Jie Dong

Senior IP Research & Standards Engineer

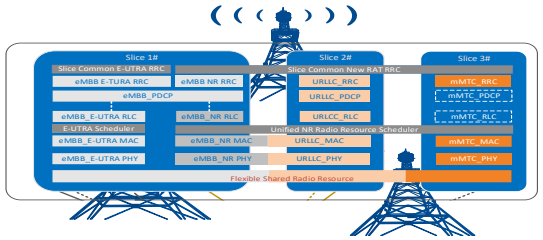
Huawei

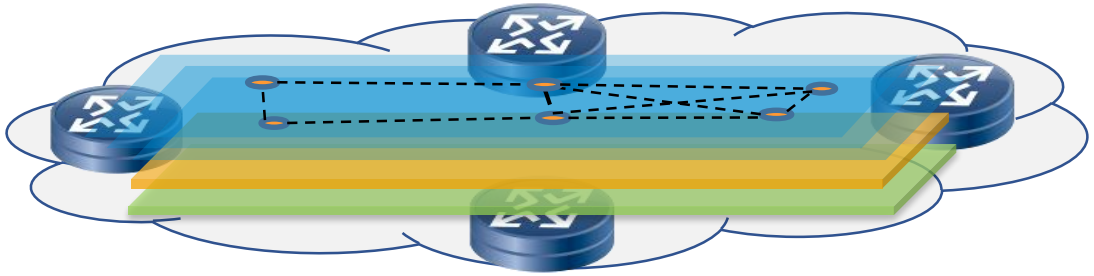
VPN+: Enable Network Slicing

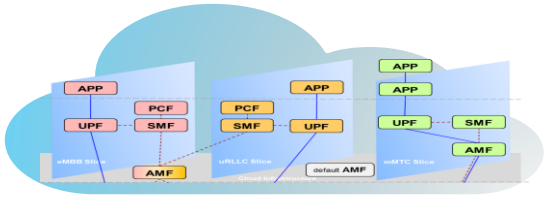
MPLS SD&AI NET VIRTUAL 21 22ND EDITION 28/30 SEPT

HUAWEI

Network Slicing Enables New Business Opportunities







New 2C Opportunities

VR/AR

VR live broadcast

+ 8K live broadcast

VR gaming

cloud gaming

Multi-channel 4K live broadcast

cloud studio

3D hologram

. . .

New 2B Fields

Wireless private line

5G transportation

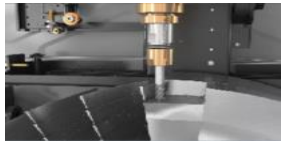
Wireless new media

hospital

Intelligent airport

Power grid

Precise manufacturing

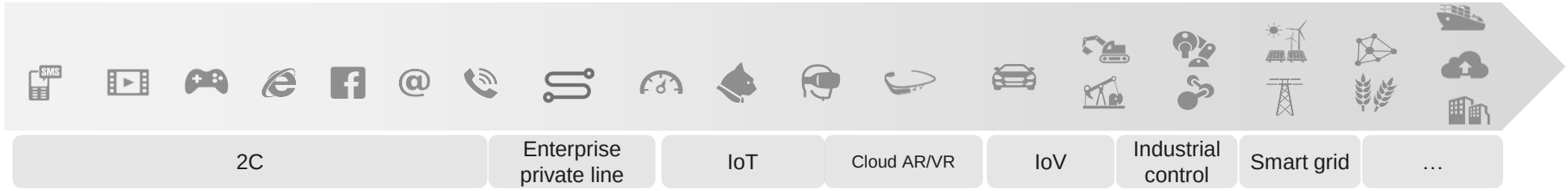


Intelligent port

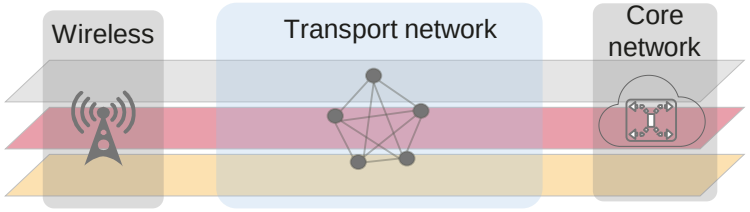
. . .

HUAWEI

Transport Network Slicing Brings Value to both 5G and Cloud

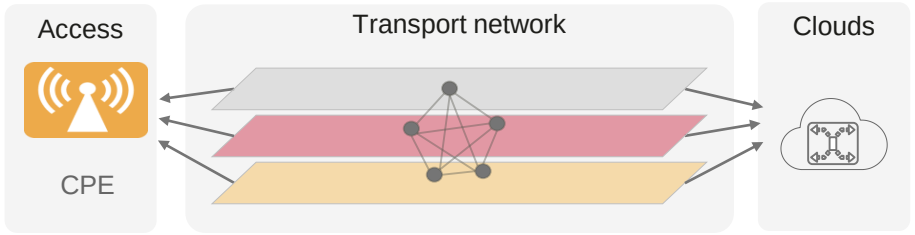


5G E2E Network Slices



- Transport network slice provides the required **logical network topology** and **network resources** to meet the SLA of 5G E2E network slices.

Cloud Network Slices

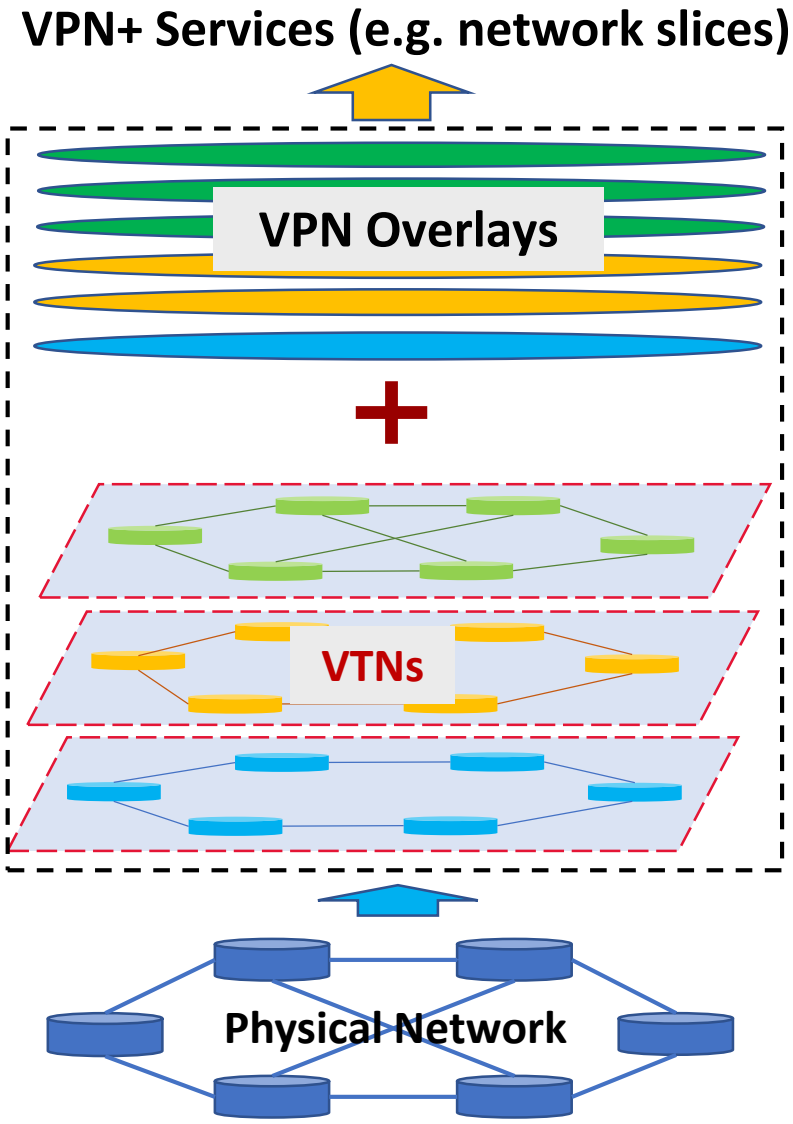


- Transport network slice provides service isolation and SLA assurance, meeting the requirements in various cloud network scenarios.

HUAWEI

Transport Network Slice Realization: VPN+

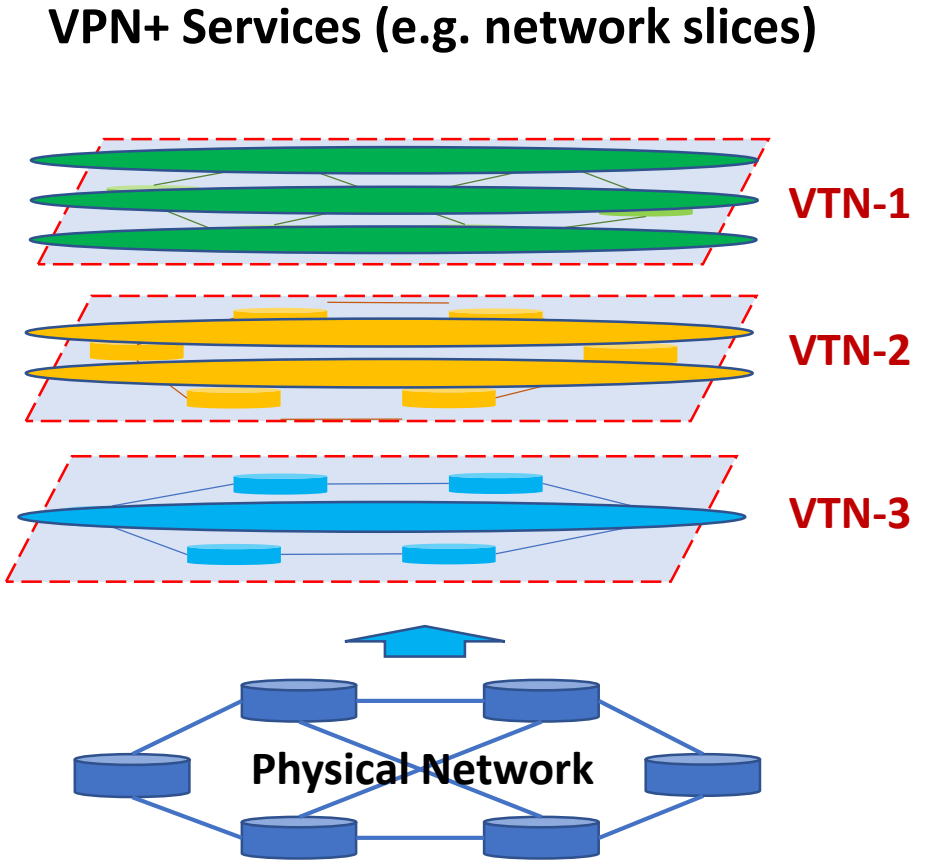
- Enable transport network slicing based on widely deployed VPN service model
  - Traditional overlay VPNs **cannot** meet all the requirements of network slicing
- Transport network slice is delivered as **enhanced VPN (VPN+) service**
  - With guaranteed network resources and performance commitment
- VTN is a **virtual underlay network** with a customized topology and a set of network resources allocated from the physical network.
- VPN+ is achieved by **integrating the overlay connectivity and underlay logical topology and network resources**
  - Overlay: VPNs (e.g. L3VPN, L2VPN, EVPN, etc.)
  - Underlay: VTNs (Virtual Transport Network)



https://tools.ietf.org/html/draft-ietf-teas-enhanced-vpn

Transport Network Slice Realization: VPN+

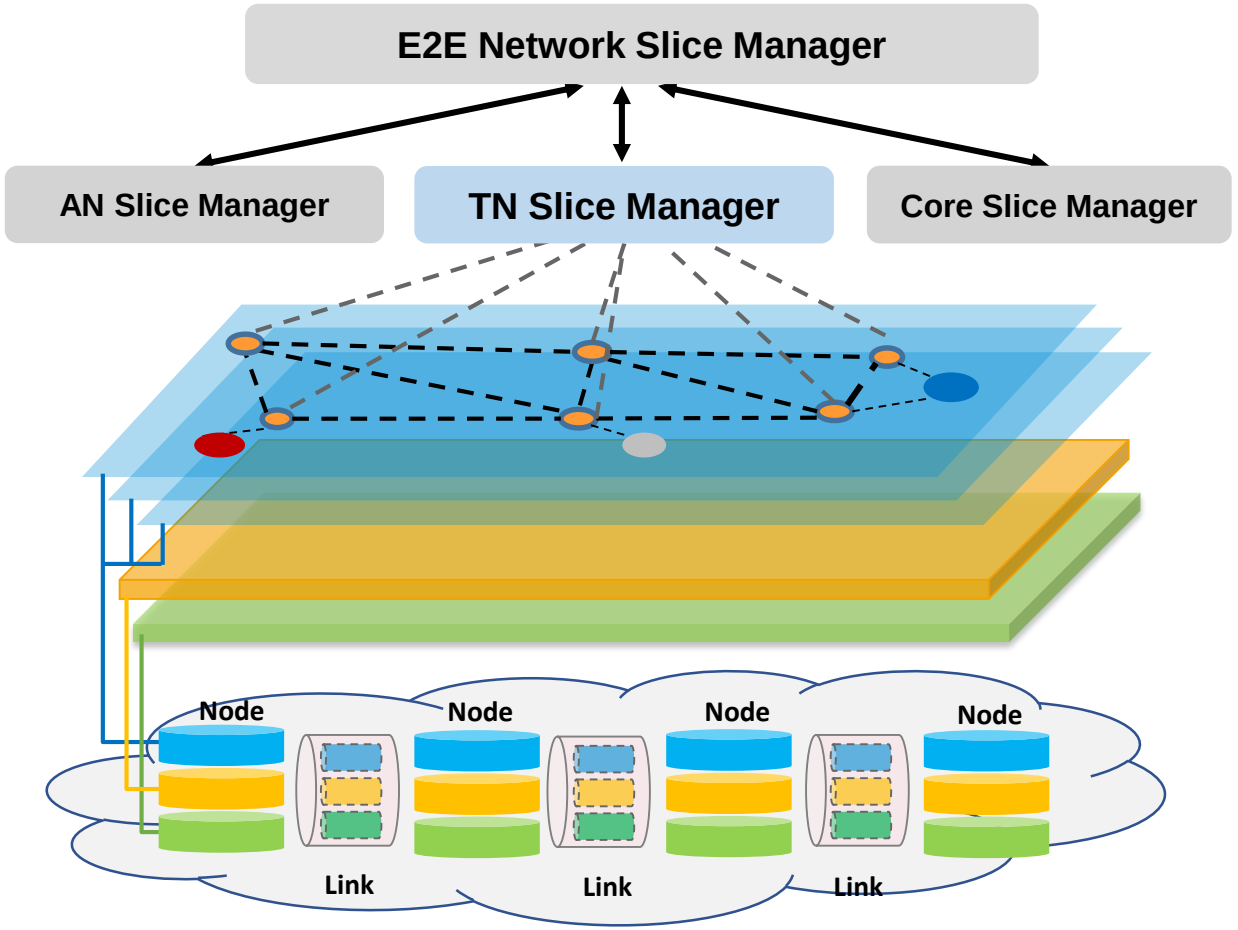
- Enable transport network slicing based on widely deployed VPN service model
  - Traditional overlay VPNs **cannot** meet all the requirements of network slicing
- Transport network slice is delivered as **enhanced VPN (VPN+) service**
  - With guaranteed network resources and performance commitment
- VTN is a **virtual underlay network** with a customized topology and a set of network resources allocated from the physical network.
- VPN+ is achieved by **integrating the overlay connectivity and underlay logical topology and network resources**
  - Overlay: VPNs (e.g. L3VPN, L2VPN, EVPN, etc.)
  - Underlay: VTNs (Virtual Transport Network)



https://tools.ietf.org/html/draft-ietf-teas-enhanced-vpn

HUAWEI

VPN+ Architecture for Network Slicing



Network Slice Management

- Interface for E2E network slice coordination
- Network slice life-cycle management
  - Creation, monitoring, adjustment, deletion

YANG Models

Network Slice Instantiation

- Integration between overlay connectivity and underlay network resources
- Customized path computation and resource-aware packet forwarding

IPv6/SRv6 Extensions

Network Resource Partition

- Physical interfaces
- Logical (sub-) interfaces (e.g. FlexE)
- Dedicated queues
- …

Underlay Innovations

https://tools.ietf.org/html/draft-ietf-teas-enhanced-vpn

Scalability is an Important Factor for Network Slice Deployment

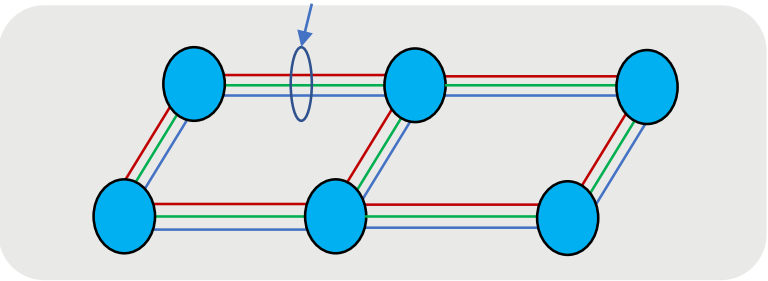
- Depends on the deployment scenarios, the number of network slices required varies from 10s to thousands or more.
- The scalability of network slice deployment MUST be considered in solution design.

Scenarios	Network slices for operator's internal use	Network slices for vertical industry	Network slices for both vertical and premium enterprises
Use Cases	Separation of mobile, fixed broadband and enterprise services	Smart grid, manufacturing, Health care, public safety, etc.	Various vertical and enterprise customers
Expected number of network slices	**~ 10**	**~ 100**	**~ 1000 or more**

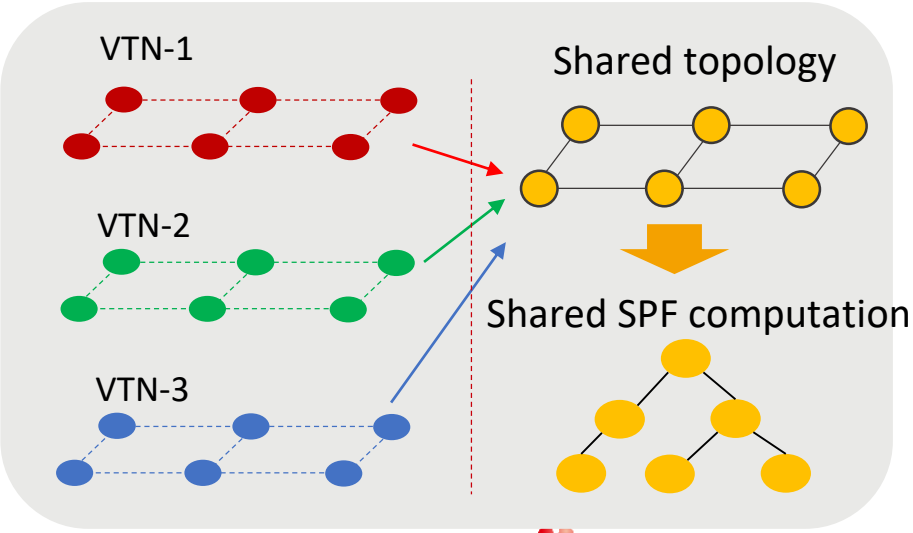
Control Plane Scalability Challenge and Optimization

- The number of control protocol instances/sessions for VTN information distribution
  - Use a shared control protocol instance/session for multiple VTNs
- The amount of information advertisement and path computation by network nodes
  - Decouple the advertisement and processing of the topology attribute and the resource attribute of VTN
  - The benefit of sharing the topology and SPF computation among multiple VTNs
- Divide up the computation load between the centralized controller and the distributed control plane
  - A hybrid control mode is recommended

- 1 IGP instance, 1 IGP adjacency for multiple VTNs



- Shared topology and SPF computation between multiple VTNs

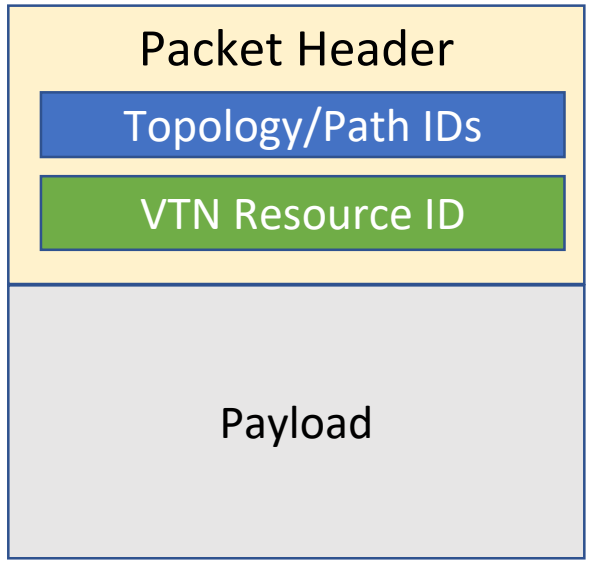


https://tools.ietf.org/html/draft-dong-teas-enhanced-vpn-vtn-scalability

HUAWEI

Data Plane Scalability Challenges and Optimization

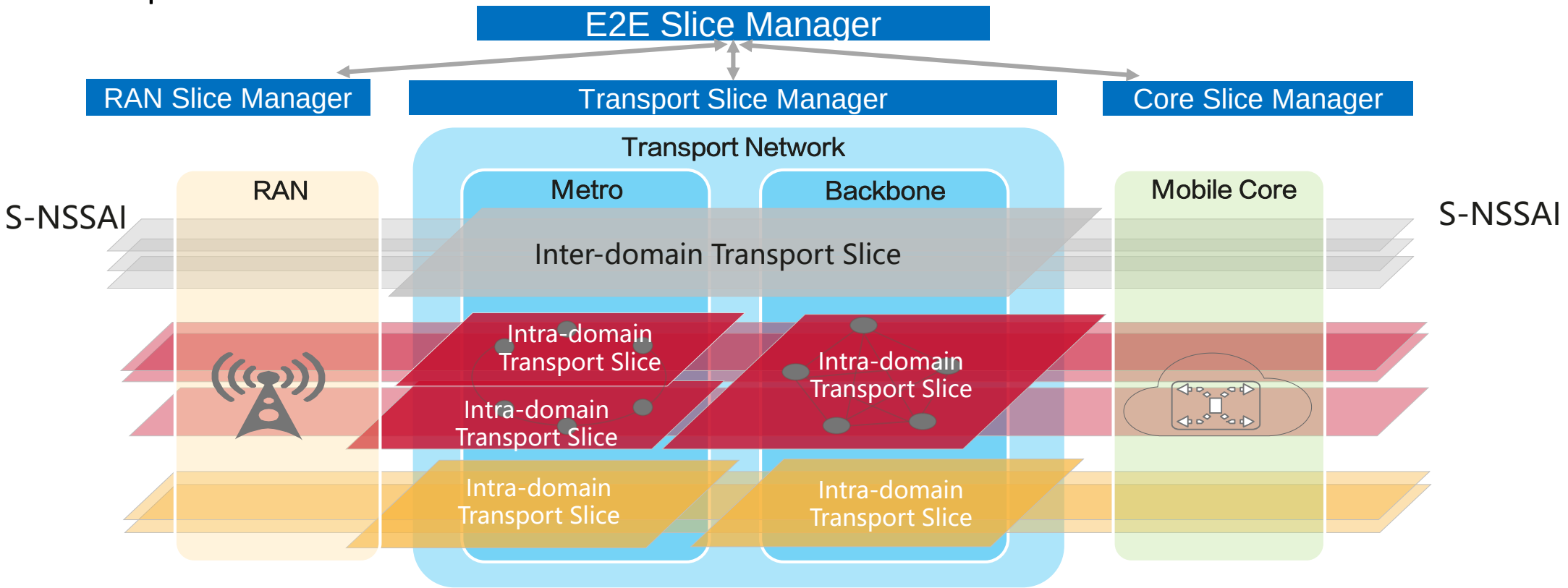
- Reduce the impact to the forwarding table scalability
  - Decouple the Resource-ID from the Topology/Path IDs in packet forwarding
- Introduce a dedicated data plane ID to identify the set of resources allocated for per-VTN packet processing
  - IPv6 data plane
    - Destination IP address is used to determine the topology/path
      - Optionally with the help of SRH
    - A new VTN resource ID in IPv6 HBH is used to identify the set of resources used for per-VTN packet processing
  - MPLS data plane
    - The MPLS forwarding labels are used to determine the topology/path
    - A dedicated label or extension header may be used to identify the set of resources used for per-VTN packet processing



https://tools.ietf.org/html/draft-dong-teas-enhanced-vpn-vtn-scalability

End-to-End Network Slice Integration

- 5G end-to-end network slice is delivered by concatenating the RAN slice, Transport Slice and Core Slice
  - Transport network slice may further consists of multiple sub-slices in different domains
- The end-to-end network slice integration requires coordination in the management plane and mapping in the data plane

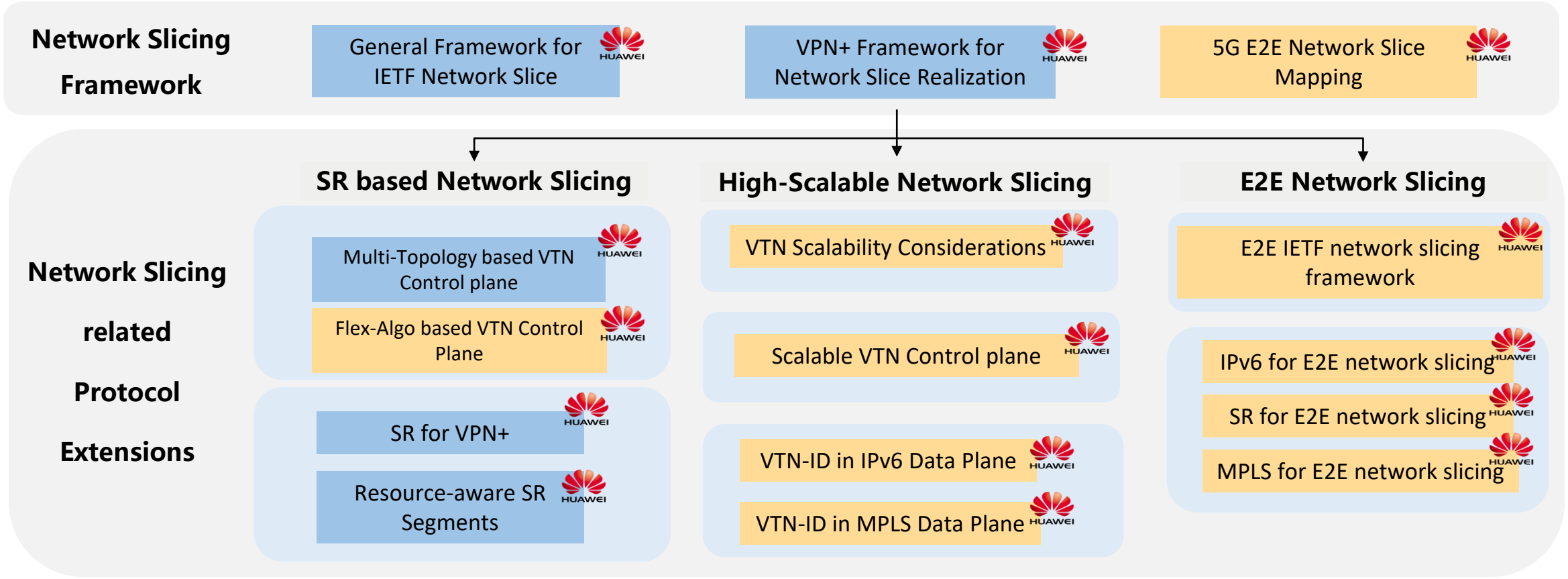


https://tools.ietf.org/html/draft-li-teas-e2e-ietf-network-slicing

HUAWEI

Network Slicing Standardization in IETF

- **IETF is responsible for the standardization of "transport" network slice**
  - Named "IETF network slice" to limit the scope and solve the debate on the term "transport"
  - Covers both the technology-agnostic network slice definition and technology-specific network slice realization



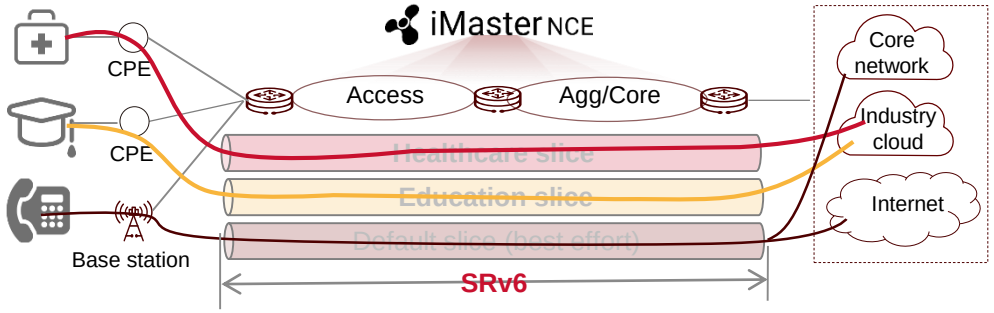
VPN+ Network Slice Deployment Cases

Operator N: Network Slicing for Multiple Vertical Industrials

Healthcare

Education

Public Internet



Operator H: Network Slicing for Fixed-Mobile Convergence

Private Line

Mobile

Home

Deployment Cases	Scenarios
Operator N	Multi-industrial network
Operator H	Fix-Mobile Convergence
Operator P	Premium Private Lines
Operator B	Separating different service types
Operator L	Separating different service types
Operator X	Multi-industrial network
Operator J	Multi-industrial network
Operator C	Multi-industrial network
Operator H	Multi-industrial network
Operator H	Multi-industrial network
Operator G	Governmental affairs

HUAWEI

Take Away

- Network Slicing is essential for enabling diversified business
  - Both for 5G and Cloud networks
- VPN+ provides the architecture and solution for network slice realization
  - Evolve towards thousands of network slices
- Deployment of network slices has started
  - More experiences with network slicing will be obtained

Thank you.

Bring digital to every person, home, and organization for a fully connected, intelligent world.