includes:
  - Template Name
  - Service Type
  - Description
  - Input/Output QOS
  - Forwarding policy
  - (Future) SLA/SLO parameters
- Templates can be created/modified through GUI or API