WAN Bonding: Enabling the Most Reliable Connections

Introduction

Reliable, redundant Internet connectivity is a core requirement for networks supporting business and transportation systems. Digi devices provide this capability with features such as Digi Surelink®, policy-based routing, and interface bonding.

These features help to prevent customer downtime caused by external network failures — a critical requirement. However, downtime isn't the only challenge. Cellular connections remain vulnerable to other disruptions inherent to wireless communication. Digi's WAN Bonding solution combines cellular and wired communication to achieve the low latency of the bonded connections, the fine-grained resilience of seamless handover, and throughput representative of the combined interfaces.

Theory

Traditional Bonding

Link aggregation/bonding — the ability to balance traffic from multiple clients over several interfaces — is a common feature of commercial routing software, but there are many restrictions and drawbacks that make it completely unsuitable for combining wired and cellular connections. The simple aggregation algorithms tend to provide the characteristics of the worst-performing interface and do not sufficiently handle the variability common in wireless data transmission.

Bondix S.A.NE

Digi WAN Bonding, powered by Bondix Simple Aggregation of Networks (S.A.NE), addresses these shortcomings. S.A.NE consists of two programs, one on the Digi device and one on an external virtual private server (VPS). The client program on the Digi device takes all traffic bound for the wider Internet and intelligently divides it between the selected interfaces based on metrics such as interface latency and consistency and priority assigned by the user. This divided traffic is reconstituted by the program on the VPS and forwarded on to its destination. Instead of being reduced to the performance of the worst interface, this bond takes interface performance into account when serving data.

Application

To increase throughput or availability of remote applications, two or more connections are often used. These can be any combination of fixed network or wireless connections — fiber, DSL, Wi-Fi, cellular, or satellite. Digi WAN Bonding powered by Bondix S.A.NE software manages the use of these different connections efficiently and easily. With the unique S.A.NE technology, customers enjoy a highly available connection and optimal throughput.

High Availability and Bonding

With a second connection through an alternate cellular network operator (or another WAN medium such as Wi-Fi or satellite), the customer can increase the bandwidth available (and uptime) for even a single TCP/IP connection, helping avoid issues with line failures or network problems at service providers.

With Digi WAN Bonding powered by Bondix S.A.NE, WAN scheduling is based on a range of policies and presets that are available in the S.A.NE client and can be selected by the user based on their requirements. With its very efficient bonding and extensive features, Digi WAN Bonding creates a highly resilient and cost-effective virtual uplink for mobile and fixed locations.

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High Availability and Bonding

Seamless backup	While multiple WAN uplinks are available, the running application uses only the primary uplink. If the primary uplink fails, the system automatically fails over to the next available interface/uplink without interruptions or disconnects.
Load balancing with seamless handover	Application data is distributed evenly over available WAN uplinks. The maximum available bandwidth for an application is limited by the available bandwidth of its assigned uplink. If one uplink fails, traffic is distributed to a different uplink. However, application performance may degrade after switching because there is now less available bandwidth.
Bonding (WAN aggregation)	The optimal solution for the simultaneous use of several WAN uplinks is Digi WAN Bonding. The user application benefits from the aggregated bandwidth drawn from multiple available WAN uplinks. S.A.NE optimizes the distribution of traffic flows across the various uplinks. This is particularly advantageous if the application requires more bandwidth than a single connection can provide.

Additional Features

Packet duplication	For low-latency real-time applications, this option reduces jitter and loss by replicating the user's packet-flow on two or more available WAN uplinks.
S.A.NE bonding proxy	A specialized optimization for TCP connections allows higher data throughput where uplink characteristics are vastly different (e.g. satellite and 4G).
Latency smoothing	By constantly monitoring the performance and latency of each uplink, S.A.NE bonding ensures a single uplink is never saturated, ensuring stable latency. Interactive, low-bandwidth streams are sent over the fastest link, while bulk traffic is distributed over all uplinks.
Optimal use of available WANs	Customers can easily add uplinks to enhance throughput of the fixed Internet uplink during peak periods. Digi WAN Bonding automatically utilizes additional uplinks as soon as more bandwidth is required, and keeps them on standby to reduce costs when bandwidth demands recede.

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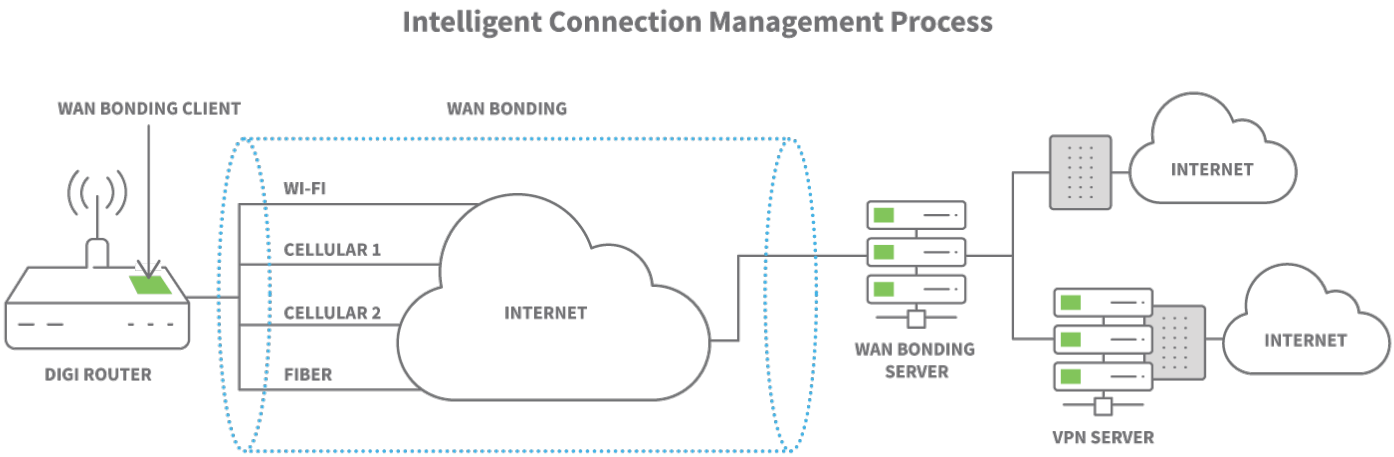
Architecture

The Digi WAN Bonding architecture consists of the S.A.NE client and the S.A.NE server (relay). The client software is installed on a Digi router and combines all existing WAN interfaces into a virtual tunnel. This tunnel can reside on any WAN connection type and uses the S.A.NE server as a relay that forwards the data to the Internet (or intranet).

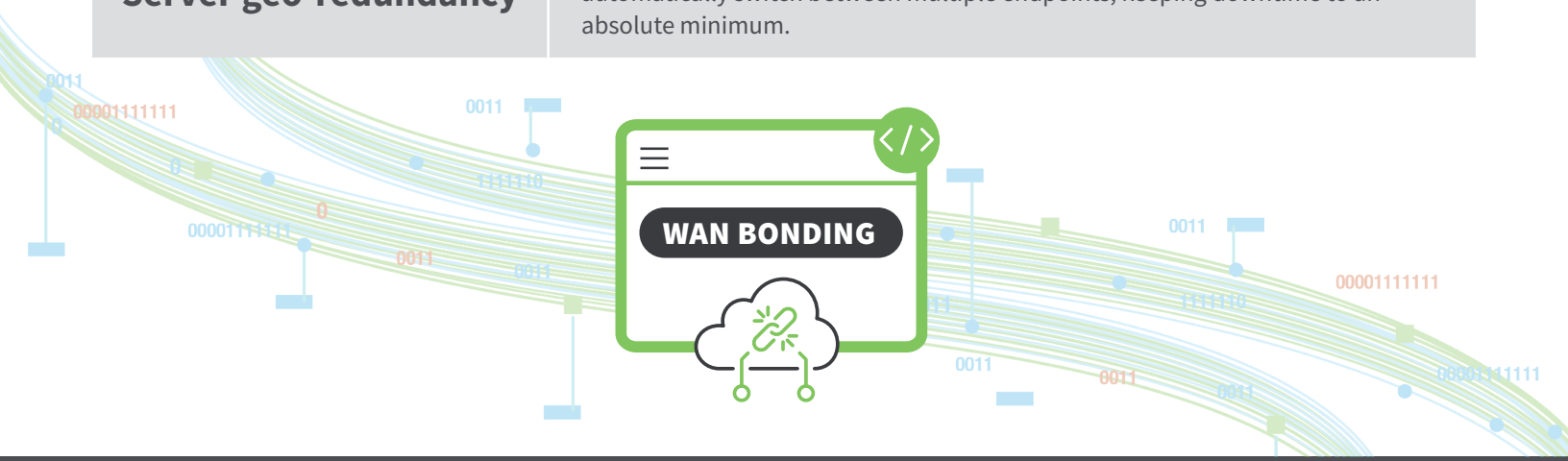
The following example provides an overview of a common router that uses a S.A.NE bonded tunnel via multiple WAN uplinks:



High Availability and Bonding

The S.A.NE software offers several built-in security mechanisms:

Certificate-based authentication	S.A.NE supports certificate-based authentication for both client and server. If a router is lost or stolen, for example, it can be immediately and permanently excluded.
VPN support	Unlike other WAN bonding solutions, the unique architecture of S.A.NE does not introduce a proprietary VPN to bundle data traffic. However, it does offer excellent support for Industry-leading VPNs like IPSec, OpenVPN and Wireguard.
Server geo-redundancy	S.A.NE supports server redundancy. If a backend failure arises, clients can automatically switch between multiple endpoints, keeping downtime to an absolute minimum.



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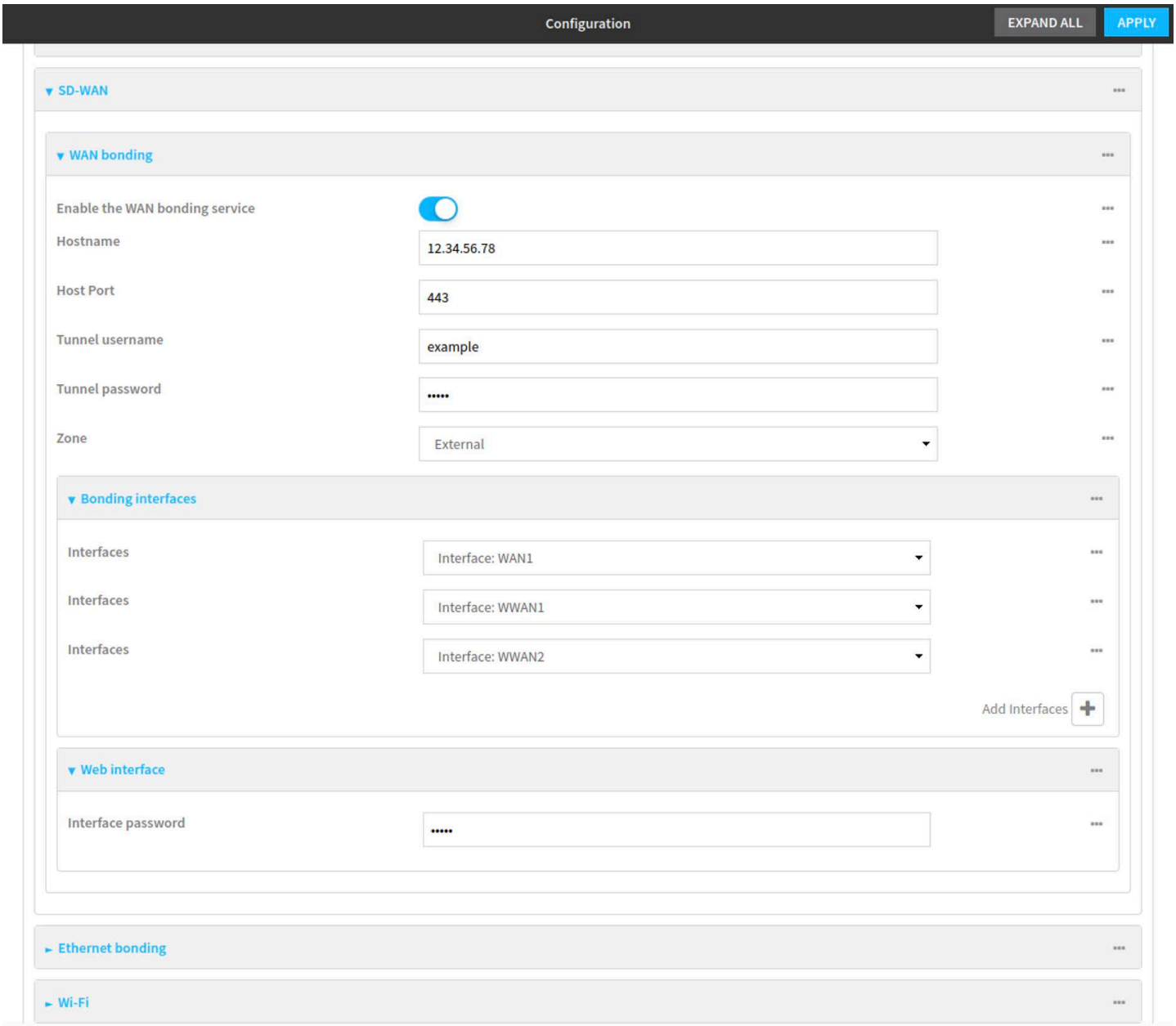
How Digi WAN Bonding Works

Digi WAN Bonding powered by Bondix S.A.NE is an add-on service to Digi Remote Manager® premier licenses that provides ultra-fast, highly reliable connectivity. Digi WAN Bonding enables users to centrally set up, deploy, scale, and manage the bonding of multiple Internet connections for increased throughput, WAN smoothing, packet redundancy, and seamless failover.

When a client initiates the WAN Bonding service in Digi Remote Manager, and the Digi devices are configured to combine WAN Ethernet and cellular WWAN interfaces, the default route for traffic is through the S.A.NE client application. This application negotiates a tunnel with a VPS and sends data to the VPS to be recombined and forwarded. Replies are sent via the VPS, fragmented appropriately, and sent to the interface that the device believes is the most performant and is not saturated. If a device sends a packet via the WWAN connection and loses connectivity before a reply is possible, the VPS sends the reply through the connected WAN interface.



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Use Case: Cellular Resiliency for Vehicles

In public transit, reliable uptime is a major priority — for passengers and operators alike. In this example, the operator has a Digi TX64 5G cellular router, which includes two cellular modems (WWAN1 and WWAN2) connected to different providers. They use Digi Surelink, so if WWAN1 goes down, it fails over to WWAN2. However, these networks do not instantly lose signal. As the vehicle travels, each connection gradually degrades (losing an increasing number of packets) before a failover is triggered.

With Digi WAN bonding the two cellular connections are intelligently balanced based on quality metrics such as packet loss and latency. As one connection degrades, it is used only when the most effective connection has been saturated.

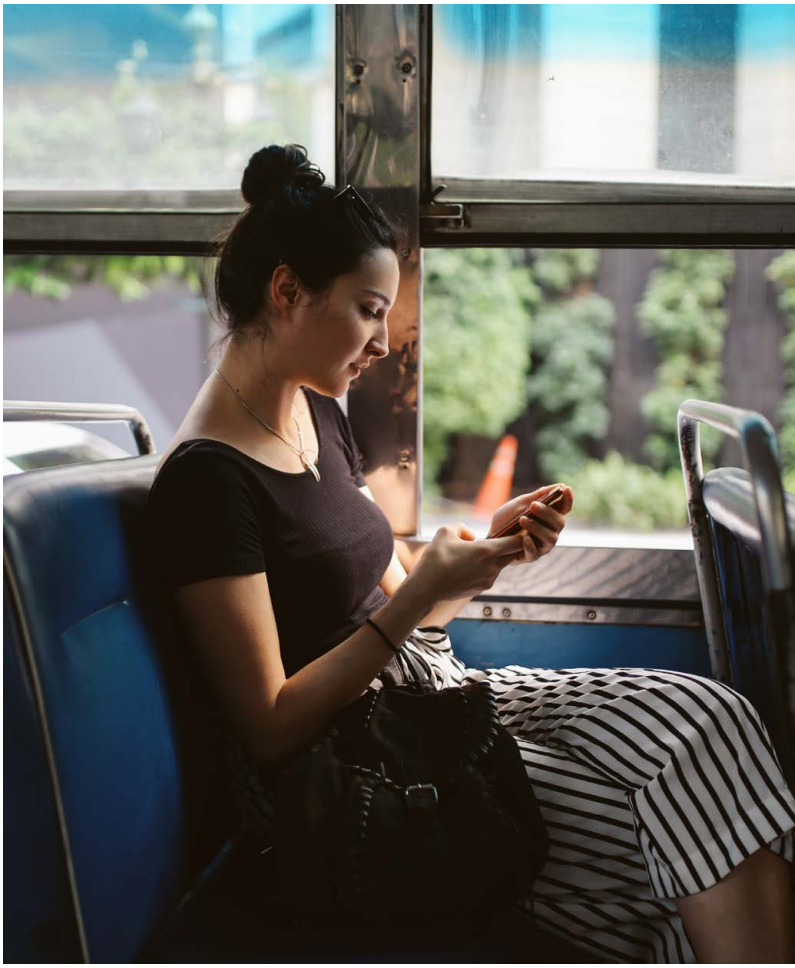
Use Case: More Bandwidth

A customer works in an office and accesses the Internet through a symmetric 100 Mbps copper line. A regular series of large and important file transfers can take four hours on this connection, while other office network capabilities slow to a crawl, particularly hampering remote workers who need VPN access to the office network.

Digi WAN bonding allows the customer to combine the symmetric wired connection with an asymmetric cellular connection. This combined connection means throughput is far greater than either single connection — without sacrificing the low latency of fiber, even when under a heavy load. Depending on the cellular access, total throughput could more than double, significantly reducing file upload times. This likely reduces the load on either individual connection, which may significantly reduce the impact other network users experience.

Use Case: Protect Mission-Critical Data in Remote Locations

With Digi WAN Bonding, packet duplication simultaneously sends packets through all available Internet connections and then only sends the first packet received on either end of the bonded connection. This use case doesn't focus on increased throughput. Instead, it provides 100% certainty that the data transmissions will be delivered, even on high-latency or spotty connections.



Connect with Digi

Digi experts can help determine if Digi WAN Bonding is right for you. Our team will partner with you to assess your needs and challenges and support your deployment at any step along the way. Whether you are just starting your journey, or you are seeking to improve connectivity across your network, we can help you plan for a seamless migration. And Digi Professional Services can help with site surveys, application development, planning, configuration, deployment, team training and more.

Here are some next steps:

- Contact us to talk to a Digi expert.
- Sign up for our newsletter to learn about emerging trends and new solutions.
- Shop for solutions from Digi and our partners.

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