

VERIZON WIRELESS WHITE PAPER

Verizon Wireless Broadband Network Connectivity and Data Transport Solutions



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1. Introduction

Wireless connectivity and data transport solutions from Verizon Wireless allow companies to establish a private, direct connection between the enterprise network and the Verizon Wireless broadband network. A direct connection to the Verizon Wireless broadband network lets companies communicate with their mobile workforces with increased data response times, while reducing concerns over security and reliability.

This white paper introduces the Verizon Wireless network, depicts typical direct connection usage scenarios, discusses connectivity considerations, and explains all connectivity options with available IP addressing schemes to help the reader make informed decisions when planning and purchasing a wireless connectivity solution.

2. Network Architecture

It may be helpful to review basic wireless network architecture prior to considering which connectivity solution option best fits a business's data connectivity needs. Understanding network architecture will also clarify the point of egress from the Verizon Wireless network to the corporate network, and show how mobile users are serviced by the wireless network.

A direct-connect circuit can be established to the Verizon Wireless broadband data network from any enterprise network through a variety of common wireline connection types. Each wireline connection type is labeled in the following illustration as a direct circuit that runs between the enterprise network and the Verizon Wireless broadband data network.

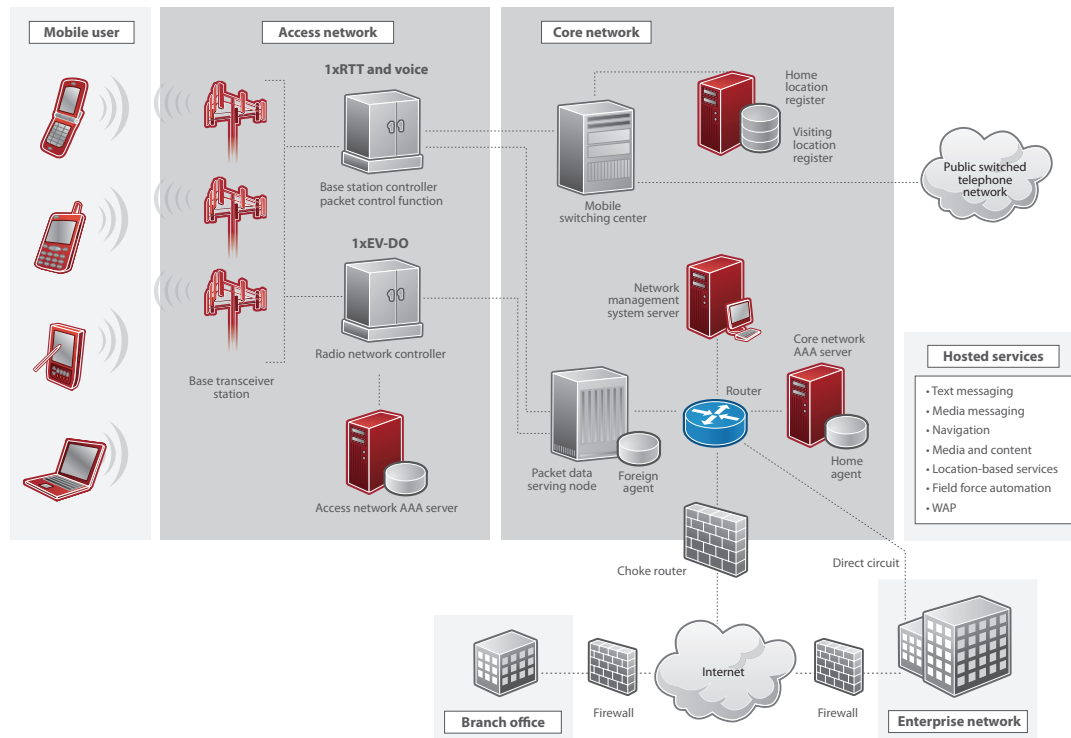


Figure 1: A simplified CDMA2000 1x data network showing 1xRTT and 1xEV-DO data structures

The Verizon Wireless broadband network comprises an access network and a core network as indicated in the previous network architecture diagram. With Verizon Wireless connectivity and data transport solutions, corporate customers can bring direct circuits into the core network through VPN, frame relay, T1 direct, or Multi-link Point-to-Point Protocol (MLPPP) connections. We will cover these core network access options in much more detail in a subsequent section of this white paper.

Mobile users access the Verizon Wireless broadband network via the access network, which provides an entryway into network services, including Verizon Wireless-hosted services and enterprise-provided network services. The Verizon Wireless broadband network uses CDMA-based 1xRTT and 1xEV-DO wireless radio broadband data standards for mobile user access to the network. Verizon Wireless now has deployed 1xEV-DO Rev. A throughout its broadband network. Typical Rev. A downlink speeds are 600 Kbps to 1.4 Mbps, while typical uplink performance is 500 to 800 Kbps.¹

3. Benefits of Implementing Direct Circuit Connections

Direct-circuit connectivity into a trusted provider's network core is an effective way for companies to improve data response times and lower latency to mobile users being serviced by the wireless network. Overall connection reliability improves with direct-circuit connections, because companies have a direct connection to the Verizon Wireless broadband network and avoid having to traverse the Internet. As a result, security threats are more contained. Verizon Wireless offers secure, reliable, and flexible access to their networks.

Secure

Data is one of business's most important assets and must be kept secure. Wireless broadband access provides enhanced privacy and security because the direct circuits are not routed over the Internet. Instead, data is transmitted through the Verizon Wireless broadband network, which reduces risk of interception or sabotage.

Reliable

Losing access to critical applications because they are down or unavailable is costly. Verizon Wireless provides businesses with America's most reliable wireless voice and broadband data networks and employs robust redundancy and maintenance measures to ensure network availability at all times. Verizon Wireless also supports redundant direct circuits for additional reliability.

Flexible

The ability to respond quickly to new or changing business requirements is essential for today's fast moving companies. Verizon Wireless provides a variety of flexible direct-circuit connectivity and IP addressing options to meet the unique needs of any business. And setting up a direct circuit with the Verizon Wireless broadband network is easy and affordable.

¹ When using a non-EV-DO Rev. A device, the user can expect download speeds of 400 to 700 Kbps and upload speeds of 60 to 80 Kbps.

4. Why Use Direct-Connect Circuits?

Direct-connect circuits have multiple uses for businesses of all sizes. Improved access speeds, low latency, and the added security of data not traversing the Internet all factor into a business's decision to use a direct-connect circuit. In conducting its day-to-day operations, a company may find that using a direct-connect circuit lends itself to a specific situation, such as credit card processing or temporary ATM machines at a concert venue, or to an ongoing business need, such as remote offices communicating back to corporate headquarters. Specific examples include:

- Corporate headquarters connecting to remote or branch offices that use wireless routers for primary or failover connections to communicate company-specific data and information.
- Enterprise to a temporary remote location, such as credit card transaction processing equipment or ATMs at an event site.
- Corporate to remote sites with no wired access, such as kiosks in a mall, a movie theater, or other retail setting.

Business wireless communications needs vary based on many factors, but most mobile or fixed-mobile wireless usage scenarios, where latency and data response times are important, can benefit from direct-connect access to the Verizon Wireless network core.

5. Connectivity Considerations

Direct-line or leased-line connections are typically permanent connections with fixed annual lease costs and carry no additional call charges, so they can provide faster data transfers on a fixed budget. Companies might consider installing a direct-connect leased line if they are facing any of the following common business problems:

- Mobile data bandwidth and performance needs have outgrown existing broadband connections.
- Multiple mobile users are simultaneously accessing corporate network resources such as the Internet.
- Increasing amounts of data or large files are being moved back and forth by mobile users.
- Web and mail servers are increasingly accessed by mobile users.
- Several broadband connections need to be consolidated for monitoring, firewall, and management.
- ISDN connection costs are much too high.

Some additional things to consider during the leased-line direct connectivity evaluation include:

Proximity to Point of Presence

Certain leased-line direct connections need to be physically installed between the nearest Verizon Wireless broadband network point of presence (POP) and the enterprise network, so installation costs will depend on location. Verizon Wireless can help businesses determine the best option to use when connecting into its broadband network.

6. Connectivity Options

Verizon Wireless has a variety of connectivity options for creating the connection between the enterprise network and the Verizon Wireless broadband network. Organizations can attach to the Verizon Wireless broadband network via VPN over Internet, single-frame relay, dual-frame relay, or multiple direct circuits. The best option depends largely on the organization's requirements for security, cost, and redundancy. The following chart illustrates the supported connectivity solution options.

Connectivity options			
Options	Benefit consideration	Consideration	One-time fee
VPN over Internet	<ul style="list-style-type: none"> • Low cost • Secure • Low redundancy 	<ul style="list-style-type: none"> • Not all VPN vendors are supported 	One-time set-up fee per connection
Single-frame relay	<ul style="list-style-type: none"> • Secure • Full routing control 	<ul style="list-style-type: none"> • Requires static or BGP routing • Verizon Wireless strongly suggests that customers implement Access Control Policies to protect their networks 	One-time set-up fee per connection
Dual-frame relay (To dual Verizon Wireless locations)	<ul style="list-style-type: none"> • Secure • Redundant • Full routing control 	<ul style="list-style-type: none"> • Same as single-frame relay 	One-time set-up fee per connection
Multiple direct circuits	<ul style="list-style-type: none"> • Secure • Some redundancy • MLPPP (required if static) 	<ul style="list-style-type: none"> • Same as single-frame relay 	One-time set-up fee per connection
Single direct circuit	<ul style="list-style-type: none"> • Secure • Full routing control 	<ul style="list-style-type: none"> • Same as single-frame relay 	One-time set-up fee per connection

VPN Connections

A VPN is a private network that uses a public network such as the Internet to connect users or remote sites together in a secure manner. VPN direct-connect solutions are extremely popular, due to their low cost to deploy. Instead of using a dedicated connection, such as leased-line direct circuits, the VPN option uses tunnels routed over the Internet from the company's private network to the Verizon Wireless network operations center. VPN tunnels are terminated by the Verizon Wireless VPN gateway.

This approach uses a business's existing connection to the Internet and requires IP Security (IPSec)-compliant VPN gateway equipment at the enterprise location. The Verizon Wireless VPN option secures the communication path between the enterprise location and the Verizon Wireless network operations center. Unlike a client-to-server solution, it does not secure the complete path from the mobile device to the enterprise's VPN gateway. A VPN solution also does not offer the typical reliability and controlled redundancy of leased-line direct connections.

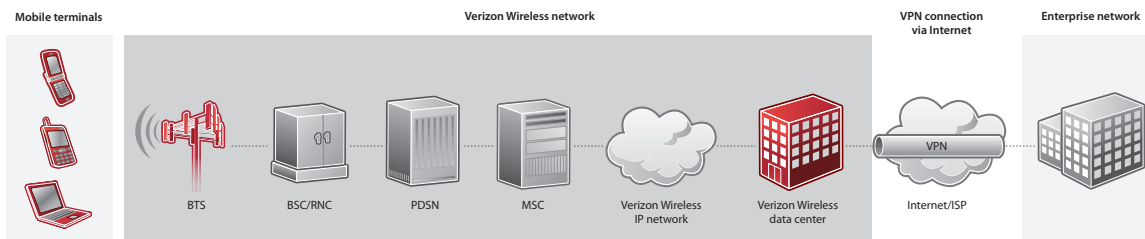


Figure 2. A customer VPN connection diagram

IPSec Protocol

The Verizon Wireless VPN solution uses IPSec, an IETF standard protocol for TCP/IP traffic security, to create a secure tunnel between the enterprise and Verizon Wireless VPN gateways. IPSec protocols authenticate the host computer, maintain data integrity, and encrypt data and shared keys. In IPSec tunnel mode, the entire IP packet is encrypted. This does not mean that the connection between the enterprise and the client is encrypted, but that the connection between the enterprise and the Verizon Wireless POP is encrypted.

Single Frame Relay

Frame relay is a data connection method where the telecommunications connection is established using a permanent virtual circuit (PVC). This PVC is a communications path that maps the physical circuit at the customer site to the physical circuit at the Verizon Wireless site. Frame relay is a popular option because it offers guaranteed bandwidth and accommodates spikes in traffic when the demand for bandwidth suddenly increases. Frame-relay circuits are available from fractional T1 data rates starting at 56 Kbps and can approach DS-3 rates of 45 Mbps.

T1 Direct

T1 direct telecommunication circuits are also available. There is typically an installation fee associated with this type of connection, based on the distance between the enterprise network and the closest Verizon Wireless POP. Fees are also influenced by local and long distance carrier rates for this service. This option is typically used when frame-relay services are not available locally or when long distances are not required. DS-3 direct circuits are available to customers on a case-by-case basis in certain areas.

Dual Frame Relay

To further enhance network reliability, consider creating redundancy with a dual-frame relay connection. Dual circuits are typically established between two geographically different locations and provide redundant connections to redundant hardware (routers). Dual-frame relay circuits are popular when residency and durability of the connection are desired.

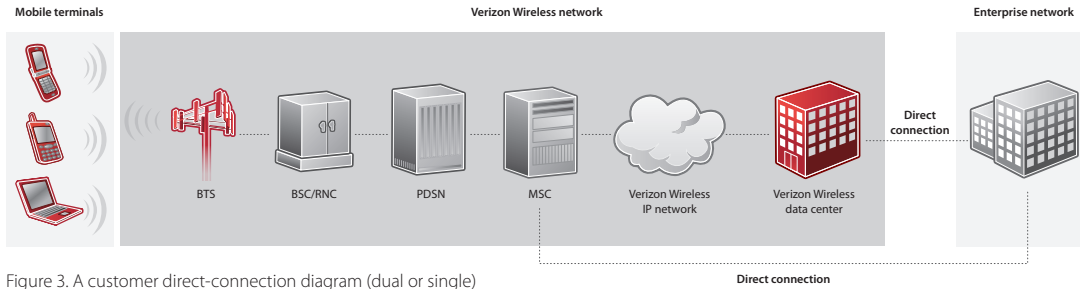


Figure 3. A customer direct-connection diagram (dual or single)

Multiple Direct

Verizon Wireless also supports MLPPP. MLPPP is a method of splitting, recombining, and sequencing datagrams/packets across multiple logical data links. Using MLPPP allows the bonding together of multiple T1 circuits to act as a single logical circuit connected to the Verizon Wireless network in order to increase bandwidth. For example, two T1 circuits can be bundled to effectively provide a single logical circuit that can supply over 3 Mbps with full-duplex capability. There is a one-time fee for each physical circuit connection.

7. IP Addressing

Verizon Wireless offers a variety of IP addressing options that provide differing levels of accessibility, protection, and manageability. It is increasingly important to organizations to be able to choose an IP addressing scheme that is appropriate for the architecture of the corporate network. The Verizon Wireless IP addressing options are designed to provide businesses with a wide variety of choices.

Public IP Addresses

Public IP addresses are IP addresses that can be reached by anyone on the Internet. While this address type is required to allow mobile-terminated connections where the host needs to access the remote device, security concerns are created by allowing public access to the device.

Private IP addresses are used for internal networking purposes and cannot be accessed from the Internet. For this reason, they do not easily allow mobile-terminated connections. Though the IP address options available from Verizon Wireless are public, restrictions are applied to Internet-restricted IP addresses, which has a similar effect as private IP addresses on the reduction of privacy problems.

Static or Dynamic Addresses

Static IP addresses are manually assigned and then never change. However, there are a finite number of available static IP addresses, and this shortage is causing network designers to issue dynamic IP addresses. Dynamic IP addresses are issued for the duration of the session, then reassigned to new sessions once they expire. Static and dynamic IP addressing schemes are supported by Verizon Wireless as indicated in the following table.

IP addressing options				
Type of address	Pool name	Designation	Benefits	Fee type
Dynamic public IP addresses	Unrestricted dynamic IP addresses	Verizon Wireless default pool	<ul style="list-style-type: none"> • Full Internet access • Supports “push” applications • Data is not “natted” or “proxied” 	No fee
	General dynamic protected IP addresses	Verizon Wireless custom pool Note: Certain devices receive this pool by default	<ul style="list-style-type: none"> • Full Internet access • Supports Verizon Wireless- branded push applications • Provides protection from “unsolicited” Internet-based traffic 	No fee
Static public IP addresses	Unrestricted IP addresses	Static IPs available by request only	<ul style="list-style-type: none"> • Full Internet access • Same IP each time there is access to the network • Administration • Easier firewall rules • Easier routing 	One-time fee
	Internet- restricted IP addresses	Static IPs available by request only	<ul style="list-style-type: none"> • Internet access is restricted • Same IP each time there is access to the network • Administration • Easier firewall rules • Easier routing 	One-time fee
Customer-provided private IP addresses	Private IP address pool ¹	Private IPs available by request only ²	<ul style="list-style-type: none"> • Extends the corporate LAN addressing scheme to the wireless workforce • Improved protection via tunneled data traffic • Easier firewall and routing administration 	One-time setup fee for private network One-time setup fee for connectivity

1 This option available only with Verizon Wireless private network.

2 When available.

8. Connection and Provisioning

Once a connection type and IP addressing scheme have been selected, a local or regional data solutions engineer from Verizon Wireless will coordinate the appropriate solution for the customer, from the choice of the correct wireless device, to the implementation process of the desired type of direct connectivity.

There is a one-time connection fee dependent on the connection type. To activate the connection and configure the IP addressing, contact a Verizon Wireless service representative. When the connection(s) are live, connectivity support can be obtained by calling 1.800.922.0204 and selecting option 3 on the menu, but support for the circuit will be the responsibility of the applicable service provider.

9. Why Verizon Wireless

A successful implementation of wireless connectivity is easy to achieve. As with wired connections, IT professionals must consider network architecture, usage scenarios, connection speeds, IP addressing, and security. Equally important is the wireless connectivity service provider.

Verizon Wireless is a world leader in network reliability, investing an average of \$5 billion annually to expand its network and increase capability. When wireless connectivity and data transport solutions are provided by Verizon Wireless, businesses can have confidence that they will have access to their network applications. The affordable connectivity

solutions from Verizon Wireless are flexible enough to support virtually any mobile application while providing the security that business customers require.

10. Terms and Conditions

Customers must use Verizon Wireless-provided WAN IP addresses for the point-to-point link and may not use their own IP address that has been assigned for their use. Additionally, Verizon Wireless does not provide a managed connectivity option in which Verizon Wireless would manage the installation and support of routers and circuits for a customer. Customers choosing the direct circuit, frame-relay, or VPN connection method will be charged a one-time Verizon Wireless port connection fee. Alternative connection methods will be available to customers on a case-by-case basis and only in certain locations, at the sole discretion of Verizon Wireless, and at prices to be agreed upon by the specific customer and Verizon Wireless.

Please note that these direct or VPN connections only provide the Verizon Wireless IP network and the customer IP network with the capability of connecting to each other. These connections do not enable the customer's fixed end systems (FES) on their enterprise network to access the Internet through the Internet connections from Verizon Wireless, or to connect to another customer FES. Verizon Wireless will not act as a service provider to the Internet from the customer FES connections, nor will it act as a transit network to the Internet.

11. Customer and Technical Support

For customer service or technical support, please contact a Verizon Wireless representative by calling 1.800.922.0204 and selecting option 3 on the menu.

12. Glossary of Terms

1xRTT (One times Radio Transmission Technology)—The first version of CDMA2000 technology that has typical downlink and uplink speeds of 60–80 Kbps.

1xEV-DO (One times Evolution Data Optimized) Rev. 0—The first phase of 1xEV technology that increases typical data download speeds to 400–700 Kbps.

1xEV-DO (One times Evolution Data Optimized) Rev. A—The updated phase of 1xEV technology that increases typical data download speeds to 600 Kbps–1.4 Mbps and typical data upload speeds to 500–800 Kbps.

AAA (authentication, authorization, and accounting)—A network server used for access control. Authentication identifies the user. Authorization implements policies that determine which resources and services a valid user may access. Accounting keeps track of time and data resources used for billing and analysis.

AN (access network)—A network that grants end user access to the network core and network services.

BGP (border gateway protocol)—The routing protocol that carries information across the Internet.

BSC (Base Station Controller)—A distributed computing structure of the access network that manages multiple Base Station Transceiver Subsystems (BTS), radio resources, and handoffs between BTS units within its domain. BSC-to-BSC handoffs are handled by the mobile switching center.

BTS (Base Station Transceiver Subsystem)—A structure of the access network that contains antennas, transmitting and receiving radio systems, encoding/decoding systems, and encryption/decryption equipment. Multiple BTS units are controlled by a BSC.

DS-3 circuit (Digital Signal 3)—Also referred to as a T3 line, a digital telephone connection or circuit that offers data speeds of 44.736 Mbps.

FES (fixed-end system)—Contains all infrastructure to maintain mobile communications systems, including base station transceivers, switching centers, and more.

HA (home agent)—A core network device that stores and forwards location and IP address information about a mobile station when it is away from the mobile station's home network. The home agent is used in conjunction with one or more foreign agents to manage mobile stations as they roam.

HLR (home location register)—A database in a cellular system that contains all the subscribers within the provider's home service area.

IETF (Internet Engineering Task Force)—A standards organization responsible for developing and promoting Internet standards, including TCP/IP protocols.

IP (Internet Protocol)—A network layer protocol used for communicating data over packet-switched networks. Typically encapsulated in a data link layer such as Ethernet, it provides a unique global addressing scheme for computing devices.

IPSec (IP Security)—A suite of protocols used to secure IP communications through authentication and encryption technology.

ISDN (Integrated Services Digital Network)—A circuit-switched telephone network that allows the digital transmission of voice and data over regular telephone wires.

MLPPP (Multi-Link Point-to-Point Protocol)—An extension to the point-to-point protocol that enables two channels to be linked together to double the throughput. It is used for ISDN transmission and channel bonding.

MSC (mobile switching center)—A core network switching structure that bridges the mobile telephone access network with another telephone network, such as the public switched telephone network (PSTN).

NAS (network access server)—A device that functions as an access control point for users in remote locations, connecting users to their company's internal network or to an Internet service provider.

PCF (packet control function)—Routes IP packets between the mobile stations connected to its associated BTS units and PDSNs.

POP (point of presence)—A point of access to the Internet, usually a collection of routers and servers housed in a physical location by an ISP.

PSTN (public switched telephone network)—A network composed of all public circuit-switched telephone networks, which includes digital, mobile, and analog systems.

PVC (permanent virtual circuit)—Used most often between hosts that communicate continuously, this is a circuit that is always available.

T1—A digital telephone connection or circuit that offers data speeds of 1.544 Mbps. It is made up of 24 separate channels, each capable of transmitting at speeds of 64 Kbps.

TCP/IP (Transmission Control Protocol/Internet Protocol)—A collection of communications protocols used to connect hosts to each other on the Internet.

VPN (virtual private network)—A private communications network used by companies to privately communicate over a public network.

13. Contact Information

For more information about Verizon Wireless, speak to a Verizon Wireless sales representative, visit verizonwireless.com, or call 1.800.VZW.4BIZ.