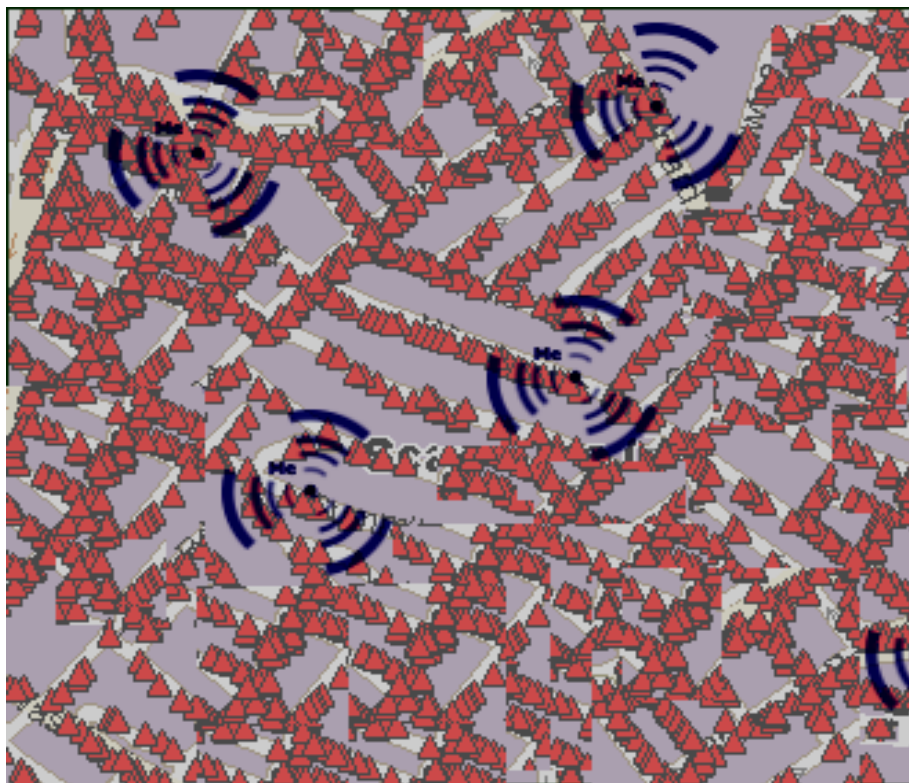


**October
2008**

Dense Wide Area Wi-Fi Deployment



**A Business
Case for ISP**

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Brovis Wireless Networks

Executive Summary

Are you interested in being a Wireless Internet Service Provider (WISP)? Are you exploring possible options of a green field network? Would you like to expand or leverage current wired infrastructure that may be available in your region? Are you feeling the cost pressure? Are you trying to create a complementary wireless service that provides mobility to your existing wire line customers? Do you want to take advantage of the growing list of new applications enabled by wireless broadband in areas such as public safety, productivity improvement, consumer access, and VoIP? Is your company ready to use wireless as a cost-effective, quick-to-deploy, anywhere, anytime, last-mile infrastructure? If your answer is YES to any/all of the above, then here is the solution.

This paper examines the advantages of distributed radio network, business factors, including investment and return, for deploying wide area Wi-Fi using BroVis' products and solutions. There is a detailed discussion on how a Dual Radio network is effective over multi-radio network, the factors behind revenue assumptions, "take" rates, capital expenditures, and operating expenses, as well as information on results and additional opportunities. It examines, analyzes, and demonstrates the cost-effectiveness of a BroVis' **BroadMESH™** and **RadioZone™** infrastructure for building a wide area Wi-Fi network.

“Business Case cannot be met by using an expensive multi-radio mesh network but can only be achieved by implementing dual radio mesh network”

Introduction & Market Overview

Broadband network is gaining importance to deliver converged services like Voice, Data and Video. Indian sub continent along with S.E.A and M.E.A regions is one of the fastest growing broadband markets. Indian market is expected to exceed 300 million internet users and 20 million broadband subscribers by the year 2010.

Despite having multiple approaches to meet this demand, Wi-Fi based wireless network tops the rest.

The biggest advantage of Wi-Fi based network is that it attracts low capital expenditure and enjoys better price-performance advantage. Wi-Fi based network enables ISP to target specific pockets where-in the sales forecast is lucrative. It allows ISP to deploy a moderate capacity



network that can scale rapidly, however the most challenging part is to assess this moderate capacity.

Complex multi-radio based Wi-Fi mesh network needs larger customer base with dense user cluster to justify economics, however in reality the user base is highly scattered and it calls in for a distributed radio setup. BroVis has rightly identified that the success of a wide area deployment is determined by well structured, distributed dual radio Wi-Fi mesh radio routers like **BroadMESH™**.

BroVis' **BroadMESH™** provides anytime, anywhere coverage similar to cellular network through distributed low cost mesh nodes and also offers the benefit of high-speed broadband access. **BroadMESH™** architecture, delivers cost-effective and secure broadband data access through standard Wi-Fi clients with coverage spanning wide areas. The mesh network offers better uplink and downlink speed than many complex multi-radio mesh network.

Wide Area Mesh Overview

Internet has become a necessity for all of us. The quest for high speed internet access has always been a major catalyst in technology revolution and in the recent past the need for mobility is spelt everywhere. With seamless internet connectivity one can stay connected to his/her eco-system anytime, anywhere. One can enjoy voice & video, enterprise & social applications, public service & secure information, and much more. The obvious and most compelling option is through Wi-Fi.

BroVis' **BroadMESH™** promises to deliver cost-effective and highly secure broadband access through standard Wi-Fi clients for coverage spanning wide areas and not just select hot zones. BroVis' outdoor **BroadMESH™** routers deliver high throughput and performance powered by BroVis' home grown **TrueEXOR™** technology. BroVis' **BroadMESH™** offers following benefits:

- Industry's first cost-effective mesh solution
- Truly customizable mesh
- **BroadMESH™** routing protocol
- Self healing
- Robust
- High Redundancy
- Truly Customizable
- Scalable
- Cost effective



Why Dual Radio network over Multi-Radio network for Dense Wide Area WLAN Deployment?

BroVis has identified dual radio mesh based distributed network as the key for any wide area network. Well crafted RF deployed using dual radio (mesh) network has significant advantages over highly expensive multi-radio systems as listed below:

Low Capital Cost: A multi-radio based network is overkill because the radio gets concentrated in one particular location, creating high capacity in a zone where it is not required. In normal cases, high capacity is needed only at the central point of the distribution system from where the bandwidth gets pumped. This can be addressed by multiple dual-radio systems at a single point. Careful RF planning eliminates any issues relating to co-channel interference.

Redundancy: Primary objective of a mesh network is to provide redundancy. And to provide redundancy the access radio must receive two or more signals from different BTS systems. To achieve this, wireless hardware used in a multiple radio mesh is very high than a dual radio mesh network.

Covering Dark Spot: Law of physics says that higher the frequency lesser the signal's ability to overcome obstacles. Despite having better receiver sensitivity, power levels, and smart antenna technologies in real world, we face lot of limitations to cover dark spots. A multi-radio mesh network placed in front of a tall skyscraper will need another set of radio on the dark spot to overcome the same. Evidently, the solution is to distribute the radios than to concentrate them.

User Density: Most ISPs are carried away by the total user/subscriber base that they might potentially have on a wireless network. However, the fact remains that better economies of scale can be attained in those clusters where the user density in a given area is high. So one has to focus on populate the given area than to acquire scattered customers. A Dual Radio mesh network can provide better economies than a multi-radio mesh network when the user density is low. This allows ISP to institute a network with lower CAPEX and scale the network based on customer acquisition pattern.

Low Power Clients: Widely overlooked factor is the lower power/capability of the Wi-Fi client cards/USB dongles. Wi-Fi client cards can best communicate to a BTS (Macro/Femto/Pico) at a maximum distance of 300 meters in practical conditions. This distance will be far less, based on other environmental factors. This means for every 300 meters one has to have an access to Wi-Fi radio BTS without which complete Wi-Fi blanketing is not possible. This again calls in for a distributed system based on Dual Radio mesh.

Cost of Scalability: Any wireless network is scalable through addition of more wireless radios, without creating bottlenecks in a cost-effective manner. At any given moment addressing scalability challenges will be cost effective by using modular dual-radio systems over a multi-radio system.



Success of the Wide Area ISP network will depend upon the following

- User density in a given area
- Capacity of the network deployed
- Capacity utilization rate of the network
- Cost of Ownership
- Ease of installation and site accessibility
- Lower maintenance cost

Application Scenario

A Wi-Fi network based last-mile wide area distribution can be implemented with a CICB¹ at \$75.00. This capital outlay includes a combination of Network Operations Center (NOC), Point of Presence (PoP), and consulting fees, plus capital expenditure for BroVis' Mesh routers and element management. This type of capital expenditure will support a multitude of low-power mobile devices and a broad spectrum of revenue opportunities, such as consumer broadband, roaming, standard and value-added business broadband, public safety, and municipal government services. Reduced capital investment enables income positive results with household densities as low as 300 per square mile. Larger networks have even better economies.

Our analysis shows a network with 30% take rate of 1,000 homes passed will have a total capital outlay of under \$50.00 per home passed, and an operating expenditure of \$5.00 per subscriber. The EBITDA² per subscriber will be more than \$37 based on a mixed-use subscriber. For want of greater economies of scale, increase the take rate to 40%. With low incremental cost of network expansion, **BroadMESH™** and **RadioZone™** solution services enable ISPs to aggressively pursue new customers quickly at competitive price points.

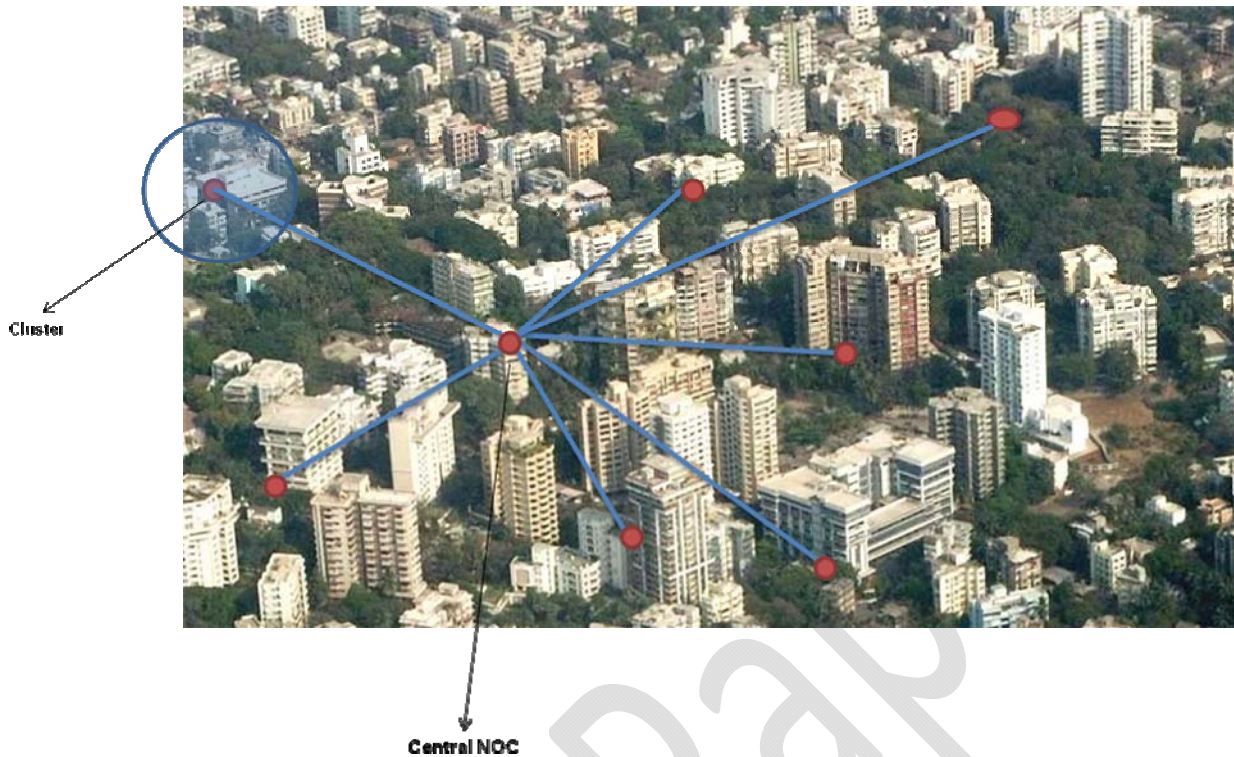
BroVis implemented Wide-Area Network for an ISP in a dense Indian subcontinent region. BroVis' 1200 MSH and AC 120 MSH models were deployed.

Internet backbone was terminated at the Central NOC of the ISP. Each NOC caters to multiple Wi-Fi clusters within a radius of 1.5 Sq.km. As many as 20 clusters were setup per N.O.C. The deployed Wi-Fi mesh network caters to 1800 subscribers with an average CICB of \$75.

The mesh based Wireless Distribution System (WDS) network caters to different broadband speed ranging from 128 Kbps – 2 Mbps per user. A **PPPoE** connection was established for this purpose.

1. Cost Per Installed Customer Base
2. Earnings Before Interest, Taxes, Depreciation, and Amortization.





A Pictorial representation of the Deployment Scenario

The successful deployment of the Dual Radio based ISP solution emphasizes the following:

- BroVis' 1200 MSH based Dual Radio network allows modularized deployment.
- BroVis' Dual Radio based network requires lesser CAPEX which directly translates to lower CICB.
- BroVis' Dual Radio mesh nodes eliminate the concentration of Wi-Fi signal in a single location unlike multi radio mesh nodes.
- Dual Radio system provides for effective distribution system to overcome dark spots than multi radio system.

With all these benefits, Dual Radio Mesh Networks are the order of the day for dense wide area WLAN deployments!

For more details please visit our website www.brovis.com or contact us at,

BroVis Wireless Networks

Regional HQ: #137/185, 2nd Flr, SPS Buildings, Anna Salai, Chennai – 600 002

Corporate HQ: #19925, Steven Creeks Blvd, Cupertino, CA 95014

