



Digital Solutions for Cisco Connected Mass Transit

Transforming the Transit Experience

BENEFITS

- Improve passenger experiences with way finding, Internet connectivity, accurate real-time information, and a network infrastructure that can securely transport wireless payments through third-party mobile applications.
- Increase operational efficiency and reduce operating and capital expenses with interconnectivity and information sharing between vehicles, bus stops, stations, maintenance yards, operations centers, staff, passengers, and an analytics platform.
- Increase visibility into operations and boost safety with video surveillance, real-time vehicle monitoring and tracking, and other location-based services.
- Build a resilient, reliable, and scalable network infrastructure using ruggedized equipment and Cisco Validated Designs and architectures for Connected Mass Transit.

longer have to incur the costs - or work around the inefficiencies - of managing and maintaining duplicate network and communication functions. Operations, passenger safety, and communications no longer need to be siloed in closed, single-purpose, proprietary systems.

What if you could securely and reliably connect your entire mass transit ecosystem - vehicles, stations, bus stops, maintenance yards, operations centers, and even passengers - to deliver a safe, efficient, and enjoyable mass transit experience?

Overview

Whether your organization manages bus, train, tram or trolley operations, you have three major imperatives:

- Ensuring the safety and security of both passengers and employees
- Operating efficiently and within budgets
- Creating a passenger experience that encourages future ridership

Many transit operators manage these objectives individually through different communication systems and networks. But now, with increasing migration towards digital solutions, you no

Instead, digital solutions for Cisco Connected Mass Transit provide a single, standards-based, end-to-end network architecture that supports multiple services. It also helps enable vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications as well as V2X, which is a combination of V2V and V2I as well as vehicle to anything communication. Use this open network to connect vehicles and cost-effectively run operational applications, such as computer-aided dispatch (CAD) and automatic vehicle location (AVL). Attract and retain riders with innovative, best-in-class passenger services and mobile applications.

“The Cisco Connected Mass Transit solution converges aging, disparate, and proprietary networks into a single resilient, secure, multiservice, standards-based communication infrastructure.”

With a secure, reliable, and interoperable network that connects passengers, drivers, operations centers, vehicles, bus stops, stations, video cameras, and digital signs, completely new possibilities emerge. Transformation is no longer just a concept - it's a capability.

Trends and Challenges

Is Your Transit System Running Behind the Times?

Mobile devices, cloud-hosted services, and social media are rapidly merging and increasing demand for mass transit that better serves an urban and connected population.

Today's passengers want reliable, predictable, easy-to-navigate transit services. They expect transit operators to provide a connected experience throughout their journeys. And they require accurate, up-to-the-minute arrival and departure time information, when and where they need it.

Many transit systems, however, are running behind the times. In some cases, operators are even learning of breakdowns and delays from their passengers, who have more timely and accurate information from social media than they can get from their own systems.

That's because today's mass-transit systems are often based on single-purpose, proprietary, non-interoperable subsystems that are individually sourced from vendors. To further complicate things, some vendors bundle their telecommunication applications and systems, causing redundancies.

All of this adds up to redundant and disparate systems that don't communicate with each other. These systems are costly and time consuming to acquire, operate, and maintain. And then there's the huge amount of valuable information that's lost or never used.

For example, analyzing video from onboard surveillance cameras can help organizations improve driver and passenger safety. But few have the time or the staff to manually collect the stored media from each vehicle and then pour through it.

Now, with the Cisco Connected Mass Transit solution, you can converge aging, disparate, and proprietary networks into a single resilient, secure, multiservice, standards-based communication infrastructure. One that enables:

- Issue detection and vehicle telematics for proactive maintenance and reduced downtime
- Digital signage with real-time information
- Real-time video monitoring and recording, onboard vehicles and at stations, bus stops, and maintenance yards
- IP-based voice, video and data communications
- Wireless passenger Internet connectivity and access to third-party mobile applications

The result? A vastly improved passenger experience. Increased safety and efficiency, greater mobility, and reduced capital expenditures (CapEx) and operational expenses (OpEx), and a smaller carbon footprint. The ability to offer new services gives you a competitive edge and the opportunity to transform your business model on a platform designed for future growth.

How It Works: Components of a Connected Transit Ecosystem

The Cisco Connected Mass Transit solution is part of our family of Connected Transportation solutions, which provide connectivity at stations, airports, and ports, and onboard buses, planes, trains, ships, and emergency response as well as other connected vehicles.

It's built on a standards-based, open, interoperable, scalable network that provides the performance, features, security, and intelligence needed to support best-in-class operational applications and passenger services from Cisco and our partners.

Cisco Validated Design

Our Cisco Validated Designs (CVDs) for mass transit provide the foundation for systems design based on tested and validated use cases. It incorporates a broad set of products, technologies, features, and applications to address your specific industry needs. It's been comprehensively tested and documented by Cisco engineers and our partners to ensure faster, more reliable, and predictable deployment. The Cisco Connected Mass Transit Design and Implementation Guides explain the use cases and configurations that have been validated and tested, providing additional documentation for connected transit vehicles, bus and trolley stops, maintenance yards, metro area network, operation centers, and network management software. Cisco Validated Designs set us apart from other vendors and provide added peace of mind as you embark on the digitization of your transit operation. For a copy of Design and Implementation Guides for Cisco Connected Mass Transit, contact your Cisco Account Team or email us at connected_trans@cisco.com.

Transit Vehicles

Cisco Industrial Ethernet 2000 and 4000 Series Switches (see Figure 1) provide resilient and reliable connectivity with Gigabit Ethernet and Power over Ethernet (PoE) support for a range of onboard devices, including

- A vehicle logic unit (VLU) with mass transit operations software, such as CAD and AVL
- An open, ruggedized server platform to run Cisco Video Surveillance Manager (VSM) and other software
- Up to eight onboard IP video cameras for recording video and responding to safety-related incidents
- Digital signage for passenger information and display systems (PIDS)
- Cisco 829 Industrial Integrated Services Routers (see Figure 2)
 - The 829 connects through an adapter to the vehicle's controller area network (CAN) bus to record and communicate telematics information throughout the network. The 829 also provides wireless connectivity, including Wi-Fi access for passengers and intelligent off-board connectivity over 3G/4G/LTE when in motion and Wi-Fi when parked.
 - The multiservice, onboard network provides partitioning and security, so passenger and operational data are secure and kept separate. The Design and Implementation Guides provide network configuration information to make the onboard network easy to deploy across a fleet of transit vehicles.

Figure 1. Cisco Industrial Ethernet 4000 Series Switch



Figure 2. Cisco 829 Industrial Integrated Services Router



Stops and Stations

Like with transit vehicles, the 829 router connects stations and bus stops along the route, tying digital devices to a station network using either Gigabit Ethernet or Wi-Fi connections. The 829 also provides backhaul over 3G/4G/LTE or Gigabit Ethernet. The station network may include the Cisco Video Surveillance 3050 IP Camera with wide dynamic range (WDR), plus digital and audio I/O integration in a rugged housing, or a Cisco Video Surveillance 7070 IP Camera (see Figure 3) with a 360-degree capability. You can also connect digital signage to the station network, providing accurate, up-to-the-minute arrival and departure information.

Figure 3. Cisco Video Surveillance Camera 7070 IP Camera



Maintenance Yard

The maintenance yard network consists of a scalable, Wi-Fi-enabled infrastructure to provide secure, high-bandwidth wireless connectivity to upload video and data, and perform software updates for vehicles parked in maintenance yard. The ruggedized Cisco Industrial Wireless 3702 Access Point (see Figure 4) provides 802.11ac Wave 1 Wi-Fi coverage while the 3050 and 7070 video surveillance cameras strengthen yard security and monitoring capabilities. The Cisco Catalyst® 3850 Series Switches (see Figure 5) provide Gigabit Ethernet with PoE connectivity for the wireless network and video surveillance. These switches also offer stacking capability for redundancy and easy expansion, routing functions for branch systems in the yard, and redundant 10 Gigabit Ethernet uplinks to a metro network.

Figure 4. Cisco Industrial Wireless 3702 Access Point



Figure 5. Stackable Cisco Catalyst 3850 Series Switch



Metro Network Infrastructure

The Cisco Connected Mass Transit solution requires a highly scalable and resilient metro network infrastructure. A Cisco Unified Multiprotocol Label Switching (MPLS) transport network, built with Cisco ASR 900 Series Aggregation Services Routers (see Figure 6) and multiple 10 Gigabit Ethernet, transports traffic between maintenance yards and back-end systems in the operations center, across the geographic region serviced by your operations.

Figure 6. Cisco ASR 903 Router



Operations Center

The operations center, where all centralized systems and infrastructure reside, includes the dispatch center, data center, and internetwork peering functions to connect to mobile and Internet service providers. The Cisco Unified Computing System™ (Cisco UCS®) hosts all back-end systems and storage for all services.

The dispatch center can include the following capabilities:

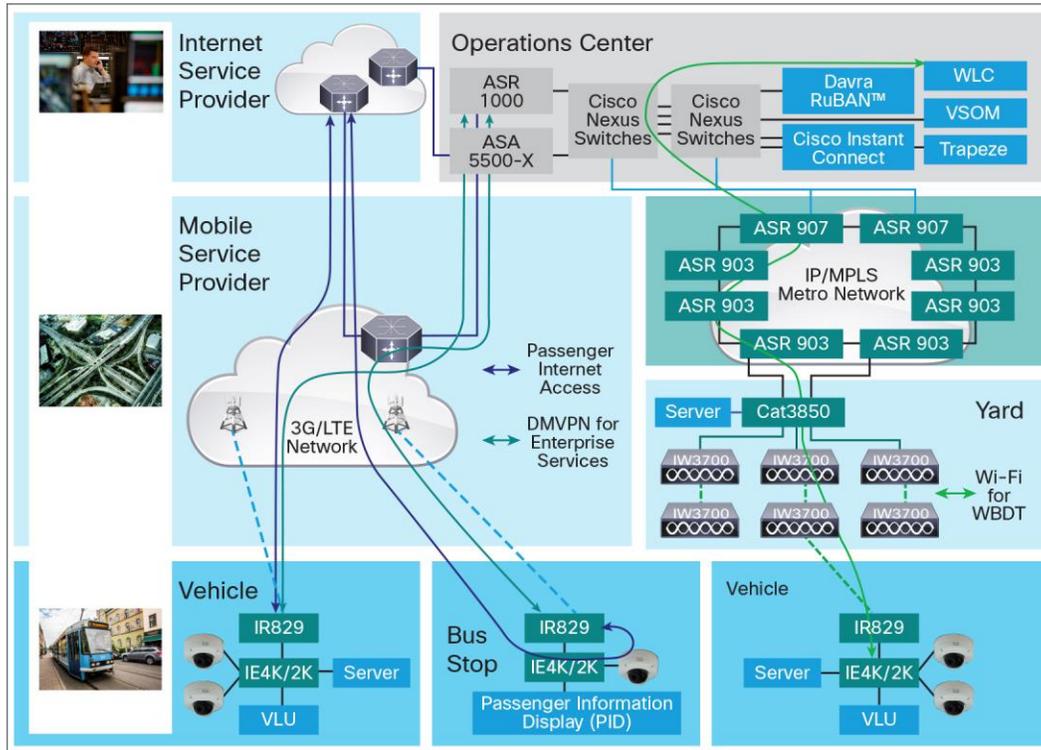
- CAD and AVL software provided by Cisco partners
- Davra RuBAN™ software for vehicle position tracking, telematics, and driver behavior monitoring
- Cisco Video Surveillance Operations Manager
- Cisco Instant Connect (CIC -formerly Cisco IPICS) server for push-to-talk voice communication with drivers
- Cisco Wireless LAN Controller (WLC 5500) to support the yard Wi-Fi network

Internetwork peering capability, built on Cisco ASA 5500-X Next-Generation Firewalls and the Cisco ASR 1000 Series Aggregation Services Routers, provides the user-to-network connections needed for contracted Internet and mobile vehicle connectivity services.

Network Management

The Davra Networks RuBAN™ platform provides management of the Cisco network infrastructure for Connected Mass Transit. RuBAN™ delivers zero-touch configuration functionality for field deployment of new devices in the field, simplifying network deployment and maintenance. The platform also can provide capabilities, such as vehicle tracking and management, geo-fencing, arrival-time prediction, and driver management tools.

Figure 7. High-Level Architecture of Cisco Connected Mass Transit



Use cases

Table 1 shows several Connected Mass Transit use cases.

Table 1. Connected Mass Transit Use Cases

| | |
|---|--|
| Fleet Tracking and Management Services | <ul style="list-style-type: none"> • Communication infrastructure for CAD and AVL • Vehicle GPS tracking and geo-fencing • Vehicle telemetry and data collection • Asset provisioning and monitoring • Customizable dashboard reports • Policy-triggered events and alerts |
| Vehicle Two-Way Voice Communication | <ul style="list-style-type: none"> • Cisco Unified Communications Integration • Dispatcher IP turret and IP phone support • Cisco Instant Connect for support of legacy digital push-to-talk radio systems |
| On-Board Internet Service over Wi-Fi | <ul style="list-style-type: none"> • Passenger 802.11n Wi-Fi access on vehicle through the 829 router • Separate Service Set Identifier (SSID) for passenger Internet, push-to-talk voice, employee, and law enforcement with secure Cisco Dynamic Multipoint VPN (DMVPN) tunnel to an operations center for authorized users • Backhaul over Gigabit Ethernet or 3G/4G/LTE using the 829 router |
| Vehicle Safety and Video Surveillance | <ul style="list-style-type: none"> • Up to eight video surveillance cameras per mass transit vehicle • The 3050 WDR IP surveillance camera and 7070 360-degree IP surveillance camera • Immediate live streaming over cellular network with incident triggers • Panic button, contact closure, accelerometer, audio, and geographic event triggers • Marking of video segments for prioritized copying to long-term storage |

| | |
|--|---|
| Passenger Real-Time Information | <ul style="list-style-type: none"> • Estimated time of arrival (ETA) calculated by algorithms running in Davra RuBAN™ and displayed on digital signage display onboard vehicles, at bus stops, and in stations • RuBAN™ API for integration of applications, such as passenger smart phone apps |
| Wireless Bulk Data Transfer | <ul style="list-style-type: none"> • Bidirectional data transferred over Wi-Fi link for vehicles parked in the maintenance yard • Data transferred can include CAD and AVL system updates, as well as log files, video surveillance recordings, and software updates for other systems |

Many of the Cisco products in the Cisco Connected Mass Transit solution are part of the Cisco Internet of Things (IoT) System, a comprehensive set of products and technologies that create IoT solutions based on a systems approach that enables stronger security, lowers integration costs, and accelerates innovation.

“With a secure, reliable, interoperable network, completely new possibilities emerge. Transformation is no longer just a concept; it’s a capability.”

Product Components

- Cisco 829 Industrial Integrated Services Routers^{*}
- Cisco Industrial Ethernet 2000 or 4000 Series Switches^{*}
- Cisco Video Surveillance 3050, 6050, and 7070 IP Cameras^{*}
- Cisco ASR 1000 Series Aggregation Services Routers and ASR 903 Router^{*}
- Cisco Catalyst 3850 Series Switches (stackable)
- Cisco Industrial Wireless 3702 Access Point^{*}
- Cisco Unified MPLS
- Cisco UCS
- Cisco Instant Connect^{*}
- Cisco Video Surveillance Manager^{*}
- Cisco 5500 Series Wireless LAN Controllers
- Cisco ASA 5500-X Next Generation Firewalls^{*}
- Cisco embedded services routers^{*}
- Davra RuBAN™ software (provided directly by Cisco or from Davra Networks)
- CAD and AVL software provided by Cisco partners^{**}

Cisco SMARTnet® Services covers Cisco products with a competitive warranty and premium product support. In addition, solution-level support is offered for customers who want a single point of contact for your end-to-end, Connected Mass Transit Cisco Validated Design.

Why Cisco?

With Cisco Connected Mass Transit, you benefit from the expertise of Cisco and our partners. As the industry leader in networking, with a validated design for the infrastructure needed to connect mass transit operations, Cisco is the ideal partner to build out your network. You’ll get the features, performance, security, scalability, and reliability you need to support innovative and cost-effective mass transit operations now and into the future.

^{*} Cisco IoT System products

^{**} Component has been tested as part of the Cisco Connected Mass Transit solution, but is provided and supported by third-party Cisco partners.

Services

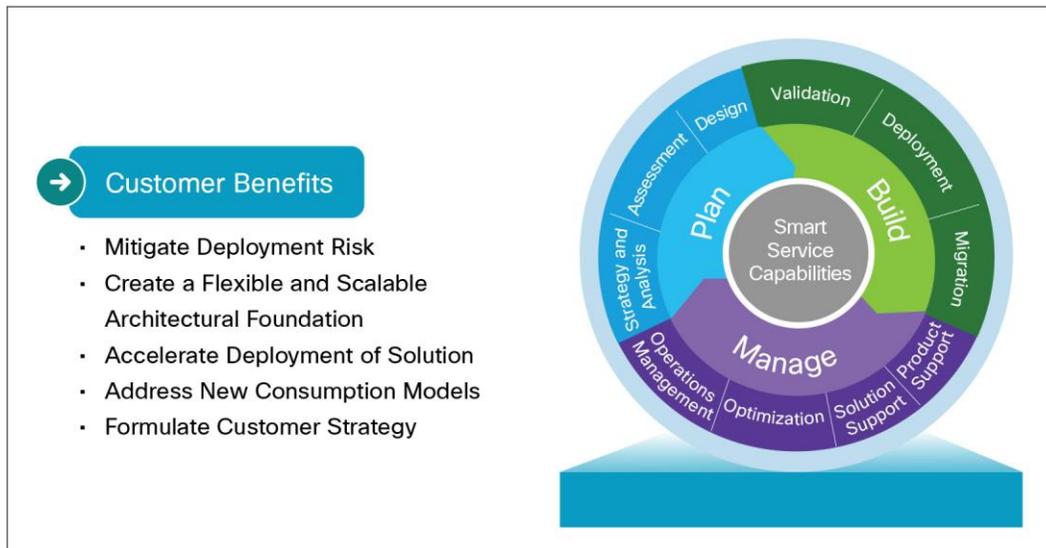
Cisco provides advanced services to help you ensure a successful deployment of your solution, for both Cisco Validated Designs and non-validated designs.

We can help turn your vision of a new digital mass transit network into reality, including assistance with the designing and building of:

- An onboard network for your mass transit vehicle fleet that supports integration with vehicle telemetry systems, onboard signage, video surveillance, voice communication, and dispatch systems
- Connected bus stops and transit stations that display accurate arrival time and other useful information on digital signage
- A high-performance wireless network in your maintenance yard that prioritizes and rapidly transfers the most important information
- A highly available, multiservice citywide network that securely ties together vehicles, maintenance yards, mobile networks, and the operations center

We can also assist with validation testing and migration from legacy systems. And our Cisco Technical Services and Advanced Services teams can stay on for continuing operations, management, and technical support. End-to-End Services for Solution Success

Figure 8. End-to-End Services for Solution Success



Cisco Capital

Financing to Help You Achieve Your Objectives

Cisco Capital[®] financing helps you acquire the technology you need to achieve your objectives and stay competitive. We can help you reduce your CapEx, accelerate business growth, and optimize your investment dollars and ROI. Cisco Capital financing gives you flexibility in acquiring hardware, software, services, and complementary third-party equipment. And there's just one predictable payment. Cisco Capital financing is available in more than 100 countries. [Learn more.](#)

Next Steps

To learn more about Cisco Connected Mass Transit solutions, visit <http://www.cisco.com/go/masstransit>.



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