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**NOKIA**  
Connecting People

**Enabling Mobile WiMAX**  
Nokia's Turn-Key Solution



## Introduction

### **The ubiquitous Internet.**

High-speed connections bringing more services at lower costs to a virtually unlimited range of subscribers. It's the ultimate goal of most major network operators.

But in a marketplace where it seems every day brings a new technology competing for mainstream adoption, it can be difficult for operators to chart their course to the future. With its end-to-end solution for the deployment and operation of WiMAX networks, Nokia is lighting the way.

WiMAX, which stands for Worldwide Interoperability for Microwave Access, is a standards-based technology that unlocks the true potential of wireless broadband. Combining the best features and overcoming the limitations of legacy wired and wireless networks, WiMAX is capable of delivering a unified stream of voice, data, and video at unprecedented distances and bandwidth. All at lower costs that allow network operators to open new doors to customer satisfaction and profitability.

# Why WiMAX?

As wireless phones and high-speed Internet services have gained widespread acceptance, consumers and businesses have an insatiable appetite for increasingly fast and unfettered broadband. On one hand, current cellular networks offer mobility, but with an inherent focus on voice communications, they lack the ability to deliver the complete Internet experience. On the other hand, Wi-Fi has given users the taste for a wireless broadband connection, but its short range prevents users

from traveling far from the base station.

The marriage of the fully functional Internet with truly mobile access is the holy grail of the telecom industry. To make it a reality, network operators require more efficient spectrum utilization, lower latency for applications, and the ability to deliver a marketable service at a reasonable cost. The WiMAX standard is designed specifically to enable this next step in the broadband evolution.



## The WiMAX Business Case

Unlike other less practical solutions, WiMAX answers the call of network operators with a “plug-and-play” approach to mobile broadband delivery. The advantages can be captured in three key areas:

- **Easy, Low-Cost Deployment:** Upgrading a network to include WiMAX technology doesn’t require a complete network overhaul. Components can be incorporated directly into an existing network infrastructure and overlaid on existing sites, which equates to fewer capital expenditures.
- **Rapid Return on Investment:** Once in place, WiMAX allows operators to blanket a wide coverage area, providing mobile Internet services to millions of customers. The expanded subscriber base and enhanced service capabilities can offset deployment costs and provide a gateway to new revenue streams.
- **Sustainability:** Operators can be confident that WiMAX is here to stay. The standard enjoys strong industry support from WiMAX Forum companies (including Nokia), which will ensure the widespread adoption of WiMAX and the development of a sustainable ecosystem. Furthermore, the WiMAX standard calls for the interoperability of network components, promoting both cooperation and competition in the equipment marketplace to further lower the long-term expenses for operators.

## Our WiMAX Vision

WiMAX proponents agree that the technology holds the key to high-quality Internet mobility. But as a pioneer and thought-leader of the mobile communications industry, Nokia sees WiMAX as something more.

Beyond its obvious implications, WiMAX presents an opportunity for a new telecom business model that allows network operators to monetize the Internet in different ways. Instead of charging incrementally for a limited and controlled set of services, operators will have the ability to offer “open-access” plans, where mobile users are free to benefit from every resource the Internet has to offer, just as they would at home or work.

Nokia’s vision doesn’t stop at wireless phones and laptops. WiMAX will be used in everything from digital cameras, to music players, to household appliances, accessing the Internet to do their jobs more effectively. It’s a stepping stone to a world where IP permeates and improves every aspect of our lives. And it’s closer than most would believe.

## Trust the Wireless Leader

From the earliest days of the wireless industry, Nokia has led the way with innovative technologies for communications providers and the consumers who rely on them. Today Nokia is one of the most recognized names in cellular radio equipment and is breaking new ground in the wireless broadband sector. For network operators seeking a WiMAX partner, there is none more qualified than the company that truly understands mobility.

Nokia offers a turn-key approach to WiMAX deployment and operation, including:

- An end-to-end infrastructure solution, incorporating the right equipment selections in the right places, from the network core to radio access.



Voice has gone mobile

Broadband access is going mobile



- A comprehensive services portfolio to assist operators at every stage of the network lifecycle.
- Innovative end-user devices to showcase WiMAX’s capabilities, such as the new portable Internet Tablet.
- More than 8,000 Nokia Solutioneers in more than 60 countries to ensure customers get the support they need, and fast.

Nokia’s WiMAX gear also provides unmatched ease of installation and a lower total cost of ownership. A key component, the Nokia WiMAX Flexi Base Station (based on the company’s revolutionary multiradio platform) is

extremely compact, and modular in construction. Its small size makes setup a one-man job and creates savings on site real estate, while its scalable nature allows operators to easily upgrade to meet capacity requirements.

Unlike many off-the-shelf offerings, Nokia’s WiMAX solution provides mobility from day one, which gives operators a choice: launch completely mobile services now, or begin with a fixed wireless broadband offering and move into mobility as demand grows. Since Nokia’s WiMAX Core ensures smooth interworking between WiMAX and other access technologies, operators can continue to offer multiple service options without interruption.

# The Nokia Mobile WiMAX Solution

When it comes to building and optimizing a complex communications network, there's no such thing as a "one size fits all" solution. Nokia's WiMAX offering draws upon an expansive portfolio of products and services to provide operators with a customized, cost-effective, and flexible delivery platform.

## Network Building Blocks

While a WiMAX-enabled network can be configured for multiple uses, in most cases the Nokia WiMAX solution begins with a combination of several key network components:

- **Nokia Flexi Base Station:** Its industry-leading small size, light weight, and durable construction allow for easy installation in a variety of indoor or outdoor settings, from telecom closets to rooftops. The RF module can be installed at the base of a tower or

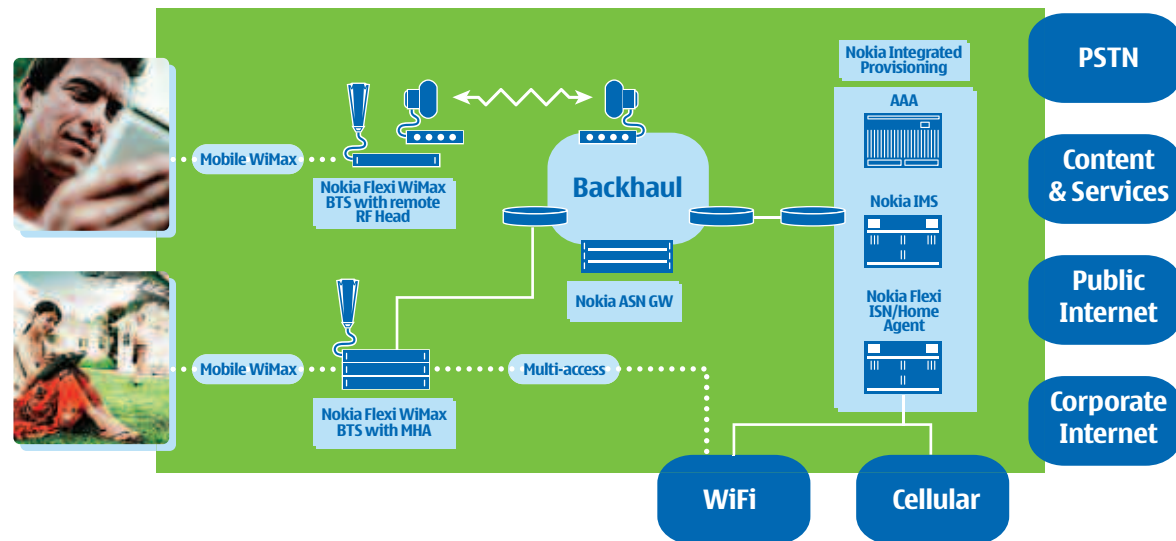
close to the antenna; within a 19" rack or mounted on a pole. Through savings on space and labor, power consumption, and operability, the Nokia Flexi Base Station dramatically reduces the total cost of ownership for operators.

- **Nokia Access Service Network Gateway (ASN-GW):** The Nokia ASN Gateway enables mobile WiMAX. It performs a number of critical functions as it interfaces with subscriber stations and the network core, including mobility control, paging, mobile IP Foreign Agent, authentication, security key distribution, and rate limiting or shaping.
- **Nokia NetAct:** Fast and easy to implement, Nokia NetAct provides the network management tools for WiMAX network elements. It provides visibility to network performance and end user behavior, and enhances the customer experience by maintaining and optimizing QoS.

Depending on the operator's intended use and existing architecture, additional elements in the WiMAX network may include:

- **Nokia Home Agent:** The user plane element in the CSN network that provides an interface between the WiMAX network and other IP networks and services. Enables seamless service availability between different access networks.
- **Nokia Authentication, Authorization and Accounting (AAA) Server:** Covers the WiMAX CSN Policy & Control function by interfacing with the operator's subscriber management and billing systems.
- **Nokia WiMAX-enabled End-User Devices:** Allow the operator to offer consumer products to take advantage of WiMAX services.

## Nokia WiMAX System Architecture



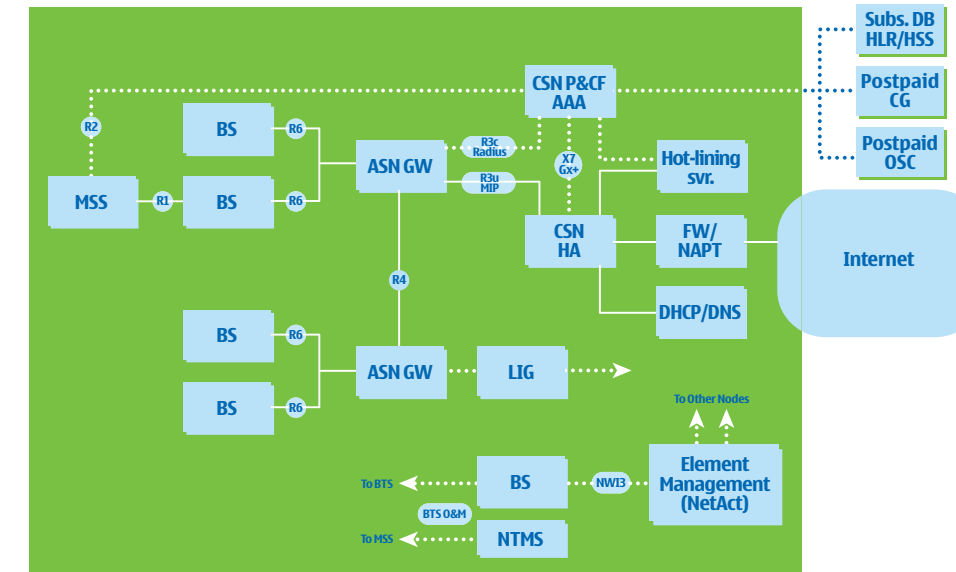
## Architecture Options

Nokia's solution for WiMAX is a flat IP-optimized architecture. The main elements of Nokia's architecture include Nokia's Flexi Base Station for radio access; Nokia's ASN Gateway (ASN-GW) for mobility, authentication, security, and QoS; and Nokia's Intelligent Service

Node (ISN) in the core network. In general, mobility will be realized via WiMAX Forum-specified mobility procedures, with a Home Agent functionality implemented for both WiMAX and multi-access roaming in Nokia's ISN network element. Authentication is based on AAA mechanisms, with QoS differentiation based on a DiffServ architecture.

An important consideration in any network architecture is the inter-working of technologies. With WiMAX, the most common case will require inter-working between WiMAX and Wi-Fi networks. The Nokia Home Agent can be used for this purpose.

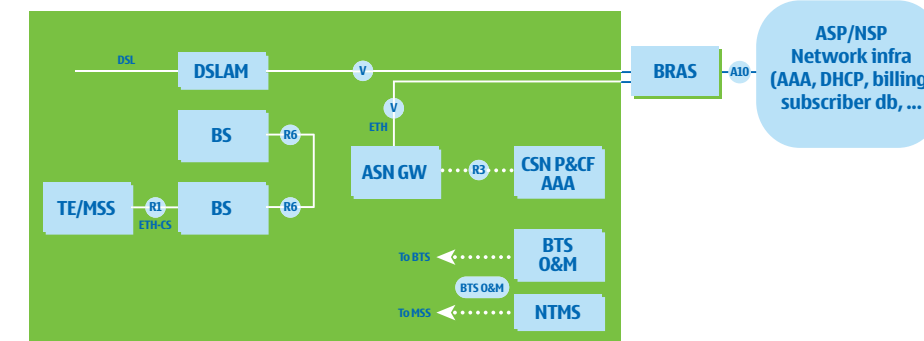
## WiMAX Network Architecture for Greenfield or Cellular Operator



Initially, Nokia anticipates that one of the following two implementation scenarios will apply to most operators.

**1** Greenfield operators or cellular operators may implement WiMAX to support full mobility. This would be accomplished through micro mobility handovers between the base stations over the R6 interface within one ASN Gateway (ASN-GW) area; and macro mobility handovers between ASN-GW areas. This WiMAX architecture may share the subscriber databases and the billing infrastructure with the operator's existing network, which would require some dedicated systems integration effort.

## WiMAX Network Architecture for DSL Operator



**2** DSL operators needing only limited geographic coverage could connect one ASN-GW directly to the BRAS, a simple solution that utilizes the operator's DSL core network infrastructure. Or, DSL operators seeking a wider coverage area could implement several ASN-GWs connected to the ISN Home Agent, and then further via the Inter-Working Unit to the operator's DSL backbone. The Home Agent enables the second layer of mobility or large area mobility between the ASN-GWs.

# A Compelling Choice

Whether an operator is building from the ground up or upgrading a legacy network, Nokia's path to WiMAX presents several clear advantages:

- **Compatibility:** Most Nokia WiMAX equipment can be purchased individually and integrated with existing network components, helping operators roll out services quickly, without major upfront investments.
- **Versatility:** WiMAX network elements can be configured for multiple uses (i.e. fixed wireless or mobile wireless), giving operators the functionality they need to meet customer demand now and in the future.
- **Lower total cost of ownership:** The factors above, along with the savings on space, manpower, and electricity provided by the "plug and play" Nokia Flexi Base Station, all serve to lower an operator's CapEx and OpEx.



## Lower Total Cost of Ownership with Nokia Flexi WiMAX BTS

	OPEX*	CAPEX	
Lower electricity bills	Power	Site acquisition	Faster site acquisition
Fewer spare parts & inventory	O&M	Planning & implementation	More installation options
Lower site rent	Site rent	BTS + power + antenna	No air conditioning unit needed
Easier to find sites with optimal transmission	Transmission	Site construction	No heavy lifting equipment, lightweight

\*OPEX over 5 years

### Nokia Services: Bringing WiMAX to Life

State-of-the-art equipment is only as good as the people behind it, which is why Nokia provides a complete range of services and business solutions to help operators ease the steps to WiMAX network deployment. With more than 20 years of wireless industry experience and 8,000 Solutioneers globally, Nokia works side by side with operators through the entire process of planning, building and optimizing access networks and services, enhancing network performance, training employees and improving operations.

Nokia offers services for WiMAX in the following areas:

- **Business Value Consulting:** Helps operators make the right decisions about end-user services by identifying the most viable market opportunities. Key focus areas include exploration and innovation, service development and implementation, in-life management, and commercial operations.
- **Service Delivery Platform Development:** Supports operators through the entire service lifecycle to ensure that all aspects of the business case and service strategy meet operator needs and provide an optimal end-user experience.
- **Service Management:** Provides consulting and supporting software to manage all aspects of the end-user experience, helping operators to deliver compelling services that generate maximum customer loyalty.
- **Network Planning Services:** Can guide the operator in deploying new equipment, making upgrades or replacements, or finding a solution for a specific site.

- Services a cornerstone of Nokia's strategy
- Services account for over 33% of Nokia's revenue from its Networks business
- Significant double digit year-on-year growth
- 1/3 (over 8,000 people) of Nokia Networks personnel work for services
- Close to 20 years in services
- 40 managed services clients in 31 countries
- Operating services contracts with over 20 customers globally
- Over 300 systems integration projects globally
- Nokia NetAct™ deliveries to more than 300 customers globally
- Over 80 service management customers globally, making us the leader in this growing market
- More than 350 service delivery platform customization and integration projects globally

- **Network and Service Performance Optimization:** Assists operators with managing the network to achieve the right capacity, availability and performance levels while also maintaining quality and profitability.
- **Delivery Services:** Produce time and cost savings for operators by minimizing the time to launch a new or upgraded network, and developing standardized plans to simplify network rollouts in terms of technology, materials and engineering processes.
- **Systems Integration:** Customizes the Service Delivery Platform to meet the operator's specific needs and integrate the WiMAX solution seamlessly with existing applications, services, customer care, billing, service control and other support systems.
- **Operation and Maintenance:** Offers several levels of support, including a network start-up package to assist with post-launch operational activities, Care Services to provide routine software and hardware support, and Hardware Services to handle repairs and multi-vendor parts logistics.
- **Managed Services and Hosting:** Assumes complete responsibility for network operations and frees the operator to concentrate on customer activities such as service development, marketing, branding, and customer relationship management.
- **Learning Solutions:** Provide training programs that teach new skills and technologies to improve employee performance and job satisfaction.



## WiMAX A to Z

The advent of WiMAX is an exciting step forward in the evolution of the telecommunications industry. For network operators, a new way of doing business is on the horizon.

As the world's leader in mobile technologies, it's only natural that Nokia is on the forefront of the WiMAX movement. The Nokia Mobile WiMAX solution offers operators a powerful combination of Mobile WiMAX-enabled equipment and services to deliver a lower cost of deployment and operation, easier network integration, and more flexible options for service provisioning.

Setting new standards for wireless technologies, Nokia is poised to bring success to operators, and a richer communications experience to consumers worldwide.