IoT Control Center – On-Demand Network Slicing and Assurance

Guaranteed service quality, digital resilience, and control with on-demand network slicing

Are you a communication service provider looking to empower enterprise customers with dedicated network slices and predefined quality of service for new services? Or a connected car OEM seeking visibility into the underlying network for SLA compliance? Cisco's market-leading IoT Control Center provides the right functionalities, technology stack, and consumption model to accelerate mobility-based service creation with digital resilience.

Overview

Enterprises, especially connected vehicle OEMs, are looking to leverage connectivity to regain control of the end-customer experience and monetize advanced onboard features. They are investing heavily in conceptualizing a brand new immersive in-car user experience with infotainment applications, Advanced Driver Assistance Systems (ADAS), and other marketplace solutions such as in-car purchasing. These applications will be offered as subscription services, pivotal to their revenue diversification strategy. Major automotive OEMs like GM and VW have signaled their

intent to phase out smartphone mirroring in newer models, aiming to take back control.

To succeed in this strategy and deliver a delightful end-customer experience, OEMs need full visibility and control over the network services that provide the underlying connectivity. Historically, Communication Service Providers (CSPs) have struggled to support this control due to monolithic network functions, fragmented operations and assurance vendors, and limited-service segregation capabilities. However, with 5G, software-defined networks, and

network slicing, CSPs can now meet these requirements through their deployments.

Cisco's Mobility Services Platform with its market-leading IoT Control Center solution offers CSPs network automation, orchestration capabilities, a fully cloud-native packet core, and a unified user experience to support self-serve service creation (network slicing and dedicated data networks) tailored to enterprise needs. This empowers CSPs to enable the revenue diversification strategies of connected vehicle OEMs through immersive in-car experiences and subscription services.

Benefits

Cisco's solution offers a range of compelling benefits:

- **Rapid service deployment:** Deploy a network slice-based service with a dedicated Data Network Name (DNN) from end to end in minutes, enabling swift time to market for new enterprise services.

- **Digital resilience:** Digital experience assurance with AI-insights, proactive and pre-emptive recommendations, and automated operations to help deliver flawless digital experiences with simplified operations, and enhanced security.

- **Unified enterprise experience:** Use a single portal for network management, subscriber lifecycle management, and connectivity management, providing a seamless and unified experience for enterprises.

- **Accelerated service innovation:** Expedite prototyping and enablement of subscription services and driving revenue diversification strategies for enterprises.

- **Value-added services:** Empower CSPs to move up the value chain, offer value-added digital services, and unlock new monetization opportunities.

- **Self-healing networks:** Establish a foundation for self-healing networks with predictive intelligence and automated service assurance, helping ensure resilient and reliable connectivity.

- **Granular traffic classification:** Augment network slices and DNNs with Cisco's self-serve traffic classification, enabling precise classification of data streams based on commercial constructs with application content providers.

- **Seamless automation:** REST API-based automation simplifies the enterprise user experience and enables scalable operations, with extensibility to TM Forum standards.

- **Optimized service inventory:** Optimize service inventory with dedicated slices tailored to specific industries and enterprises, enabling customized solutions.

Unlocking revenue streams with connected car subscription services

According to ABI Research, the growing Enterprise IoT market segment will account for over 50% of Service Providers' 5G revenues in the next decade. The connected car industry is a prime example of this trend. The global connected car subscription business is expected to reach about $65 billion, with each connected car OEM striving to diversify its revenue streams through software-enabled subscription services as part of its growth strategy.

For instance, General Motors, a major global OEM headquartered in the United States, plans to generate $135 million in incremental revenue per month with new connected, onboard services – Super Cruise (an ADAS application), Maps+, OnStar Insurance, OnStar Vehicle Insights, Marketplace, and Connected Dash Camera – as highlighted during its Investor Day 2021 event. Software-defined vehicles are

also enabling personalized collaboration applications (likely with stringent Quality-of-Service [QoS] expectations) for consumers to stay connected while on the go. Ford's recent partnership with Cisco to enable Webex conferencing paves the path for mainstream adoption by other OEMs.

Each of these applications will have its own dedicated QoS and Service-Level Agreement (SLA) requirements. Enterprises will require the ability to drive rapid prototyping by creating new mobility services to aid with device and application certification. Service providers have a unique opportunity to capitalize on this market by empowering enterprises with full visibility and control, enabling them to launch and monetize new subscription services using Cisco® IoT Control Center. Figure 1 represents a broad spectrum of use cases for a connected car with its unique service requirements.

Connected Car (advanced) 5G mobility use-cases
Assurance KPIs

Safety and Security, Telematics

Predictive maintenance with diagnostics

OTA updates (cybersecurity correction, driving features, etc.)

Telematics, Fleet Management and Location based services

OEM led usage based insurance

Consumer Experiences

Infotainment applications, Wi-Fi hotspot

Accident Avoidance: Lane Merge, Hazardous Location Warning

Ecommerce/marketplace for 3rd party apps

C-V2X and ADAS: HD Maps, VRU protection services, VPA, Tele Operated Driving, etc.

Connected Car use-case	Network Slice KPIs and QoS requirements
Infotainment applications	High data rate (throughput) and high priority
OTA SW update	High data rate (throughput) and high/low priority
C-V2X (HD Maps and ADAS)	High data rate (throughput), low latency, reliability and positioning
C-V2X (AI powered VPAs)	High data rate (throughput), low latency, reliability
Accident Avoidance	High data rate (throughput), low latency, reliability and positioning
Diagnostics/Telematics	Low data rate (throughput) and low priority

Figure 1.   Use cases for connected car 5G mobility

Enabling secure and reliable enterprise connectivity with on-premises network slices

Enterprises that require physical and logical isolation of network services, but do not need a fully private network, are considering network slices to obtain secure and reliable connectivity for their cellular-enabled devices and select applications. For instance, large airports (for passenger terminals) and connected vehicle OEMs with smart manufacturing facilities are exploring seamless interoperability with a CSP's macro network.

CSPs have a significant opportunity to serve these enterprises by leveraging their macro spectrum and deploying localized edge (User Plane Function) and packet core components as a network slice on a Multi-access Edge Computing (MEC) host closer to or inside the enterprise premises. This approach opens the possibility of procuring mmWave spectrum and strategically deploying small cells or repeaters to leverage this spectrum for Ultra-Reliable Low-Latency Communications (URLLC) type applications, such as Augmented Reality (AR), Virtual Reality (VR), new traffic control systems, and high-speed robotics used in manufacturing.
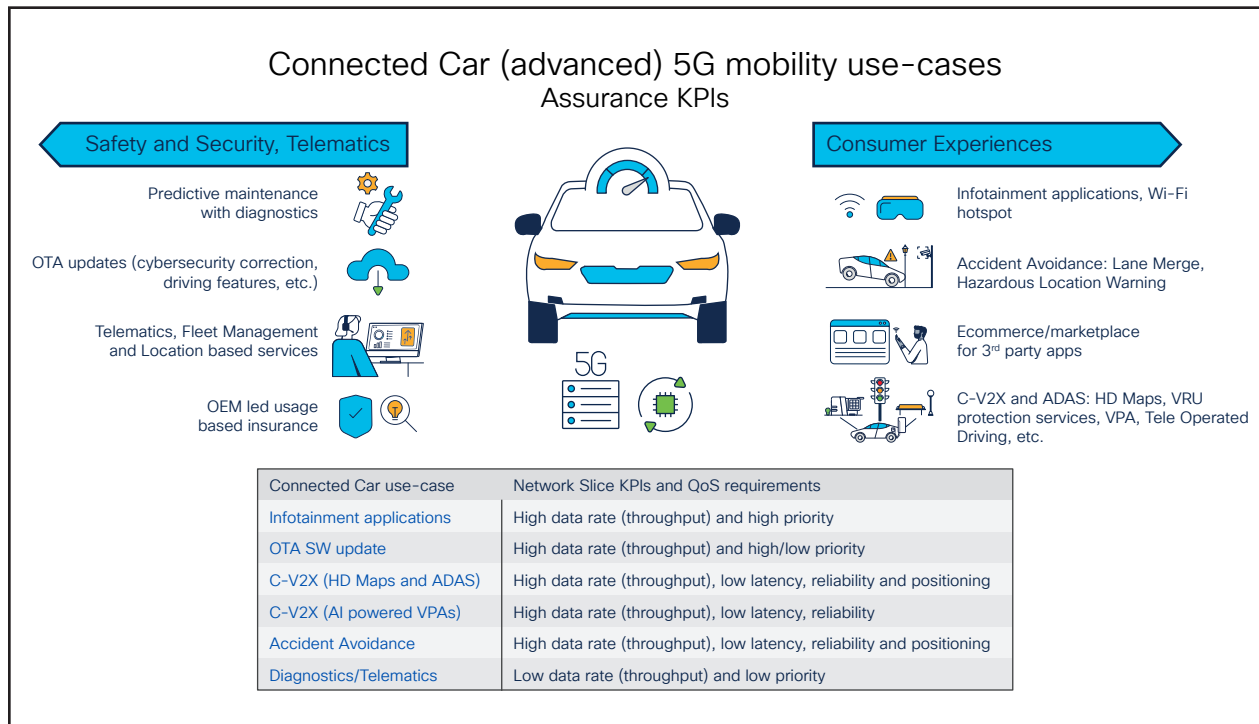
This framework also empowers enterprises to procure SD-WAN devices (using a CSP's digital buy flow) with embedded connectivity and serve them with the same network slice, interoperating with the underlying business applications. Additionally, it presents a future possibility for CSPs to optimize their overall spectrum inventory with carrier aggregation to boost network performance. Figure 2 presents an overview of private-macro interoperability with 5G – and each of these could be network slices.
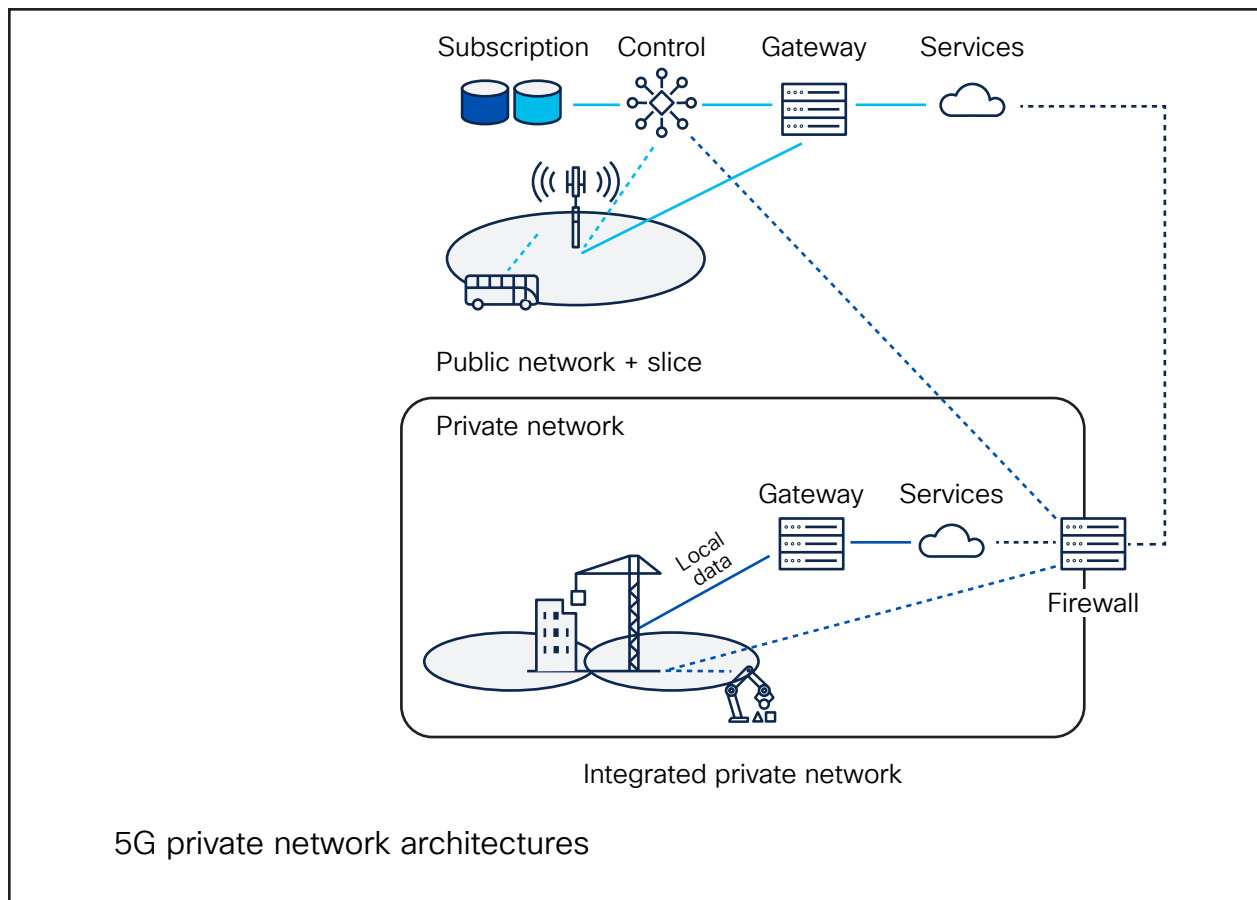

Figure 2.   Private-macro interoperability with 5G

Empowering the developer ecosystem with network programmability

The broader application developer community (enterprise, consumer, gaming, etc.) and enterprises are looking at optimizing business outcomes by leveraging API-based network programmability. For example, a connected car enterprise using a private network slice could drive slice-based traffic prioritization to reposition manufacturing-assisting robots using hyper-accurate positioning technology in an indoor scenario. The same technology can also be used by the same enterprise to assist their ADAS applications, which could be served by dedicated low-latency, high-data-throughput network slices. Device OEMs like Apple[1,2] are also enabling this slice-based selection to serve on-device applications in a macro and private context. CSPs like T-Mobile[3] are empowering the developer community to test video calling applications that require steady uplink and downlink speeds, lower latency, and increased reliability. We're at the cusp of a transformative opportunity for CSPs to empower enterprises to get full visibility and control and, in the process, drive monetization up through the value chain.

1. **Apple Brings 5G Network Slicing Closer to Reality**

2. **Apple Device Support for Private 5G and LTE Networks**

3. **It's Time to Unleash Network Slicing**

4. **Transforming Enterprise and Industry with 5G Private Networks**

How it works

CSP partners can choose to get Dynamic Network Slicing as an optional feature of the Cisco IoT Control Center Advanced Network/premium services offer. They can choose from one of two integration options: Cisco APIs integrated with a CSP network orchestration stack and the underlying core network, or enabled through Cisco's full-stack IoTaaS solution (preintegrated with our homegrown network orchestration stack), which is easy to consume.

For each enterprise application or service that requires network slicing, Cisco will enable CSPs with a self-serve option to model commercial SLAs for these services with supporting slice templates and onboard these slice templates into IoT Control Center to help drive network provisioning of a slice. A slice instance post-network provisioning will be added to the Control Center Slice Catalog/service inventory. Control Center users can activate this slice-based service and assign the slice to a subscriber to help with Protocol Data Unit (PDU) session establishment. Users can manage the lifecycle

of network slices and subscribers and have the checks and balances to ensure that a subscriber is served by an active slice on the network.

Figure 3 illustrates a conceptual overview of how CSPs can empower enterprises to configure the service parameters and drive deployment of a network slice. The actual network provisioning of a slice is orchestrated by a tight-knit handshake between IoT Control Center and the orchestration stack that controls outcomes on the end-to-end network (including the Radio Access Network [RAN], transport, and core).
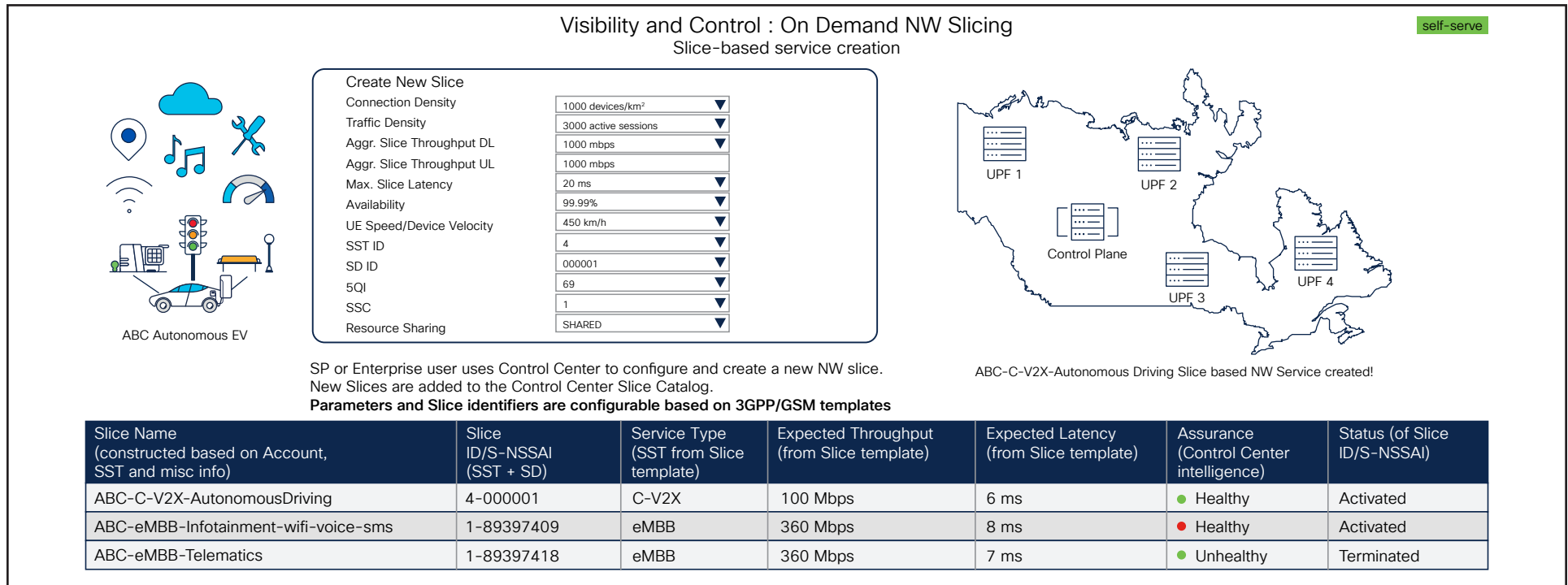
Visibility and Control : On Demand NW Slicing
Slice-based service creation

`self-serve`

Create New Slice

Connection Density	1000 devices/km² ▼
Traffic Density	3000 active sessions ▼
Aggr. Slice Throughput DL	1000 mbps ▼
Aggr. Slice Throughput UL	1000 mbps
Max. Slice Latency	20 ms ▼
Availability	99.99% ▼
UE Speed/Device Velocity	450 km/h ▼
SST ID	4 ▼
SD ID	000001 ▼
5QI	69 ▼
SSC	1 ▼
Resource Sharing	SHARED ▼

ABC Autonomous EV

UPF 1 UPF 2 Control Plane UPF 3 UPF 4

ABC-C-V2X-Autonomous Driving Slice based NW Service created!

SP or Enterprise user uses Control Center to configure and create a new NW slice.
New Slices are added to the Control Center Slice Catalog.
Parameters and Slice identifiers are configurable based on 3GPP/GSM templates

Slice Name (constructed based on Account, SST and misc info)	Slice ID/S-NSSAI (SST + SD)	Service Type (SST from Slice template)	Expected Throughput (from Slice template)	Expected Latency (from Slice template)	Assurance (Control Center intelligence)	Status (of Slice ID/S-NSSAI)
ABC-C-V2X-AutonomousDriving	4-000001	C-V2X	100 Mbps	6 ms	● Healthy	Activated
ABC-eMBB-Infotainment-wifi-voice-sms	1-89397409	eMBB	360 Mbps	8 ms	● Healthy	Activated
ABC-eMBB-Telematics	1-89397418	eMBB	360 Mbps	7 ms	● Unhealthy	Terminated

Figure 3.   On-demand network slicing

The process of enabling a slice-based service and assigning it to a subscriber consists of three key steps:

1. A CSP or enterprise user can leverage the interactive UI with a drop-down or import from a prepopulated Excel template the configuration parameters that describe the network service SLAs. This process of provisioning an end-to-end slice on the network typically takes several minutes to a few hours and depends on the complexity of the underlying deployment and sophistication of the technology stack.

2. Once a slice is provisioned on the network, it will be added to the Slice Catalog in IoT Control Center. The Slice Catalog is typically an inventory of all network slices that are live on the network, whether dedicated or shared among enterprises and applications. CSP users can also manage the lifecycle of these slices on their network using the Slice Catalog. For example, they can terminate a service to release network resources or deactivate a slice temporarily to help with operational enhancements.

3. On activation, a CSP or enterprise user could typically assign a slice to a subscriber using a slice identifier as part of the services that are allowed during session establishment.

Use cases

Figure 4 shows network slicing-based use cases across industries. Table 1 also articulates different types of connectivity-enabled services.

	Industrial routers	HD Cameras	Connected car	Smart banking	Gaming venues	Telemedicine
Industry vertical	Utility, Retail, Travel and Infrastructure	Utility and Public Safety	Automotive	FinTech	Entertainment	Manufacturing and Healthcare
Use cases	Wireless hotspots for Smart Office, Smart Grids, Retail, Smart Travel Service	Public safety and Smart Grids	Diagnostics, Wi-Fi, Infotainment, navigation, FOTA/SOTA, telematics, C-V2X for autonomous driving	SmartPOS terminals, ATMs	AR/VR headsets and streaming	Remote surgery and smart manufacturing
5G Service requirements	Broadband Slice	Broadband Slice	Broadband, Low-Latency Slices	Broadband Slice	Broadband, Low-Latency Slices	Massive, Broadband, Low-Latency Slices

Figure 4.   Use cases based on network slicing

Industry	Use case description
Connected vehicle	• Predictive maintenance and fleet management with telematics and diagnostics • Retail consumer subscription services with Wi-Fi hotspots and infotainment applications • Cellular vehicle to everything (C-V2X) and high-definition mapping applications for autonomous driving assistant systems • Emergency services with firmware and software updates over the air (FOTA/SOTA)
Utilities, retail, travel, and infrastructure	• Wireless hotspots for smart offices, smart grids, retail, and smart travel service
Public safety	• Wireless-enabled high-definition cameras for public safety and smart grids
Smart manufacturing	• AR- and VR-enabled headsets, new traffic control systems, or high-speed robotics used in manufacturing • Slice-based traffic prioritization to reposition manufacturing-assisting robots using hyper-accurate positioning technology
Healthcare	• Secure private on-premises network slices for wearables, AR/VR headsets, and other connected assets • Remote healthcare and telemedicine to transfer tomography files securely
FinTech	• Smart branch office connectivity with 5G leased lines to serve smart point-of-sale terminals, ATMs, etc.
Entertainment and broadcasting	• High data throughput, reliable, secure, and transitory network slices to support broadcasting use cases

(1)   Mythbuster: Slice up 5G outcomes

"We reached a huge milestone, pulling off the country's first use of 5G network slicing for remote video production on a commercial network. This customized slice gave the broadcast team supercharged wireless uplink speeds so they could easily and quickly transfer high-resolution content from cameras and a video drone circling the event to the Red Bull production team in near real time over T-Mobile 5G. And when I say supercharged uplink speeds, I'm talking up to 276 Mbps!"

John Saw
EVP & Chief Technology Officer, T-Mobile

[1] **Source: It's Time to Unleash Network Slicing**

(2)   Secure the enterprise

"T-Mobile SASE with T-SIMsecure and Security Slice is yet another example of innovation being delivered to our business and government customers. Not only does this complement and expand our security portfolio to offer protection for corporate networks, applications, and data — it also reinforces our commitment to leverage our 5G leadership for good."

Callie Field
President, T-Mobile Business Group

[2] **T-Mobile Unveils SASE Solution with Two Industry-First Capabilities**

The Cisco Advantage

As the foundational component of Cisco's Mobility Services Platform, IoT Control Center stands as the industry's leading connectivity management platform, serving over 250 million subscribers today. Dynamic Network Slicing, an optional premium feature, provides CSPs with a robust technology stack and intuitive consumption model (UI/API) to rapidly bring innovative, mobility-based enterprise solutions to market.

Cisco's comprehensive enterprise networking portfolio demonstrates our deep understanding of unique enterprise needs. We closely monitor the LTE to 5G transition, helping ensure seamless migration while enabling tailored outcomes across industries through various offerings (Cisco Private 5G, mobile IoT, consumer broadband, etc.).

Moreover, Cisco provides connectivity services for over 50% of these subscribers, built on a robust foundation – an industry-leading converged 5G standalone packet core. Our efforts are centered around driving monetization up the connectivity value chain, creating new revenue opportunities for our customers.

With Dynamic Network Slicing, CSPs can leverage Cisco's technology leadership, industry expertise, and comprehensive portfolio to unlock the full potential of 5G and drive innovation in enterprise mobility solutions. Gain a competitive edge and accelerate revenue growth with Cisco's cutting-edge offerings.

Our goal is to build innovative features that can deliver tailored outcomes across industries, connecting people, places, and things through various offerings.

Leverage Cisco to launch and monetize advanced network services

Connected vehicle OEMs: Are you seeking to regain control and launch seamless, brand-new subscription services tailored to your consumers?

CSPs: Are you aiming to leverage your 5G (and underutilized LTE) spectrum to launch secure, slice-based fixed wireless access services with a digital buying experience? Or kickstart an enterprise developer ecosystem with slice-based network programmability?

Unleash the full potential of your offerings with Cisco's Dynamic Network Slicing. Our cutting-edge solution empowers you to deliver innovative, tailored services, unlock new revenue streams, and gain a competitive edge in rapidly evolving markets. Take the leap and prepare your business for the future with Cisco's industry-leading technology and expertise. To learn more about Cisco IoT Control Center, visit: **https://www.cisco.com/c/en/us/solutions/internet-of-things/iot-control-center.html**.

To learn more about Cisco Mobility Services for IoT, visit **https://www.cisco.com/c/en/us/products/wireless/iot-mobility-services/index.html**.

To learn more about Cisco's Mobility Services Platform, visit **https://www.cisco.com/c/en/us/solutions/collateral/internet-of-things/mobility-services-platform-so.html**.

To learn more about the broader 5G IoT market landscape and how to unleash the power of 5G, visit **https://www.cisco.com/c/en/us/products/collateral/wireless/iot-mobility-services/5g-iot-services-wp.html**.

For a demo of IoT Control Center, contact your local Cisco sales representative.