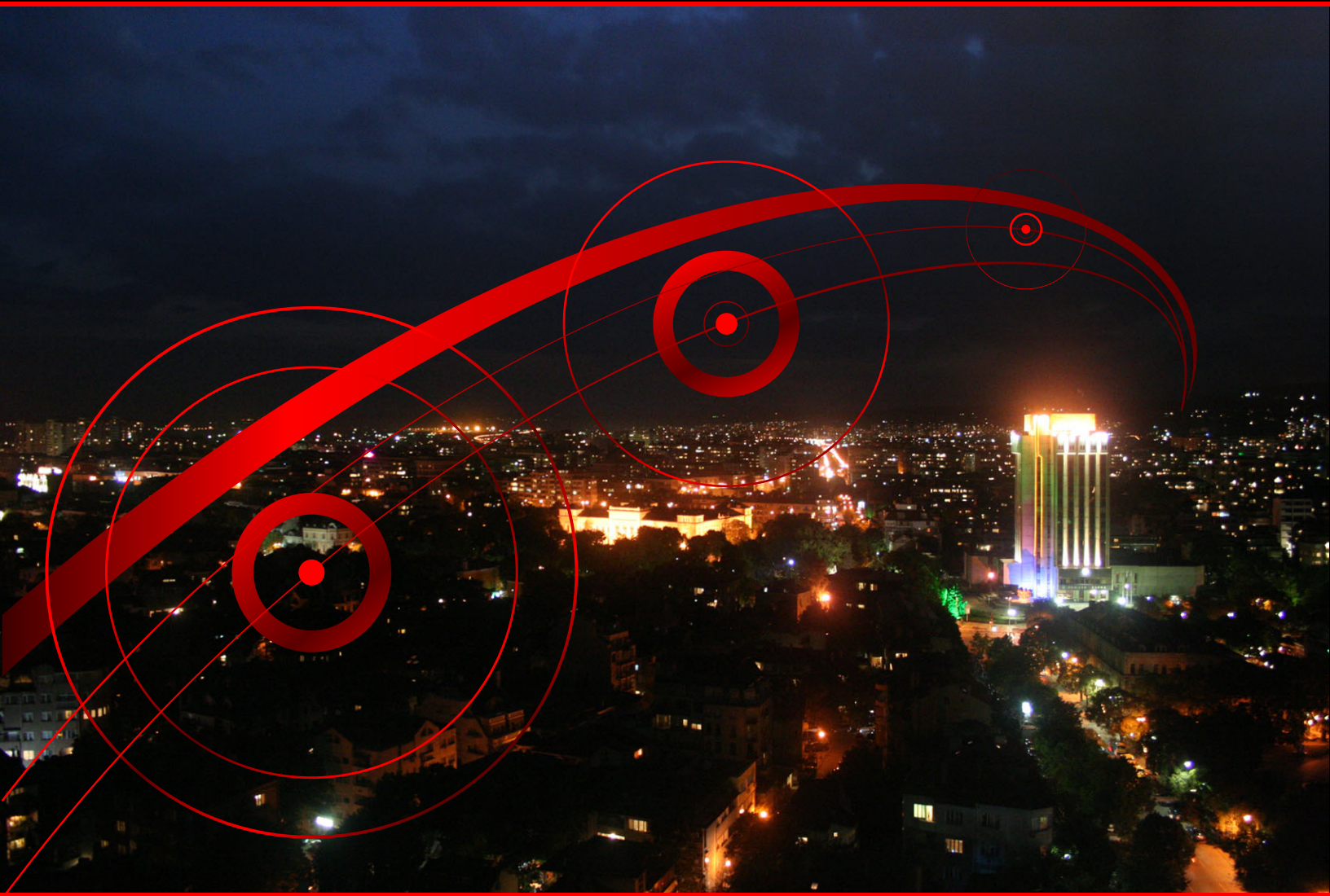


Novo.bg Deploys First Citywide Mesh Wireless Broadband Network in Varna, Bulgaria to Offer Triple Play Services



Bulgarian licensed telecom Novo.bg deploys SysMaster's citywide WiFi network in Varna, Bulgaria. The network covers the whole city, an area of 40 square kilometers and population of over 350,000 and allows Novo.bg to offer triple play services, including IP Television, VoIP telephony and mobile Internet access to business and residential users.

Background

The city of Varna, a top Bulgarian travel destination, has experienced a dramatic period of development and regeneration during the last five years. Located on the picturesque Black Sea, Varna is an important destination for tourism and a fast-growing hub of European commerce and transportation. The second largest city in Bulgaria with a population of over 350,000, Varna attracts a lot of domestic and foreign businesses who crowd to offer services to the booming tourist sector. The economy of the city is additionally invigorated by Bulgaria's anticipated entrance into the European Union Community in January 2007.

In 2006, the largest ISP in Varna, Novo.bg, decided to become the first Bulgarian provider of mobile Internet access and next-generation triple-play services. The initiative will allow Varna's residents and visitors to enjoy new technology phenomena such as Internet Protocol Television, Wireless Internet Access, and Wireless VoIP Telephony. After the launch in Varna, Novo.bg plans to aggressively expand its triple-play services to other major Bulgarian cities as well as to other Eastern and Central European countries.

Challenges and Solutions

Novo.bg envisioned building a network that will support real-time delivery of triple-play services, such as data, voice and television, to subscribers anytime and anywhere. To evaluate vendor offerings, Novo.bg established several criteria, including high bandwidth capacity, cost-effectiveness, high-scalability, seamless roaming, ease of deployment and operation, and low deployment costs. After conducting extensive research, Novo.bg found only one solution capable to fully satisfy all above criteria - SysMaster's Wireless Mesh Infrastructure solution with CellNode M100 access nodes. Field tests conducted by Novo.bg have determined that only SysMaster's solution provides reliable, cost-effective and scalable way to carry data, voice and television over wireless network infrastructure.

Novo.bg has experienced a number of challenges with the practical implementation of the wireless network infrastructure. Some of the Novo.bg's challenges and SysMaster's solutions to those challenges are discussed below:

Challenge: High Network Capacity

Novo.bg required that the wireless network infrastructure has sufficient capacity to support real-time transmission of at least 20 IP television channels in addition to data and voice traffic.

Solution:

During the tests conducted by Novo.bg, CellNode M100 achieved best performance with 108Mbps network speed in both the 5 GHz and 2.4 GHz bands. The tests showed that CellNode M100 can reliably support the delivery of 20 IPTV channels, 50 VoIP calls, and 15 MBps data transfer over multiple hops. During tests, a network of 4 CellNodes spanning over 25 km achieved throughput of 4.4 MB/second. Competing products could not measure up on IPTV level alone.

Challenge: Separation of Network Access and Backhaul

Novo.bg required that each WiFi access point use separate radios for client access and backhaul transport. Such radios should not interfere with each other.

Solution:

Each CellNode M100 has two radios operating in Super-G (2.4GHz) and Turbo-A (5GHz) modes. The substantial difference in operating frequencies practically eliminates interferences between the radios. Each CellNode supports network speed of up to 108Mbps with effective transfer rate on a single connection of over 35Mbps.

Challenge: Operation Under Interrupted Power Conditions

Novo.bg intended to install the access nodes on the roofs of residential and business buildings and on street light-poles. That presented unique challenges as power outages are frequent in Varna due to atmospheric conditions and problems with existing energy infrastructure. As street light-poles are powered for only 6-8 hours during the night Novo.bg required that access nodes be able to work under interrupted power conditions.

Solution:

SysMaster's CellNode M100 has a long-lasting built-in UPS module that allows it to function without any power for over 23 hours under full traffic load. In addition, the UPS module protects the device against lighting surges and notifies the central NOC server whenever the power is lost. This way, operators are immediately notified so that they are able to repair a power problem before a device goes out of service.

Challenge: Physical Separation of Client Network

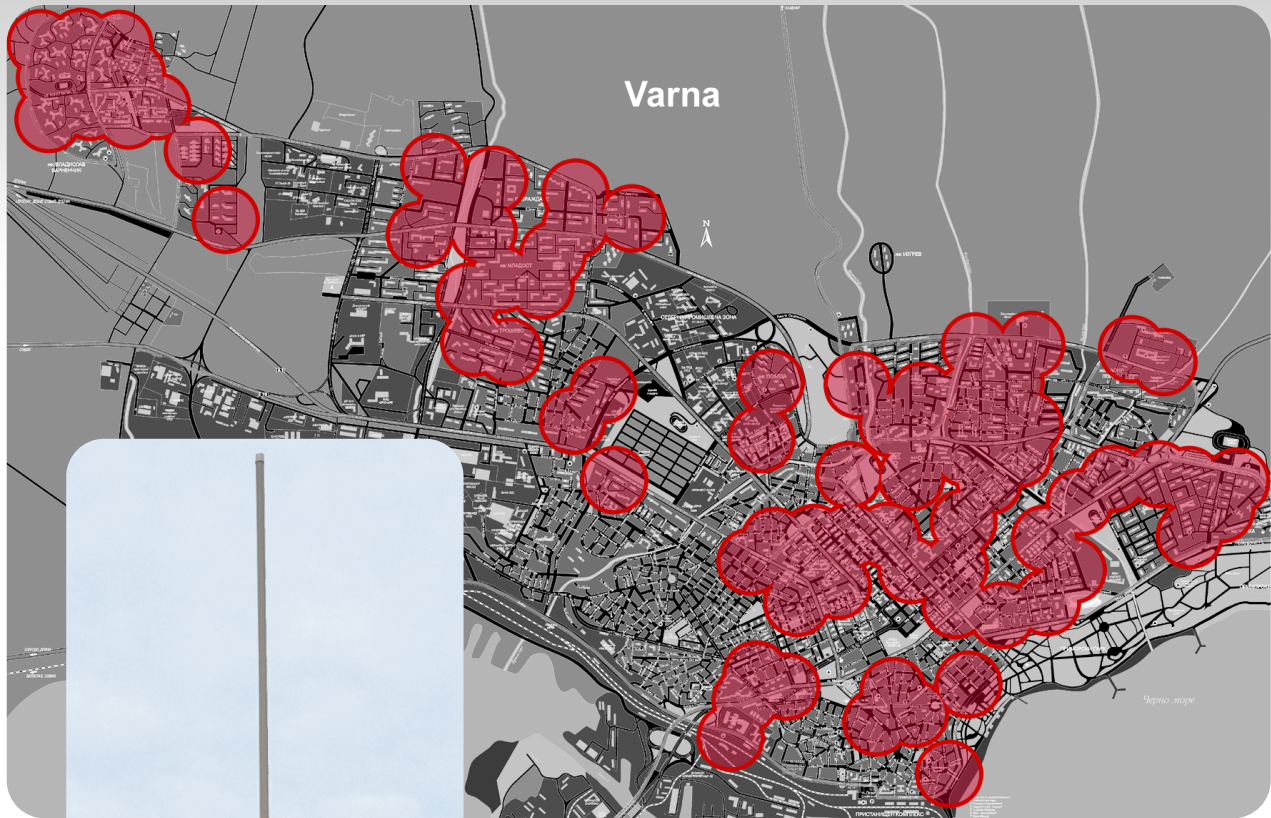
Novo.bg required that subscribers be able to access the network via both wireless and wired connections. In some cases, subscriber will prefer to use wired connections (e.g. residents of one building may need to be connected physically to the access node). The direct connection allows more flexibility in network planning but also brings additional challenges in terms of preventing network flood, network attacks, and virus attacks. Therefore Novo.bg required that regardless of connectivity (wired or wireless), clients be physically separated on a router level from the underlying backhaul.

Solution:

SysMaster's CellNode M100 was able to deliver 100% on that customer requirement. CellNode M100 has two wireless radio units and one Ethernet unit that allow both wireless and wired clients to connect to it. CellNode M100 is the only device that supports client network separation using an advanced ARP management technology. The device does not allow clients to directly connect to the network, thereby guaranteeing that all types of client access can be strictly managed and monitored. CellNode M100 also prevents ARP poisoning, ARP flooding, broadcast flooding, Evil Twin attacks, Virus propagation, and other known forms of LAN attacks. The device uses a proprietary mechanism to take over the ARP identity of all registered clients and provide ARP proxy services, thus providing the functionality of a dynamic router.

Challenge: Uninterrupted Wireless Roaming

Novo.bg intended to use the wireless infrastructure to offer mobile VoIP telephony services. To provide clients with uninterrupted voice services, Novo.bg required a technology that will allow clients to maintain their originally assigned IP addresses while roaming between access nodes.



Solution:

SysMaster was the only vendor to offer a technology to address the wireless roaming customer requirement. SysMaster's technology allows every CellNode M100 to take over the identities of all registered clients and notify the network if one client switches from one CellNode to another. As a result the wireless network can adjust its routing and ARP tables so that it can sustain communication with the client.

Challenge: Centralized Network Management and Provisioning

Due to the large network size which makes manual nodes setup prohibitively costly, Novo.bg required that all access devices be centrally managed and provisioned. Additionally, the company required that all client connections be billed, monitored, and managed in real-time.

Solution:

CellNode M100 integrates natively with VoiceMaster Wireless Management server. That server enables administrators to perform centralized network management and provisioning of all network nodes via a browser based GUI console. The server pushes all configuration and firmware changes to any network node in real-time.

Challenge: Reliable Operation Under Harsh Atmospheric Conditions

Because Novo.bg intended to install access nodes on building roofs

Table 1 - 5-year Business Projections of Novo.bg

| | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
|-----------------------|-----------|-----------|-----------|-----------|-----------|
| Subscribers | 3,000 | 6,000 | 9,000 | 11,250 | 13,500 |
| Sales | 684,000 | 1,368,000 | 2,052,000 | 2,565,000 | 3,078,000 |
| EBIT | 217,000 | 541,000 | 865,000 | 1,108,000 | 1,351,000 |
| Net Income | 184,450 | 459,850 | 735,250 | 941,800 | 1,148,350 |
| CapEx | 535,000 | - | - | - | - |
| Free Cash Flow | (350,550) | 459,850 | 735,250 | 941,800 | 1,148,350 |

and light-poles, it required that the access nodes function reliably under harsh atmospheric conditions.

Based on the 802.11a/b/g WiFi standard for access and backhaul connections, CellNode based networks deliver broadband speeds (1+ Mbps) to users using standard 802.11b/g clients (e.g. PDAs, laptops etc.). Such networks also offer user mobility via proprietary roaming technology. When users move within the network, CellNodes transparently perform node-to-node handoffs, ensuring that wireless clients have continuous access to the most optimal path back to the edge gateway. This transparent roaming is even possible across multiple IP subnets within the network. During roaming, all wireless clients preserve their originally assigned IP addresses.

Operating in the unlicensed 2.4 Ghz spectrum can be challenging as interference from foliage, large mobile objects, and other 2.4 GHz devices can cause traditional access point (hot spot) technologies to become unpredictably spotty in their availability. The intelligent mesh network deployed in Varna, however, eliminates such problems by dynamically monitoring path quality and automatically rerouting traffic around any interference. Additionally, if a network node becomes temporarily unavailable, neighboring nodes will pick up and reroute traffic by utilizing STP protocol along the most optimal path to the edge gateway. The result is a network with minimal RF interferences that is always on, always available to the end user.

Because of the STP protocol intelligence built into each CellNode, the network is easily and economically scalable. Increased network capacity is easily achieved by adding additional access nodes or access controllers without changing the rest of the network. Following a network change, all CellNodes automatically re-organize themselves to take advantage of increased capacity.

Network and Subscriber Management

Billing, network and subscriber management functions for the Novo.bg network are performed by SysMaster's VoiceMaster Wireless Management server and wSwitch Access Controller. VoiceMaster performs tasks vital to the smooth business operation of the network, including provisioning, authentication, administration, customer relationship management (CRM) and roaming. It also provides customer billing with separate charges for IP Television, VoIP Telephony and Internet access services. Access control to the network is performed by wSwitch. When subscribers access Novo.bg's network, wSwitch redirects them to a web page on the Novo.bg web server. That page acts both as a log-in screen, where subscribers enter their username and password, and a company home page.

Subscriber authentication is handled by the VoiceMaster server

utilizing SSL connection and user login name and password or system generated PIN number. All system logins can be dynamically managed, thus allowing support for both pre-paid and post-paid access. For example, a visitor can log into Novo.bg's network utilizing a prepaid voucher. After he is logged in, his IP and MAC information is stored in VoiceMaster and used for billing of services which will be provided until the voucher is depleted.

Utilizing the VoiceMaster Wireless Management server, Novo.bg staff can monitor and manage the WiFi network from a centralized location. The VoiceMaster server is built on client/server architecture. It collects and stores management information from devices in the network and provides graphical user interface to server data (via web based GUI). All CellNode M100 devices report traffic, status, and other management information in real-time and check for configuration and firmware changes periodically. All configuration and firmware changes can be pushed to any CellNode M100 from the VoiceMaster Wireless Management server in real-time. This allows rapid and simple field deployment, minimizing costs and time-to-network while automatic discovery makes scaling the network simple.

VoiceMaster Wireless Management server provides Multi Router Traffic Grapher (MRTG) style graphical view of the wireless network as well as its status and performance. A single alarm manager interface monitors performance and identifies actual and potential problems, including backhaul, mesh router failures, and path/WDS failures due to obstruction or radio frequency (RF) interference. In addition, the management server monitors for power and temperature problems and reports them to the NOC.

The results

Never before has broadband triple-play services been so affordable and rapidly deployable. By utilizing SysMaster's wireless mesh technology, Novo.bg is now able to provide triple-play services at prices up to 60% less than competitors. At 29lv (\$19) per month for residential triple-play package, Novo.bg was able to capture an unprecedented 6% market share in the cable services segment within the first three months of network operation. Novo.bg expects to pay for the full investment in 22 months.

All Novo.bg's subscriber can access triple-play services in real-time both from their homes or from a mobile location. The services include mobile Internet access, 20 IP television channels and fixed/mobile VoIP telephony. For these services subscribers pay 29lv (\$19) per month which has allowed Novo.bg to become the market leader among the local ISP, telecom, and cable operators. Included in the service is a low cost indoor bridge manufactured by SysMaster (CellNode BR/BRAP) which allows multiple subscriber devices to connect to the network and at the same time expands the overall coverage of the network within the subscriber's home.

Solution Economics

Novo.bg is excited about the economics of the deployed SysMaster's wireless network solution. The company has achieved profitability in the first year of operation and expects to fully recoup its initial investment in less than 22 months. Table 1 below lists Novo.bg's business projections based on the phenomenal market response to its services during the first three months of network operation.

Solution Benefits

Novo.bg's services are available to all 150,000+ homes in the city of Varna as well as to mobile users throughout the community. The SysMaster powered wireless network offers the following benefits to Novo.bg:

- High network bandwidth, capable of supporting triple-play services
- Low capital expenditures
- High network scalability with low incremental costs to expand footprint
- Robust control of interferences and high reliability supported by self-healing mesh architecture
- Support for both fixed and mobile applications

Novo.bg has experienced low system operating costs due to:

- Few incremental additions to the Novo.bg network operations, maintenance and management team - the network is largely run by existing personnel
- Low costs for traffic backhaul due to use of point-to-multipoint wireless connections and existing Novo.bg fiber infrastructure
- No truck rolls for customer installation

The Future

Encouraged by the results from the deployment in Varna, Novo.bg intends to extend its network to cover several other major Bulgarian cities, including Sofia, Plovdiv, Burgas, and Rousse in 2007 and to expand to other countries in Eastern and Central Europe in 2008 and beyond. The proven reliability, value and scalability of SysMaster products will be a key factor in helping Novo.bg to carry out its goals.



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