The bridge to possible

Ascent of DSL with the Sunset of PSTN

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In today's digital world, it is pivotal for networking devices to have connectivity to applications wherever they are located, in an enterprise data center or in the cloud. When deploying operational technologies in the field, device management, monitoring, and troubleshooting tools require operators to be able to reach devices remotely. Key to this operation is a reliable and secure communication link between the systems and the remote devices. This is the glue that binds the remote field devices to the business.

To meet this business need, Industrial Internet of Things (IoT) devices can leverage diverse wired and wireless WAN connectivity options such as Ethernet, DSL, PSTN, Wi-Fi, 4G, 5G, and LoRa. The cost, coverage, and infrastructure availability drive the choice of connectivity for each deployment scenario.

In Europe and the United Kingdom (UK), for remote locations the analog public switched telephone network (PSTN) has been the preferred deployment option until now, due to its cost-effectiveness and ubiquitous availability. With the sunsetting of PSTN, service providers are leveraging the existing copper network to provide digital forms of communication such as xDSL. These changes have triggered a recognition that businesses must take a leap into modern digital technologies for operational monitoring and control of their critical IoT networks.

Here are some key factors that are making the transition to xDSL attractive.

- High cost of operating older-generation systems
- Removal of legacy systems that are out of date and out of support
- A controlled transition from legacy equipment and services to new IP-enabled devices
- A latitude to enable new, higher-bandwidth security and supervisory control and data acquisition (SCADA) services without major disruption or reinvestment in communication capability
- An opportunity for a managed service, leading to less reliance on specialists and expensive in-house technical skills

Cisco has been at the forefront of this transition and offers both cellular and wired options. We have introduced an xDSL Small Form-Factor Pluggable (SFP) module on the IR1101 to enable customers to migrate from PSTN to xDSL. The Cisco® 1101 Industrial Integrated Services Router (IR1101) offers 3G/4G/5G, fiber, and DSL uplinks through a single networking platform.

Figure 1. Cisco® IR1101 Integrated Services Router Rugged

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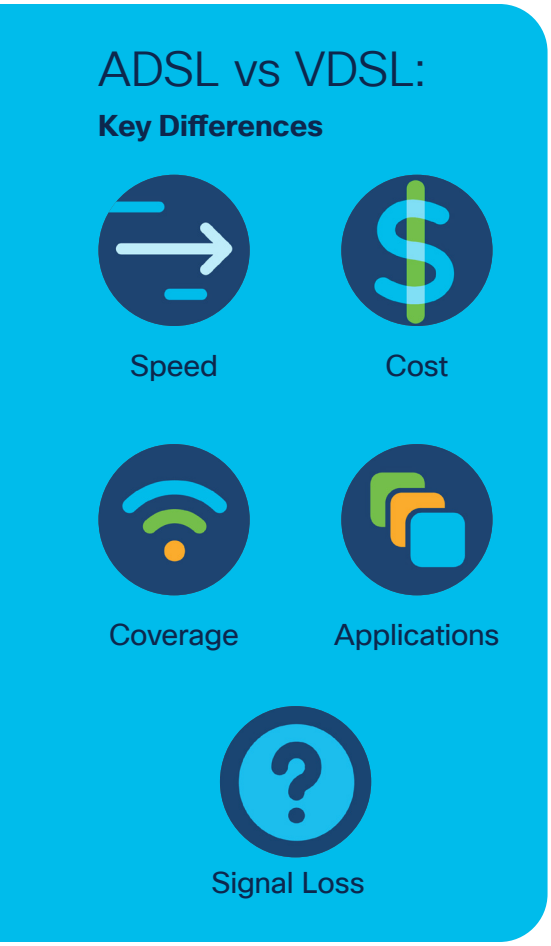


DSL technology standards

Digital Subscriber Line (DSL) is a technology that brings high-bandwidth internet connections to businesses over ordinary twisted copper telephone lines. These broadband connections come in a variety of flavors. The Cisco DSL SFP supports the asymmetric DSL2 (ADSL2) and ADSL2+ and very high-speed DSL2 (VDSL2) standards and is capable of handling line-rate traffic. These standards differ in the speed of data transmission or data rate.

A broadband signal may travel considerable distances along the copper cable from the central office of the service provider to the street cabinet, and then along another cable from the street cabinet to the customer premises. The broadband signal suffers attenuation (loss) as it travels along the cable from the exchange to the broadband modem, therefore reducing the speeds that can be delivered to end users. ADSL connections are faster and provide more bandwidth downstream compared to upstream, which has to be considered when designing the network.

ADSL2 and ADSL2+ provide the greatest benefit for distances up to 3.0 km from the central office. Beyond that distance, they offer data rates comparable to ADSL. VDSL2 provides higher broadband performance up to 1.5 km. After 1.5 km, VDSL2 exhibits performance rates comparable to ADSL2/ADSL2+.

- The table depicts the maximum theoretical numbers for DSL technology.
- The actual data rate negotiated during the line training process is dependent on the profiles supported by the DSL access multiplexer (DSLAM), for example ADSL2/2+, VDSL2
- CPE's distance from the central office where the DSLAM is located, noise conditions, and other parameters associated with line quality will affect performance.

Table 1. DSL maximum theoretical performance

ADSL2/2+ Annex	Upstream*	Downstream*
ADSL2+ Annex A	1.4 Mbps	24 Mbps
ADSL2 Annex A	1.3 Mbps	12 Mbps
ADSL2 Annex B	1.8 Mbps	12 Mbps
ADSL2 Annex L	0.8 Mbps	5 Mbps

VDSL2 Profile	Upstream*	Downstream*
8a	15 Mbps	50 Mbps
8b	15 Mbps	50 Mbps
8c	15 Mbps	50 Mbps
8d	15 Mbps	50 Mbps
12a	22 Mbps	68 Mbps
12b	22 Mbps	68 Mbps
17a	50 Mbps	100 Mbps

* These are theoretical numbers only

Roadside infrastructure

Use cases for xDSL on IR1101

There are a variety of use cases in which xDSL is the WAN uplink of choice, here we will focus on the examples of roadside infrastructure and water management systems.

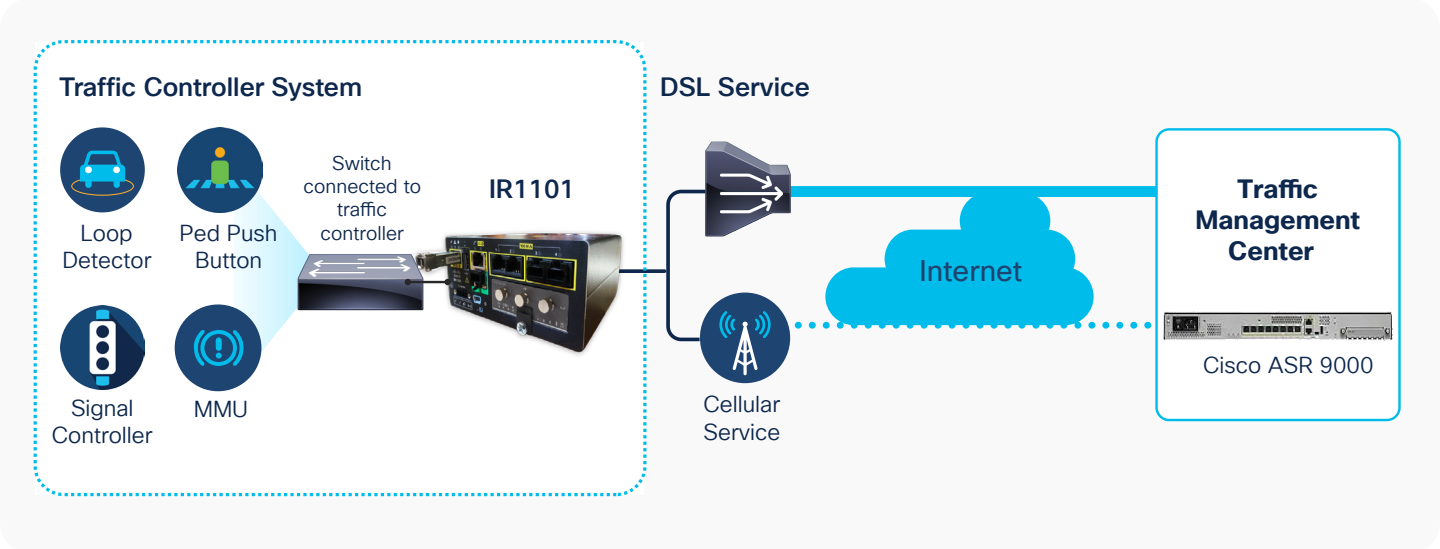
Roadside infrastructure

A public sector customer in the UK has one of the world's biggest city transportation networks of road and rail routes. They adopted an adaptive signal control (ASC) system as a cost-effective way to manage traffic flow in real time based on prevailing conditions and traffic congestion.

An ASC technology known as the split-cycle offset optimization technique (SCOOT) adjusts the traffic signal timings in frequent, small increments based on real-time traffic demand. This system uses inductive loop or wireless vehicle detectors to monitor traffic. The telemetry data is streamed to a central system for traffic flow modelling. Based on the telemetry data from multiple locations, a central system calculates signal timing for splits, offset, and cycle length. The new timing is programmed back to the traffic signal in real time. The optimized traffic flow results in people spending less time in traffic.

The Cisco IR1101, located in a street-side cabinet, provides reliable, all-weather connectivity with DSL for primary data connectivity and a 4G LTE high-speed cellular data connection for secondary data connectivity. It provides high bandwidth link between traffic signal and central system which is used for bi-directional flow of telemetry info. This allows traffic signal intersections to be connected in a secure, reliable manner regardless of their location.

Figure 2. Traffic control system



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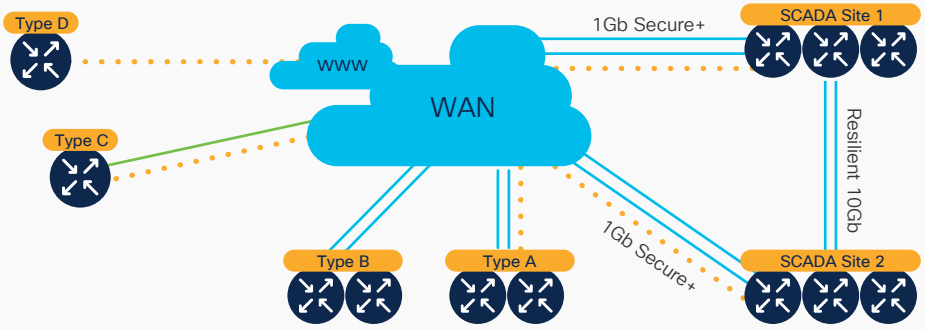
Water management system

A European utility enterprise customer manages a huge network of SCADA systems that provide water and sewage services for millions of customers. The water management is done through a SCADA system that uses hundreds of digital and analog sensors to monitor and regulate the flow of water, reservoir levels, and pipe pressure. These sensors are located at sewage pumping stations, reservoirs, water pumping stations, and water treatment plants. They measure data such as flow rate, valve pressure, and water levels in tanks.

They monitor and control assets are spread over 6000 remote locations. Key to this business is secure communication links between the systems and the remote devices. These links carry remote telemetry data for monitoring and control signals to automatically manage pump control systems.

For remote location without cellular coverage the DSL technology was selected. For a fully fault-tolerant uplink WAN network, Cisco IR1101s at every site are connected to a service provider network via redundant ADSL2+/VSDL and 4G uplinks. Each data center has a pair of Cisco headend devices, for example Aggregation Service Router (ASR), Cloud Services Router (CSR) or Integrated Services Routers (ISR) with multiple virtual routing and forwarding instances (VRFs) configured. The connection between the IR1101 and head-end routers is secured with Cisco FlexVPN or other VPN technologies. In addition, strong security enforcement is performed to protect the connected devices and sites. This topology provides a secure and independent fault domain with no single point of failure.

Figure 3. Water management control system



Site Type	Description
A	Fully resilient Fiber with 4G
B	Full resilient Fiber
C (IR1101 OT site)	xDSL with 4G fallover on single router
D	4G only

4G
Fiber
xDSL

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Key benefits


Security


Modular


Rugged


IoT Operation Dashboard


Inventory management


Partner Ecosystem

Key customer benefits

The Cisco IR1101 is the "swiss-army knife" of choice for customers transitioning from PSTN, while investing in future proofing solution. It helps protect customers' investments in their IoT deployments with the following competitive advantages:

- Provides a modular, expandable platform designed to reduce costs and eliminate forklift upgrades
- Is a ruggedized, industrial-grade platform suitable for deployment under extreme conditions
- Provides the capability to add and upgrade expansion modules to keep up with newer technologies such as 5G as they get rolled out
- Can be deployed on roadside infrastructure, substation cabinets, and utility cabinets, and can be mounted on a wall or horizontal surface using DIN rail or mounting brackets
- Has a small form factor (less than 2RU), low power consumption (10W), and fanless cooling, making it easy to install in space- and power-constrained cabinets
- Offers simplified inventory management and image management
- Can be managed using the Cisco IoT Operation Dashboard (OD), which manages platform software images and configuration and monitors platform health
- Secures all underlying communication between the platform and the applications using Cisco IOS-XE VPN technologies, i.e. FlexVPN
- Is backed by Cisco's world-class partner ecosystem and support

Orderability

Hardware	Description
IR1101-A-K9	Cisco IR1101 Integrated Services Router Rugged with SL-IR1101-NA software license
IR1101-K9	Cisco IR1101 Integrated Services Router Rugged with SL-IR1101-NE software license
SFP-VADSL2+-I	DSL Cisco SFP option for Cisco IR1101
SFP-VADSL2+-I=	Spare DSL Cisco SFP option for Cisco IR1101

Learn more about Cisco® IR1101 Integrated Services Router.

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