



## Wireless Mesh Networking for Developing Countries

*Never before has it been so economical to provide high quality broadband access to vast populations. Today high quality networks are being enabled around the globe via wireless mesh networking and stimulating the next new world economy.*

### Introduction

Wireless mesh networks have become a new economic stimulus for the developed economies of North America, Europe and East Asia. Internationally the application for wireless mesh networks has taken off. There is a real need to provide Internet and other network services at speeds greater than 128 or 256k. This is especially true at the municipal level, where city after city are announcing major Wi-Fi initiatives.



However, the impact of Wi-Fi and mesh is even more significant in developing countries, where telecom services have been limited. The pending arrival of integrated multimedia communication devices, such as Wi-Fi-enabled handsets and low-cost laptops, could dramatically open politically-stifled economies.

As interest in wireless mesh networks has swelled, technically savvy investors are now realizing a new business opportunity exists—and it is not just limited to providing phones. By cost-effectively implementing a countrywide wireless mesh network, every person in that country can now become a part of a new opportunity. In the near future, wireless mesh networks will go global on a massive scale. This will change the way people do business, providing the tools to create new business opportunities and the potential to uplift third-world economies.

Service providers, entrepreneurs/investors and governments are testing and implementing wireless mesh networks worldwide and the audience is growing. Countries including Kenya, Africa, India,

Greece, Finland, Belgium, UK and others have announced their deployments. Some larger than others. Some deployments are hundreds of square-mile's and the largest mesh network deployments in the world, while others are more strategic and related to public safety, railway, surveillance, security and sensor technologies, corporate communications, military etc. Networks such as this are not just providing Internet or email access, but making use of high density data applications, voice communications and streaming video as well.

Wireless mesh network products are proving that large-scale and future-proof networks can be built to support large populations of people in vast regions cost-effectively, enabling VoIP and broadband Internet access.

As these networks grow and users come online, thousands, if not millions, are being served and a multi-radio (three radios or more) technology is required to provide the performance and scalability for such networks.

Capable of handling the challenges of mountainous terrain, deep basins, large valleys and dense foliage where most single- and dual-radio solutions fail to provide acceptable coverage and performance, not to mention real-time services like wireless VoIP (wVoIP), Strix wireless mesh network system dedicates radios for each separate function of the mesh (client access, backhaul ingress, and backhaul egress). By engaging the advanced algorithm characteristics and high performance of Strix wireless system, integrators are able to eliminate many of the challenges commonly associated with other systems.

Strix's Access/One solutions employ a unique modular, multi-radio, multi-channel, and multi-RF wireless mesh architecture that provides the high throughput and low latency needed to support wireless voice, video, and data applications today. This modular architecture is fully flexible and scalable, allowing a countries network to grow simply and affordably in the future. Strix architecture already provides mechanisms to support QoS, solving problems such as bandwidth degradation, network latency, and application priority contention. Because Strix networks operate at 2.4 GHz, 5 GHz unlicensed and 4.9 GHz licensed spectra on multiple channels of each spectrum simultaneously, Strix can separate client access from the mesh backbone, enabling the system to dynamically optimize data paths, circumnavigate network congestion and interference, and adjust in real time to avoid network failure.

### **The Profile of a Mesh-Ready Nation**

While there are opportunities for mesh networks worldwide, not every country is a good candidate for a nation-wide wireless mesh network. While some nations may already be looking for ways to proactively stimulate growth and propel their economies, others may be too isolated to consider alternatives.

Wireless mesh networks can provide the stimulus a developing nation needs, breaking its isolation and enabling it to enter the global marketplace.

Nations that fit the profile must have a number of prerequisites in place before they can deploy a network. First, business-savvy people who understand of the country—its politics and the role politics plays in developing telecommunications solutions, its business climate and how a service provider would operate within that climate, its terrain, and more—must be involved in the process of bringing a wireless mesh network to the country. There must also be people who understand, or are capable of understanding, the international telecom industry, since building a mesh network will connect the nation to that industry. The next requirement is for an integrator or service provider, local or international, capable of providing service to the country.

No deployment will be truly successful without a plan or business model that takes the country's existing economic situation into consideration and tailors the deployment accordingly. Especially in a depressed economy, it will be very important to establish the relationships needed to create economical programs for education and business to sustain the network's growth. With all of these prerequisites in place, a service provider can develop a plan for implementing a wireless mesh network.

### **Why a Mesh Network Is Right for Developing Nations**

Wireless mesh networks are an attractive solution for developing nations because they will work over any type of terrain, no matter how mountainous, and reach any region, no matter how isolated, far more economically than other approaches. All the country needs is one link—a landline link, a satellite link, or a long-range wireless link—to connect everyone on the mesh network to the outside world.

The benefits of the mesh network are myriad. Deployment can take place in a matter of months—far less time than required to deploy cellular or any other service—and the network is very cost effective. For example, a network with nodes powerful enough to have a transmission range of 16-24 kilometers provides maximum service reach and costs less to deploy because it requires fewer node-to-node hops to reach isolated areas, for example beyond a mountain range or across a wide river. In addition, a wireless mesh network provides excellent service. Throughput can be as high as 108 Mbps near a node, and it can average from 24-54 Mbps, down to perhaps 16 Mbps at the edge. One node can thus serve many individual subscribers, each with a 1 Mbps broadband service or even a 3 Mbps service—much better than the best cellular service, which costs far more. For the price of 20 cell phones, for example, a mesh network approximately can serve upwards of 768 voice subscribers.

A mesh network with a multi-radio architecture that employs three or more radios is particularly appropriate for developing nations, since the country can carve up bandwidth to offer multiple separate services such as public Internet access, voice, business communications, public service, and education, with throughput optimized for the needs of each service. Such an architecture can also

support voice, video, and data communications upon deployment; the developing nation does not need to wait to deploy new services or create overlay networks to offer all forms of communications immediately. Perhaps the most important benefit of a multi-radio wireless mesh network is its ability to scale easily as the user population grows. Subscriber density can increase and new technologies can be added to the network without forklift upgrades of the solution or of the devices in it. A scalable mesh network that supports multiple services can provide three to four times the revenue capability compared to solutions that support only one service.

### **Changing Lives for the Better**

Deploying a mesh network in a developing country can literally change lives. These countries frequently have limited residential and business phone services, and the cost of service may be well beyond the pocketbook of the average person. In addition, businesses may have little or no access to data communications. Expecting the existing landline service to step into the breach is unrealistic. These services are often limited and expensive, and customers may wait months or even years before their service is installed. As a result, consumers may never have access to even basic voice service. Nor is cellular service a viable option because it is typically too expensive for those with low incomes.

In contrast, a wireless mesh network allows subscribers with a PC, PDA, or cell phone with Wi-Fi capability to sign up for and receive an economical service very quickly. A VoIP application such as Skype running over a wireless mesh network can for the first time provide an affordable voice service to someone making as little as \$2,000 a year; international Skype-to-Skype calls are free and VoIP service prices are dropping.

While the ability to establish international communications on a countrywide scale can have a positive effect on the country's economy, it can also have an effect on the global economy, as other businesses in other countries begin to benefit from the relationships they establish with local businesses.

### **New Opportunities Enabled by New Services**

A high-quality communications infrastructure that enables far better and far more available communications service will have a profound impact on businesses as on a country's international relations. For the first time, the country will be attractive to international companies looking to establish outsourcing facilities because the wireless mesh network enables the facilities to connect to customers around the world easily and cost effectively. Communications will also stimulate the growth of R&D and manufacturing capabilities by making it possible for local companies to sell their products far beyond their country's borders.

Communications will have an even more profound effect over the long term; used in an educational setting, a combined voice, video, and data communications capability will enable the emergence of a

new generation of technology leaders who will have a direct impact on the country's new economy. Learning how to use the new communications capabilities will enable users to take advantage of new opportunities in the short term, while making technology part of the learning process in schools and universities has a long-term effect.

## **Making the Mesh Network Happen**

Despite the best planning efforts, and despite all the economic benefits mesh networking brings, actually implementing the network may require more resources than are available in-country. Programs to set up, maintain, and reimburse the costs of building the mesh network are key to making it happen. Developing nations can receive assistance from a number of U.S. and international agencies and organizations that provide expertise and funding, such as the U.S. Agency for International Development, an independent government agency that conducts foreign assistance and humanitarian aid to advance the political and economic interests of the United States. Private business groups that encourage an interest in international commerce can also be sources of assistance. Most importantly, the country needs service provider partners, which may be local or international that can work with local authorities and carriers to make the network happen.

The challenges of deploying a countrywide wireless mesh network are many, but the rewards are great. These networks are not just a convenience or a new source of revenue for a municipality; they can be an engine for growth that integrates a formerly isolated country into the global community.

## **Strix End-To-End Solution**

### ***Access/One® Networks***

Strix Access/One family of products provides the broadest coverage in the industry reduces the number of nodes required per square mile and accelerates deployment therefore lowers CapEx and operational expenditures (OpEx). Unrivaled value is delivered via the highest capacity in the industry—a maximum of 768 users per node as well as over 100 Mbps throughput per node resulting in 3-6 times the norm. Enable minimal throughput loss and minimal latency for over 10 hops means real-time application support with a minimum number of wired connections required for a given area and significantly lower CapEx and OpEx. Provide future-proof modularity lets the OWS 2400 scale to up to six radios as needed and migrate smoothly to WiMAX without a forklift upgrade and the lowest cost per radio in the industry results in significantly lower capital expenditures (CapEx).



### ***Access/One® Network OWS***

Strix Access/One Network OWS 2400 and 3600 are the industry's Only Modular (chassis-based) Multi-Radio, Multi-Channel, Multi-RF Wireless Mesh network systems supporting Multi-Channel

Sectorization and Optimal Channel Reuse technology enabling exceptional range and coverage for large-scale city/metropolitan and country-wide networks.

Access/One Network OWS enables the deployment of 802.11 networks across large urban areas, rural counties and entire regions — ideal for government agencies, public utility, high-speed transportation systems and mobile users who want uninterrupted service on a citywide basis. Traditional single and limited multi-radio solutions are restricted by radio hand-off contention and are incapable of providing future-proof scalability and coverage. Strix products step well ahead of the competition by enabling proven high performance intelligent wireless mesh networking capable of extending hundreds of square miles and providing exceptional user density and multi-hop wireless backhaul coverage. Strix Access/One provides the industries highest throughput and lowest latency for integrated voice, video data networks. Strix Access/One is a fully integrated and coherent wireless network system that delivers intelligence, scalability, security and unrivaled performance to the outdoor environment.

Access/One OWS delivers any mix of backhaul and client access services in a single form-factor to simplify planning and installation, reducing deployment costs, and delivering the industry's highest performance wireless mesh networking system.



Access/One Network OWS builds on our proven indoor dynamic distributed mesh architecture by offering backhaul and client services in a high performance 802.11 a/b/g model, unlike competitive solutions that offer either a single wireless technology or require third party APs to provision client services. The roles of specific nodes within the network are determined by the mix of modules mounted in the enclosure and how they are configured—either client connect, network connect, or network server. The Access/One Network OWS can support any combination of 802.11 a/b/g/j and 4.9Ghz for public safety networks, both to the client and in the mesh backbone, dedicating modules for specific functions within a node. Supporting up

to 6 radios in an Access/One Network OWS node means maximum flexibility to deliver multi-radio mesh backbones, and multi-RF client connectivity.

### ***Access/One® Network IWS***

Strix Access/One IWS is the industry's first fully modular wireless mesh system enabling secured mission critical data, voice, video and public Internet wireless access whether for a large Enterprise, distributed corporation, government agency, or public transportation system such as a train moving at 200MPH. The need to provide 100% mobility and reach-ability is complimented by Strix highly scalable and high performance Indoor Wireless Systems.

The IWS is not just another wireless access point. With Strix DMA and patented designs, Strix has set the bar very high - completely wireless, easy to deploy, and easy to manage, incredibly scalable, and extremely resilient and has no single point of failure. The IWS provides high density access allowing the industry's largest number of users connected through the system at any time. This performance is complimented by the multi-radio architecture which also supports mesh distribution over wireless backhaul. Whether each node is distributed wirelessly with a network backhaul connection for every 5<sup>th</sup> or 10<sup>th</sup> node, or the backhaul is connected directly for each node directly, Strix Access/One family maintain the industry's highest performance levels – greatest bandwidth, highest throughput and lowest latency.



The IWS delivers innovative, intelligent management functionality. Its distributed intelligence at it's finest. Each node, an intelligent and independent thinking machine, capable of self configure, self discovery, self tuning and self healing, yet all nodes work in concert, constantly inter-communicating to optimize network operation.

- Simple "plug-in-play" wireless services
- Wireless to Network, Wireless in house
- Multiple "in-house" devices supported
- Seamless roaming inside and out of house
  - Smooth Voice Service (VoIP) hand-off
- End-to-end customer management



### **Access/One® Network EWS**

Strix Systems Edge Wireless System EWS-100 series of Network Edge Service Device is a new member of Strix Access/One family of products powered by Strix Dynamic Mesh Architecture (Strix DMA).

The EWS-100 is a CPE-type device for low-cost residential and business connectivity. The EWS provides dual radio access, simplified connectivity and the highest performance connectivity between an outdoor Wireless Wide Area Network (Strix OWS nodes), an indoor Local Area Network (LAN), and an indoor Wireless Local Area Network (WLAN). The EWS-100 provides double the transmit power for and supports 802.11g or 802.11a for Station-side connectivity to the outdoor wireless mesh, 802.11a or 802.11g for indoor access point functionality with automatic address assignment to clients, provides an Ethernet connection for multiple PC's and devices such as multimedia gateways etc., remote management functions for WISPs and is completely plug-n-play for the subscriber.

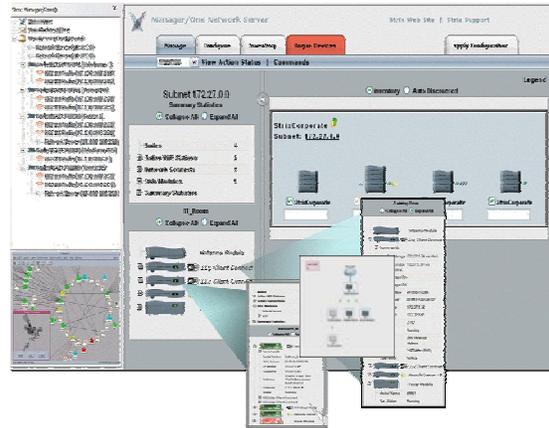
The ability to provide seamless roaming is a significant achievement in that it enables devices such as dual mode phone supporting wifi to roam from inside a home or business to the outside mesh. Today

the EWS and Strix Wireless Mesh Network can maintain a VoIP call with excellent quality while transitioning from the home, to the car and down the street.

Configuration and management is provided by a simplified web-based interface, Strix Manager/One network management system and other industry-leading management systems.

### **Manager/One®**

While Access/One OWS, IWS and EWS are self-managing, the same management is further enhanced via Strix Manager/One® software interface, giving the network management personnel complete configuration, monitoring, statistics, fine-tuning and customer assistance control over the wireless mesh network's operation.



Strix Manager/One provides enhanced control over the network and configuration can be as simple as a single push of a button, whether for a single unit installation, a city or country-wide deployment. Each network device can be managed as a group or individually via a secured connection and an assortment of graphical and statistical displays provide the detail needed to isolate potential trouble spots. *Segment View* provides a window into each Ethernet connection segment within the network, with a choice of views (list or icon). Simply choose the view you prefer with a click of the mouse. *GPS Positioning* provides exact geographic mapping of Strix network elements. Once the mesh network is formed, the network creates and *inventory control* used for secured encrypted bi-directional authentication of Strix network devices list which is distributed to all Strix devices participating in the network and any devices that are not part of the inventory list cannot participate in network topology building, exchanging configuration information, or managing Strix devices. *Secure Remote Management* and an industry compatible and *Strix enhanced proprietary MIB* (Management Information Base) make management simple. SNMP management consoles such as HP OpenView and other industry-leading systems can be used to manage the network remotely and securely. Network Management traffic on the Ethernet between the network server and module is automatically encrypted to prevent "listening" on the LAN/WAN.

For more information please visit <http://www.strixsystems.com> or call 1-877-STRIXSYS

