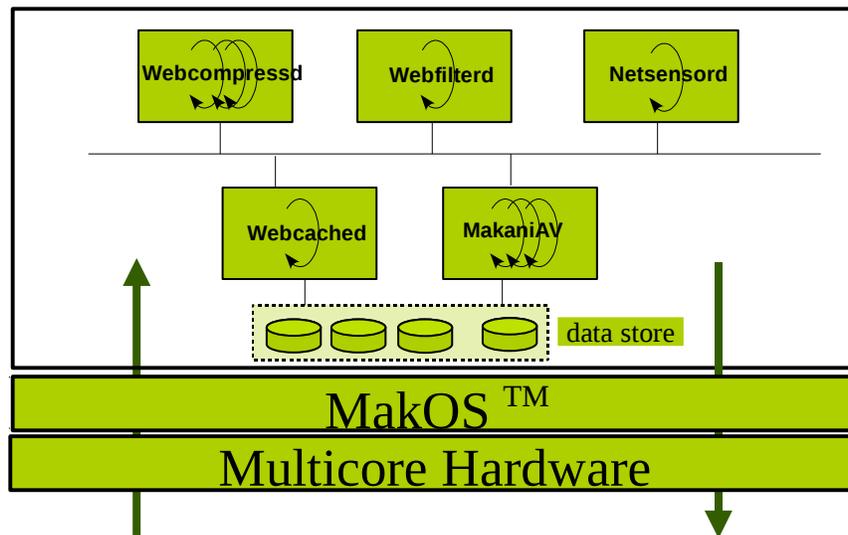


Makani Mobile WAN Optimization

The Makani Mobile WAN optimization appliance offers secure high-speed data access over a wide-range of wireless access networks. Makani's patent-pending technology and breakthrough **Latency Buster™** architecture makes core IP services through optimized protocol handling, app-aware acceleration, and management services available through a single platform.



Architecture of Makani Mobile WAN Optimization appliance

The Makani Mobile WAN optimization technology implements multiple servers designed specifically for enhanced mobile web access:

- **Webcached** service performs asynchronous web file/object caching; performs both in-memory file caching and disk-based file caching. By placing this service closer to the end-user helps improve overall access latency and performance. The file cache can be specifically tuned to meet the requirements of any workload.
- **Webcompressd** service performs “on-the-fly” compression of web objects. Both variable fidelity web objects (e.g., JPG, GIF, MPEG, WMV) as well as fixed fidelity objects (e.g., test, JS, html) can be compressed. This service dramatically reduces the amount of data transferred and hence reduces latency. Due of the compute-intensive nature of the compression algorithms, this service runs a fixed number of multiple “light-weight” processes that also help exploit the parallelism offered by the underlying multicore hardware.
- **Webfilterd** service performs dynamic web content filtering and deep web content inspection. It can block unwanted web content for more efficient web delivery. Alternately, this service can be used to insert or replace ads. For instance, policies can be specified to block or replace targeted ads from e.g., google or yahoo.

- **MakaniAV** service dynamically scans web traffic and immediately blocks a web connection if it detects a worm, virus, trojan, spyware, malware, adware, or other malicious content. The scanner database is augmented with roughly half a million signatures of viruses, worms, malwares, etc. and is updated daily.
- **NetSensor** service proactively detects, notifies, and prevents unwanted intrusion attempts to the device.

Makani Mobile WAN optimization appliances are "network-aware" appliances can be easily customized and flexibly configured for a wide-range of wireless access networks: GPRS, CDMA, WiMAX, 802.1x WLANs and 4G UMB/LTE. Load-balanced clusters can be deployed as per scale, access, and bandwidth requirements. This makes it simple and cost-effective to deploy completely fault-tolerant configurations, where always there are Makani appliances available and running for fast real time bandwidth optimization and application latency reduction.

The mobile WAN optimization appliance retains the **Makani Latency Buster™** architecture based on the following key building blocks:

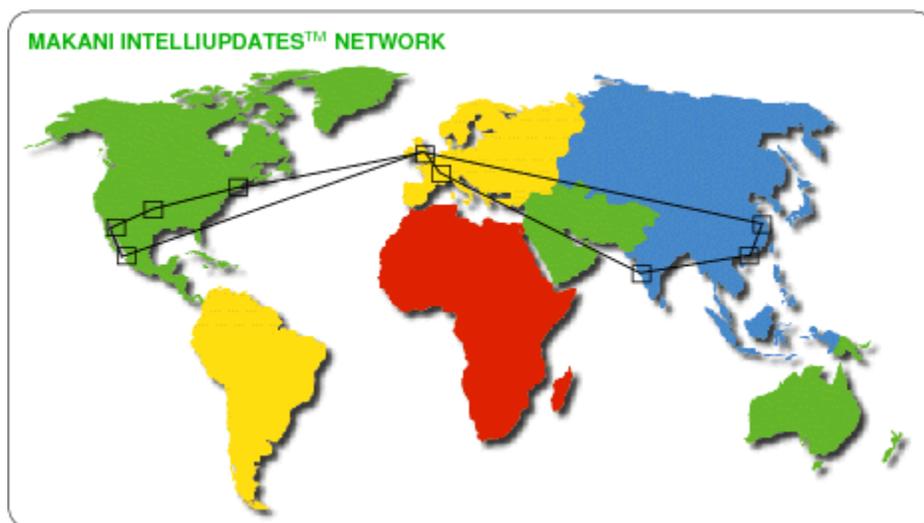
- **Split Control-Plane:** Makani decouples control from the data path. By separating control from data, Makani delivers a breakthrough system architecture that is highly optimized for both control and data.
- **File Transformers:** File Transformers correlate objects at the information level and employ patent-pending algorithms to remove redundancy that gets the best storage, bandwidth, and latency savings.
- **Virtual Channels Abstraction:** Virtual Channels is a high-level resource abstraction that enable fine-grained QoS control to offer the fastest acceleration for real-time and business critical data.
- **Protocol Transducers:** Makani optimizes and accelerates protocols at all levels. Besides TCP window resizing and other transport layer optimizations, a patent-pending "Async Messaging Layer" is employed that mitigates app and protocol chattiness and round-trips to deliver substantial reduction in latency.
- **Hierarchical Memory Technology:** By employing object- and byte-level data store with hierarchical hash technology, Makani detects data duplicates leading to significant bandwidth savings and manifold reductions in application latency.

MakOS™ Operating System

Makani appliances builds on the power of a customized Linux operating system. The MakOS™ architecture offers a "**software bus or backplane**"—style construct that is highly distributed and designed to provide high availability, flexibility, and performance. The MakOS™ achieves this by dividing up the processing into distributed modular, light-weight "processes" that separates, for example, online network data processing from I/O-intensive network data disk-based storage. By judiciously distributing load of the group of processes across all processors in the system, overall performance is significantly improved and latency is reduced. The distributed design provides exceptional performance, ease of management, and service protection while fault containment significantly limits impact when a fault occurs.

Makani Global IntelliUpdates™ Network

Makani appliances can harness the power of Makani's global IntelliUpdates™ Network, the world's first online traffic and diagnostic tracking database. The IntelliUpdates Network is a global network of data centers that continually captures data from each Makani appliances deployed worldwide, providing a large information base of customers traffic patterns and device diagnostic information. Customers traffic patterns and device diagnostic data are continuously analyzed, and appliance reconfiguration data and updates/upgrades or patches are remotely provisioned to fine-tune the Makani appliance to deliver the max performance on the network.



Makani Global IntelliUpdates™ network

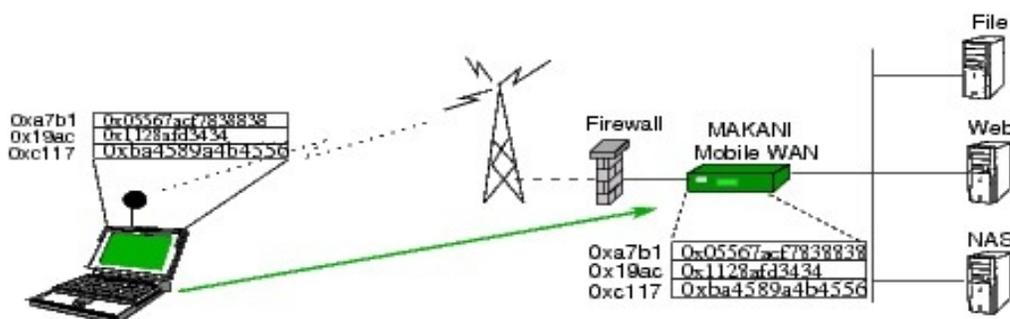
Smart Appliance Management™

Makani appliances are "future proof" appliances in that they can be flexibly customized, remotely diagnosed and easily reconfigured to suit the requirements of each customer. Smart Appliance Management™ technology enables dynamic reconfiguration of appliances with software updates/upgrades or patches that can potentially add new features or functionality or even fix bugs within the device. Thus, if a customer's network traffic patterns change or if there are any problems within the device, then using SAM™ technology we can remotely reconfigure the appliance and adapt it to the new traffic patterns or application requirements, or simply fix the bugs. Indeed, Makani's SAM™ technology in conjunction with the IntelliUpdates™ Network helps eliminate tremendous amounts of IT management.

Dual point solution using Hierarchical Memory®

Makani also offers a dual-point Mobile WAN optimization solution with patented compression and caching to gain instant WAN capacity on the existing network. Two techniques are crucial in a dual-point solution:

- **Online Byte Reduction™ (OBR™)** technology, which uses a highly efficient in-memory based pattern dictionary to detect and eliminate data repetitions that occur across a range of applications. Depending on the application mix, businesses gain many fold increase in the capacity on their existing WAN links by eliminating repetitious data with a small token (called rabin hash) ; in some cases as much as a 5x-100x increase.
- **Network Byte Caching™ (NBC™)** technology, which dramatically increases WAN capacity by recognizing much larger data patterns than OBR™ compression. This technology relies on hard disks to store longer data patterns for longer periods of time, replacing them with a token for transmission over the WAN.



Makani replaces longer data patterns with a hash (fingerprint)

Traditional file caching used in Mobile WAN optimization is designed to eliminate large redundant file transmissions, but it often fails to deliver because of two key limitations. First, file caching works only on a single application; because enterprises have a heterogeneous mix of applications, the overall impact that file caching has on reducing WAN transmissions is limited. Second, file caching operates only on exactly repeated files. In contrast, Makani's NBC™ technique recognizes repeated data patterns and eliminates them, even when a file has been modified. In addition, the use of on-board hard disks provide tens to hundreds of gigabytes of persistent storage; hence sequences seen several days earlier can be eliminated.

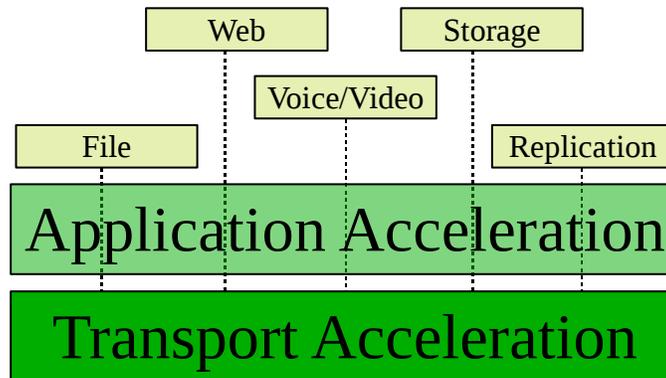
A key attribute of OBR™ technology is its compression capabilities even on very large amounts of bandwidth. These attributes are traditionally mutually exclusive when using compression techniques such as Lempel-Ziv, or its derivatives.

Online Byte Reduction and Network Byte Caching techniques reduce traffic for any IP traffic — not just TCP or UDP. The efficiency of traditional compression is limited, since they can buffer only a limited number of repeated patterns. In contrast, Online Byte Reduction and Network Byte Caching techniques store many more and longer repeated data that dramatically reduce traffic flows while adding only a negligible amount of latency.

Bottom Line: The compression capabilities in Makani platforms work across the broad spectrum of repeated data pattern sizes and dramatically increase the capacity of WAN links.

Application and Protocol Optimizations

Latency affects application performance because the underlying protocols and applications rely on a back-and-forth sequence of data transmissions and acknowledgments.



Makani accelerates a broad range of apps and transport protocols

An application acceleration platform requires both TCP acceleration to benefit a broad range of applications and application-specific acceleration to speed applications whose Layer-7 protocols are less efficient than TCP. The Fast Startup™ technique improves the performance of short-lived connections, speeding up applications that use chatty protocols.

The Flow Streamlining™ technique accelerates TCP performance by streamlining TCP connections using a more efficient transport protocol between devices. This feature significantly benefits performance on high-latency connections.

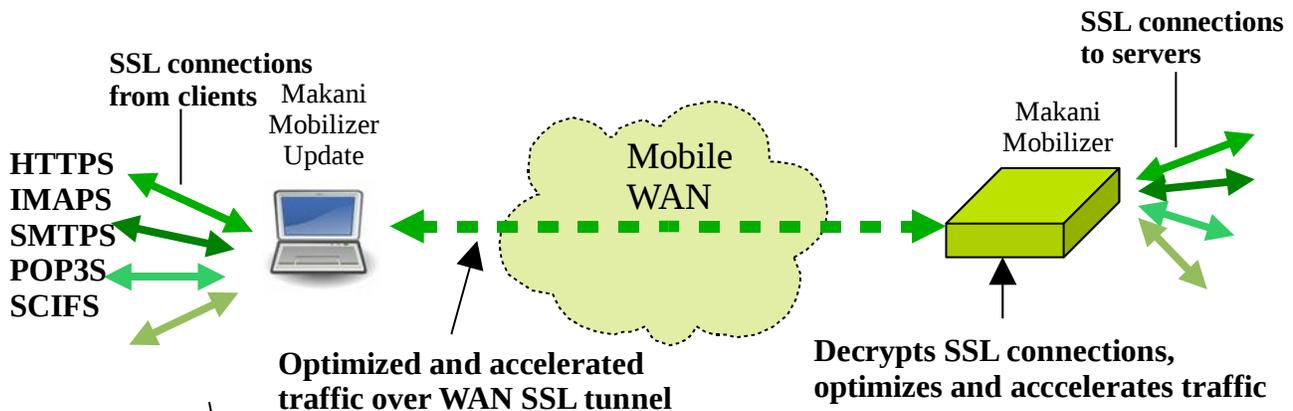
Certain applications can't benefit from TCP acceleration until they are accelerated at the application layer, at which point application-specific acceleration and TCP acceleration provide a compound performance improvement. The Makani's Application Acceleration™ (AAC™) technology accelerates the underlying protocols of these applications: the **Messaging Application Programming Interface (MAPI)** used by Microsoft Exchange; the **Common Internet File System (CIFS)** at the heart of Microsoft file services; and HTTP for web applications. In the case of Exchange and file services, their underlying protocols send data in small blocks and require an acknowledgment for each, resulting in hundreds or even thousands of RTTs to complete a single transaction. As a result, performance drops dramatically when used across a WAN link with even modest latency—20 ms or 30 ms—resulting in user frustration and lower productivity. For web applications, HTTP requests objects one at a time, so dozens of RTTs are needed to load a single web page, again impacting user productivity.

The AppFlow™ technology accelerates applications by pipelining the data blocks and web objects, sending as many in quick succession as needed to fill the available WAN capacity and deliver up to a 50-fold improvement in application performance.

Bottom Line: Makani platforms enhance performance across a broad range of application types and WAN link characteristics; improve user productivity associated with existing applications; and enable deployment of new applications that previously could not run across a WAN.

Security and SSL Acceleration

Makani appliances are designed to accelerate traffic that are encrypted using **SSL**. Makani appliances do so by applying all of the same set of optimizations they apply to unencrypted traffic over the WAN. Makani accomplishes this while maintaining complete end-to-end security and maintaining the trust model that enterprises require. The breakthrough approach from Makani allows end-to-end secure traffic and secure WAN traffic optimization and acceleration that offer LAN-like performance over the Mobile WAN. Each client uses unchanged server addresses and each server uses unchanged client addresses; no application changes or explicit proxy configuration is required.



In an ordinary SSL handshake, the client and server first establish identity using public-key cryptography, then negotiate a symmetric "session" key to be used for data transfer. Using Makani platform, the initial SSL message exchanges take place between the client and the client-side Makani appliance, which initiates a connection with the server-side Makani appliance. The server-side Makani appliance then sets up a SSL connection to the server to satisfy the client request. The net effect is that the client's SSL connection logically terminates at the server, but physically terminates at the client-side Makani appliance. The approach is completely transparent to the user or application.

This powerful form of SSL acceleration gives enterprises new, better choices in the security vs acceleration tradeoff. With Makani's approach to end-to-end SSL traffic acceleration, enterprises may choose to mitigate more of their applications to SSL-encrypted protocols to give them the data security they are looking for. With Makani, they can be assured that their distributed workforce can still access the information they need at LAN-like speeds, no matter where in the world their office is located.

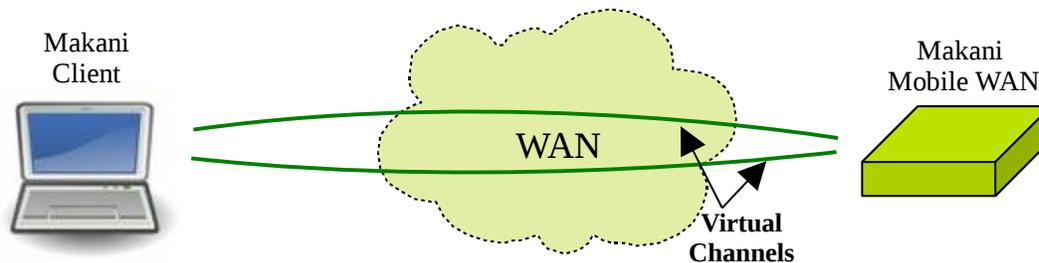
The Makani platforms also ensure the security of their network-level data transmissions. With Makani platforms one can optionally deploy a standards-based IPsec encryption feature in sites without a VPN deployment, securing data sent over unsecure links such as the Internet or satellite and also securing device-to-device communications.

Bottom Line: Makani Networks platform accelerates and optimizes encrypted (SSL) content and provides a wide range of security features needed to ensure appropriate access and secure transmission of data.

QoS with Virtual Channels Abstraction

The dramatic discontinuity in wired and wireless bandwidth means that contention for mobile WAN resource needs to be addressed with an effective and realistic QoS and bandwidth allocation model that enforces practical business priorities.

Makani provides customized QoS templates based on business priorities to simplify QoS configuration. This approach strikes the needed balance between performing QoS in the most appropriate device — the mobile WAN optimization platform — and keeps implementation simple.



Traffic prioritization with Virtual Channels

At the network level Makani implements QoS with a novel resource abstraction called **Virtual Channels™**. Up to six Virtual Channels™ can be dynamically instantiated: Customized QoS policy templates ensure that interactive and Internet-critical control traffic are prioritized first using high priority Virtual Channel. Voice and other real-time apps are similarly prioritized while ensuring that Web and business-critical enterprise applications get the major share of the link bandwidth (whenever they need it) even during periods of excessive app or resource contention. Finally, email (e.g., IMAP, SMTP) and bandwidth-hogging P2P applications get the remainder but never starve; per-user and application-specific rate control ensures the implementation of cost-effective and consistent QoS management policy. And by quickly looking inside the payload at the network level, Makani Platform also differentiates and then prioritizes one enterprise application traffic (e.g., Citrix ICA) over another (e.g., SAP).

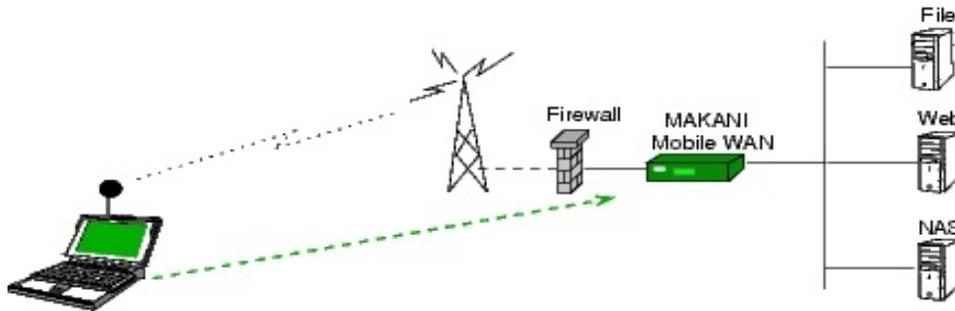
Makani Networks has designed the QoS feature such that ToS/DiffServ settings can be mapped to other network devices, tunneled traffic is still identifiable by application, and MPLS CoS information can be communicated to the edge devices in service provider networks without permanently overwriting anything in the original packet.

The “dual-sided” deployment allows Makani platforms, for example, to automatically map traffic according to the QoS template assigned to that destination device. The dynamic knowledge also enables IT to adopt the appropriate QoS policies. While the dual-sided approach provides for the greatest link understanding and dynamic behavior, the platforms also support “one-sided” deployments of QoS as well, to enable a consistent QoS policy across the distributed enterprise.

Bottom Line: *Makani platforms provide the adaptive and dynamic QoS functionality enterprises need, without the complexity typically associated with defining granular bandwidth control.*

Transparent Deployment

The Makani platform is designed to not only provide up to a 5X-100X optimization and acceleration of data, but also to provide a fully fault-tolerant solution with no single point of failure. Makani appliances can be deployed with no changes to your servers, routers, applications, or user desktops. Makani appliances can accelerate data without interfering with your basic network infrastructure.



Makani appliances are transparently deployed in the network

For network placement, a WAN optimization equipment can be deployed either on the network between a LAN switch and WAN router, or attached to a switch and router in a one-armed fashion. The Makani platforms support both these modes, with both InPath Mode and OutPath Mode options. A basic inline configuration is a common feature among WAN optimizers, but Makani devices are also unique in their awareness of 802.1Q and their ability to compress traffic within the full 4095 number of supported VLANs. The platforms can optionally preserve the VLAN tags as packets are transported to other destinations through the tunnel. Further, load-balanced clusters can be deployed as per scale, access, and bandwidth requirements; clusters also offer the additional service reliability and fault tolerance.

The Makani platforms include a number of redundancy features. The devices support an active *fail-to-wire* mechanism so that in case of a device failure, all traffic will pass through the box at wire speed untouched. For additional levels of redundancy, Makani platforms support dual-active redundancy with no need for extra configuration of surrounding network devices, as well as an n+1 backup mechanism. The platforms also work with routers configured with redundancy protocols, and the devices can load-balance tunnel traffic to redundant WAN routers or load-balance to redundant destination Makani devices.

Bottom Line: *Makani Networks platforms provide the deployment flexibility needed for IT to meet the varying configuration and transport needs of different locations of the distributed enterprise.*

Ease of Use

A number of factors determine a device's usability—an intuitive interface, automated configuration and deployment capabilities, and synchronized communications among platforms are a few of the necessary elements.



Makani offers intuitive easy-to-use webGUI

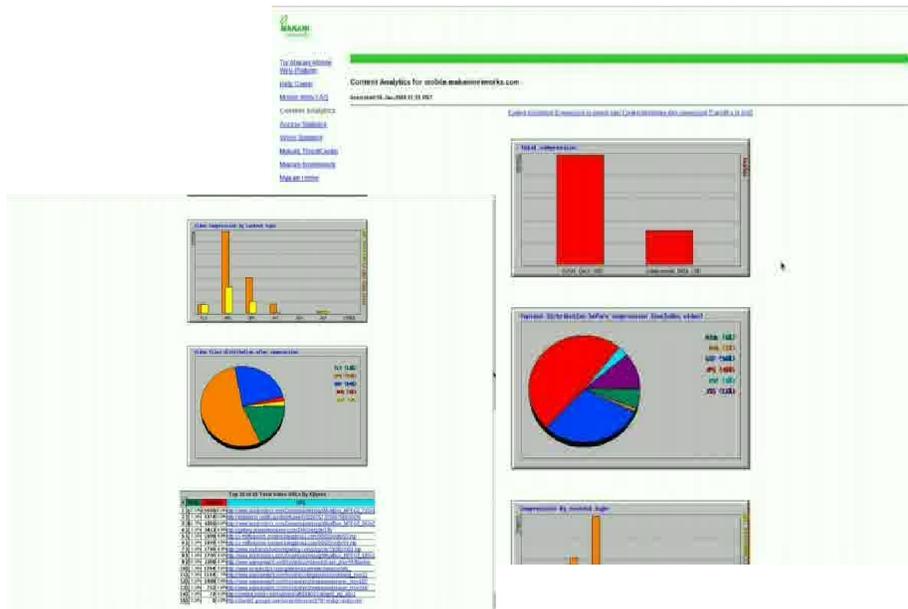
The Makani platforms are easy to use and manage, offering GUI-based views that allow IT to manage the devices individually or as a collection. Branch-office staff needs only to plug in the device and connect it to the network. Straight out of the box, the device will automatically procure a network address, locate the centralized management software (CMS) via the domain name service (DNS), request a configuration, download it, and begin operation. This produces a significant savings in staff time and money and enables rapid, pervasive deployment.

After a Makani device is up and running, it connects to the server to learn about other remote devices and how they're configured — for example, which devices are hubs and spokes; whether key compression techniques are enabled; whether security is enabled; and whether a device is sending out traffic over WAN links and other optimization. These communications provide distributed stateful intelligence about the network state and enable devices to act on changes such as link loss or increased congestion on a path. These automated synchronizations and communications dramatically simplify both setup and ongoing operations of the platforms.

Bottom Line: An intuitive web GUI, significant automation capabilities, and synchronized communications among Makani platforms result in a very easy-to-use product set.

Visibility with Makani Analytics

Makani Analytics offers web-based visibility like no other: compression statistics, detailed traffic statistics, cache performance statistics, cache hit/miss statistics, access statistics, data usage statistics, as well as application-specific compression analysis.



Makani offers comprehensive statistics and visibility

Makani Analytics performs in-depth analysis of logs: compression engine, cache engine and storage. Makani offers the option to view information per device, and insight into such aspects as packet size distribution, error rates, throughput statistics, and TCP and application acceleration data.

Complementing the Makani Analytics software is the CMS software, which allows to configure and manage multiple Makani platforms from one central location. The CMS software provides a unified view into the systems' capabilities throughout the distributed enterprise. Makani offers metrics about compression performance, application acceleration, WAN utilization, and QoS and bandwidth allocation. The CMS software provides information about what traffic is traversing the WAN, which applications are consuming most of the valuable WAN capacity, and which traffic is being impacted by the application of QoS. Makani can help schedule system upgrades, apply new configurations, update QoS policies, and automate license management.

Bottom Line: Makani platforms provide comprehensive insight into WAN and LAN traffic patterns that's easy for IT to understand and quickly enables policy adjustments that maximize the acceleration capabilities of network devices.

Scalability

WAN optimization must scale from small branch offices to regional deployments to centralized hub locations. It must support a breadth of network traffic, a number of remote locations from a single-hub, high throughput of any single WAN optimizer, and the ability to support a worldwide implementation and deployment.

The Makani platforms meet these demands, easily scaling to support high compressed output speeds and thousands of connections per device to other application acceleration platforms. In addition to a high tunnel count, application acceleration platforms must enable tunnel configurations that support large, hierarchical networks. The architecture should provide automatic tunnel aggregation to support these complex topologies as networks increase in size. Makani platforms provides exactly that capability, enabling any-to-any communications between any two sites without requiring a full mesh setup of tunnels linking the sites. Makani offers the option to view multiple parameters at the same time, such as application, destination, and flow direction. Seeing this information tied together, it becomes easy to scale the WAN optimization to meet the broad needs of the enterprise.

Bottom Line: *Makani platforms provide a highly scalable product set and software suite that meet the wide range of application, bandwidth, and monitoring capabilities demanded in distributed enterprises.*



Makani offers high-performance, easy-to-use and technically innovative solutions for next-generation wide-area networked data services. Makani Enhancers™ are deployed for wide-area data acceleration and optimization. Makani Mobilizer™ appliances are deployed in the customer's network for blazing-speed data access over a wide-range of access networks. Founded in 2006, Makani is headquartered in San Francisco with regional offices all over the world.

Frequently Asked Questions (FAQ)

1. What is Makani Mobile WAN Optimization?

Makani Mobile WAN Optimization Platform is a Makani Networks product that makes web access significantly faster, more efficient and secure.

2. How does Makani Mobile WAN Optimization work?

Makani Mobile WAN Optimization product uses the revolutionary **Makani Latency Buster Architecture**TM to make web access significantly faster, more efficient and secure.

The single-point Makani solution implements a number of strategies:

- 1) Compressing content, both fixed and variable fidelity, before sending it to your mobile or PC.
- 2) Accelerating and optimizing transport protocol connections over slow and high-latency channels.
- 3) Tracking and proactively anticipating users' web activity and then adapting both the connection and content to reduce delays.
- 4) Dynamically scanning users' web traffic for any worms, viruses, trojans, etc., and if detected, immediately blocking the connection.
- 5) Intelligently Storing or Caching copies of frequently looked at pages to make them quickly accessible.
- 6) Prefetching certain pages in advance.

3. Does Makani Mobile WAN Optimization speed up web enterprise applications and web videos?

Yes. Makani Mobile WAN Optimization not only speeds up web pages or other web-based enterprise applications, but also attempts to speed up large web downloads such as PDF, PPT, Word, Spreadsheets, MS-Excel files etc. by further compressing them. In addition, Makani WAN Optimization dynamically transcodes (recodes) and reshapes online video content, e.g. FLV, MPEG, WMV files etc., whenever possible, leading to major web video speed up.

4. Does Makani Platform accelerate only web-based applications?

No amount of compression or acceleration will solve all the problems over wireless links. The dramatic differences between wireless and wireline link characteristics must to be addressed with a realistic QoS and bandwidth allocation model that enforces practical business priorities at multiple levels. Besides optimizations at the transport level and fine-grained QoS control at the application-level, Makani implements network level QoS with a novel resource abstraction called **Virtuals Channels**TM. Upto six Virtuals ChannelsTM can be dynamically instantiated: Customised QoS policy templates ensures that interactive and internet-critical control traffic are prioritized first using high priority Virtual Channel. Voice and other real-time apps are similarly prioritized while ensuring that Web and business-critical enterprise applications get the major share of the link bandwidth (whenever they need it) even during periods of excessive app or resource contention. Finally, email (e.g., IMAP, SMTP) and bandwidth-hogging P2P applications get the remainder but never starve; per-user and application-specific rate control ensures the implementation of cost-effective and consistent QoS management policy. And by quickly looking inside the payload at the network level, Makani Platform also differentiates and then prioritizes one enterprise application traffic over another.

5. How secure is web access using Makani Mobile WAN Optimization?

Two aspects of security are critical: securing the Makani Platform itself and securing the data that traverses the device. Makani WAN Optimization dynamically scans users' web traffic and immediately blocks a web connection if it detects a worm, virus, trojan, spyware, malware, adware or other malicious content. The scanner engine database consists roughly half a million signatures of viruses, worms, trojans, malwares, spywares, adwares, etc. and is updated daily. Makani Mobile WAN Optimization also protects against other common known web attacks: cross-site scripting, cookie/form tampering, buffer overflow, phishing, OS command injection and web protocol validation. Makani maintains blacklists that ensures isolation from online threats. Makani NetSensor engine further proactively detects and prevents unwanted intrusion attempts. Access to Makani Mobile Platform can be (optionally) secured using either SSL-VPN or IPSec-VPN. The Makani WAN Optimization can also be configured to talk either single-sided (client) or dual-sided (client+target) HTTPS in "trusted" SSL VPN mode by first decrypting, optimizing, and then accelerating users' encrypted web connections. Makani Mobile Web Platform is one of the most secure platform for Mobile Internet access.

6. Can I see the (quantitative) benefits using the Makani Mobile WAN Optimization?

Yes. Makani Mobile WAN Optimization provides detailed statistics of its benefits.

- 1) For Makani sample DEMO videos, see [Makani Video Demos](#)
- 2) For Makani appliance webGUI configuration screenshots, see [Makani webGUI screenshots](#).
- 3) For content compression and web speed up, see [Content Analytics](#).
- 4) For user access and cache content statistics, see [Access Statistics](#).
- 5) For video transcoding and reshaping statistics, see [Video Statistics](#).
- 6) For web security analysis and secure web traffic scanning, see [Makani ThreatCenter](#).
- 7) For dynamic pop-ups, banners, and ads replacement/insertion, see [Makani AdsNetwork](#).

7. Can I use Makani Mobile WAN Optimization with a dial-up connection?

Although designed specifically for mobile users, Dial-up users may see significant improvement, as Makani Mobile WAN Optimization is designed to speed up web access for all connections.

9. Does Makani Mobile WAN Optimization reformats online content, inserts and replaces advertisements?

Makani currently replaces web advertisements and banners with a MakAds logo. We are continually refining our network ad-replacement and ad-insertion technology; Makani plans to introduce dynamic ad insertion and replacement in the future through the Makani AdsNetwork.