SIEMENS

Spearheading Broadband Wireless Access with the Triple Play Radio Strategy

Content

1 Executive Summary

Originally launched to cater to office demands, broadband services have gained currency in the private sector in recent years. Wireline broadband's ascent is attributable to the vigorous efforts to deliver DSL services to consumers' homes.

Now business users are demanding faster response times and download speeds. What's more, they want their wireless front ends to match the pace of wireline performance. This demand affords mobile operators a wealth of new business opportunities. While initially the clientele for wireless broadband will entail primarily business users, the market will soon encompass a broad consumer contingent.

The first stride towards mass broadband access has been made with the launch of 3G W-CDMA networks capable of handling high-speed data transmission. Surging sales of UMTS data cards for PCs attest to this demand and the industry's success in meeting it.

These global trends are spelling out the future of communications in big, bold letters: Mobile is poised to go broadband; fixed is sure to go mobile. Savvy carriers and operators will be looking to capitalize on these opportunities and proactively molding customers' expectations.

Siemens offers the right selection of BWA equipment and support for every deployment scenario:

- HSPA (High Speed Packet Access) with HSDPA (High Speed Downlink Packet Access) and HSUPA (High Speed Uplink Packet Access)
- WiMAX (Worldwide Interoperability for Microwave Access)
- FLASH-OFDM 450 MHz (Fast Low-latency Access with Seamless Handoff - Orthogonal Frequency Division Multiplexing)

With the benefit of experienced consultants and an approach that has proven its merits in countless real-world applications, Siemens is able to help each customer select the perfect solution to match his strategy, local regulatory issues and the competitive environment.

Once the appropriate access equipment is selected and deployed, the entire system must be integrated into the legacy backend infrastructure and its IT core, particularly to enable key functions such as authentication, accounting and authorization. Sophisticated and flexible charging options are also critical. Siemens rises to both these challenges with the Wireless Integration Platform and the Intelligent Packet Solution.

2 The BWA Market – an Overview

Today demand for broadband services is dominant in the wireline market, where they have been a fixture for a decade now. However, two wireless add-ons have made inroads into this conventional market:

- In-house and hotspot WLAN connections serving as a mobile front end for DSL connections limited by restrictions such as short ranges
- Technologies bridging the last mile to the subscriber as well as enabling roll-out in regions lacking cable infrastructure

The next rung up WLAN's evolutionary ladder is called WiMAX, which entails microwave access. The standardized solution WiMAX 802.16 2004 is geared to offer BWA connections to stationary as well as nomadic subscribers with WiMAX modems in their laptops. Next-generation WiMAX 802.16e enables high-speed mobile data services.

Concurrently, GSM mobile network technology is steadily advancing to accommodate packet data capabilities. GPRS and EDGE led the way with fully mobile connections delivering ISDN-caliber performance. Offering up to several 100 kbps under real-world conditions, 3G W-CDMA raised the performance bar. And UMTS has recently been extended with HSDPA to enable DSL connections on the downlink. Slated for introduction in 2007, HSDPA with HSUPA will accommodate symmetrical connections and offer high-speed uplink connections, thereby empowering providers to market applications such as interactive gaming, video conferencing and VoIP. HSUPA's many benefits include 30% greater capacity and significantly lower latency.

BWA has more to offer than merely conventional fixed and mobile use cases. It transcends the limitations of range in many scenarios, for example, by feeding WLAN connections to trains rolling down the track. This requires advanced low-frequency technology such as the Siemens FLASH-OFDM 450 MHz system.

All these systems will eventually migrate to 4G mobile systems, with the diverse predecessor radio technologies converging in advanced systems. Today's and tomorrow's access systems will connect to an all-IP network controlled by IMS, an access-agnostic IP multimedia system. This means that regardless of strategy, operators can start gearing up for tomorrow today to seize all the business opportunities that future services will bring.

This demand for mobile and broadband technology is real. The number of UMTS data cards sold in the three months following their release was fivefold the amount of all GPRS data cards sold in a span of a full three years. Analysts are predicting similar success for HSPA cards.

3 Different Operator Requirements, Different Technologies

Every operator pursues a different business strategy informed by the given target markets, the network infrastructure in place, and extrinsic conditions such as the competitive environment and spectrum or license regulations. And operators' requirements vary according to their different business strategies.

Each strategy of course focuses on the target market first. For example, an MNO may choose to address enterprise or consumer markets, or branch out into the DSL market, while an FNO may aspire to offer greater mobility to subscribers.

The determining factor for a proposed technology's suitability is its ability to satisfy the target market's requirements. Several criteria play a vital role in selecting a technology - for instance, its potential to enhance mobility, increase capacity (more users per cell), increase bandwidth (high data rates), reduce latency (particularly for time-critical applications), facilitate roaming, and accommodate varying classes of quality (for example, to deliver higher data rates to premium customers) with the appropriate quality of service (QoS). The available spectrum, license ownership and roll-out costs are equally crucial considerations in every operator's strategy.

BWA technologies offer a host of options well-suited for satisfying markedly different market demands throughout the usage spectrum ranging from fixed indoor communications to nomadic scenarios and high-speed mobility. Each technology has its advantages in terms of data rates, latency, capacity and mobility. The key issue is which technology is best for the given operator and his unique approach to doing business.

3.1 HSPA

3.1.1 HSPA – Supercharging Downlink and Uplink Data Rates

A step up in W-CDMA's evolutionary chain, HSPA comprises the downlink solution HSDPA and the uplink solution HSUPA. The two solutions afford operators owning W-CDMA licenses a very cost-effective option for evolving their network. Upgrading networks with HSDPA and HSUPA boosts downlink and uplink data rates as well as the performance of services such as business e-mails sent with attachments and ultra responsive interactive games.

3.1.2 HSDPA - The Downlink Turbo for W-CDMA

An evolutionary stride in W-CDMA's development, HSDPA is deployed to speed up 3G mobile data services. The target group for HSDPA comprises MNOs owning 3G W-CDMA (Wideband Code Division Multiple Access) licenses. The cost-effective option for these operators is to enhance their networks with a relatively simple upgrade to HSDPA to enhance their Siemens Network.

HSDPA brings to the table capability akin to "wireless DSL," thereby supplying the caliber of broadband access that premium and business users expect at home, in the office and on the go. Lower network latency and faster response capacitate time-critical applications such as live video conferencing and multi-player gaming.

With HSDPA, operators will be able to deliver full-fledged international roaming, seamless roaming between 3G W-CDMA and HSDPA, and high levels of data security. With faster downlink data speeds, per-bit costs drop significantly as data service is provided to growing numbers of customers, while greater volumes of data can be transported. HSDPA affords operators considerable improvements in capacity and painless upgrading is assured – a software upgrade is all it takes for Siemens W-CDMA networks.

Standards and Technology

The Third Generation Partnership Project (3GPP) standardized HSDPA in Release 5 of the 3G specification. HSDPA furnishes a fat-pipe shared channel, enabling existing bandwidth to be used more efficiently. It makes the most of adaptive modulation and coding to deliver peak downlink data speeds of 14 Mbit/s. In real-world conditions with networks operating at full loads, HSDPA is able to deliver downlink speeds of 2 to 3 Mbit/s.

Siemens was one of the first HSDPA suppliers to demonstrate this new data "turbo" live, with the third quarter of 2005 marking the solution's commercial release. Endowed with HSDPA's power to boost data performance, the new Node B range of NB-88x products delivers better performance and consumes less power.

3.1.3 HSUPA - The Uplink Turbo for W-CDMA

While HSDPA spearheaded the efforts to bring mobile and fixed network capabilities up to speed on the downlink, the uplink stood to benefit from a solution with similar performance-boosting power. Symmetrical connections, in particular, mandate a high-performance uplink.

Enter HSUPA, a solution designed to bring the benefits of further capacity increases and enhanced latency, throughput and coverage to operators. Beyond that, it will significantly improve spectral efficiency, as well as enhancing bidirectional hand-shakes e.g. email synchronization for applications such as Outlook.

The HSUPA / HSDPA combination empowers operators to offer high-speed, two-way data services such as multiplayer gaming, video telephony and conferencing. With a more sophisticated service offering, MNOs will be able to compete successfully with fixed line DSL providers and eventually assume the mantle of wireless Internet service provider.

This added performance power enriches the user experience for every extant application. The market for HSUPA-enabled, two-way high-speed data services will comprise two segments - for one, corporate and enterprise users and, for the other, consumers demanding high-speed access. With this one/two combination operators can introduce service classes to differentiate offerings in local markets.

Standards and Technology

Anticipating the requirement to increase uplink capability (that is, mobile-to-Node B), 3GPP has standardized HSUPA in Release 6 also known as Enhanced Dedicated Channel (E-DCH). But upping capacity was not the sole intent of standardizing HSUPA; 3GPP also sought to reduce uplink latency, enhance cell throughput and, most importantly, boost user throughput.

HSUPA donates a new dedicated channel (as opposed to HSDPA's shared channel). This channel's power management boosts transmission power when channel quality deteriorates. For the uplink, it is vital that transmission power is limited whenever excessive interference is generated at the user's end. With the benefit of HSUPA, the Node-B is able to curb the amount of interference generated by each mobile device. In W-CDMA networks, the Radio Network Controller (RNC) was tasked to manage power (and hence interference). With the base station (Node-B) performing power management, communication paths are shorter, thereby accelerating response time. This is a tremendous advantage, particularly in times of peak demand.

A key attribute of the HSUPA standard is that it coexists with legacy W-CDMA radio bearers. This means HSPA could be operated in parallel with circuit-switched traffic on one physical W-CDMA channel.

Siemens is developing the first HSUPA implementation compatible with 3GPP Release 6. With trials due to commence in the second half of 2006, commercial availability is slated for the first half of 2007.

3.2 WiMAX - Peak Data Rates for Hot Zones

WiMAX is an advance in W-LAN's evolutionary trajectory. While W-LAN is widely deployed to provide high-speed data access in hotspots and homes with limited ranges of some 100 meters, WiMAX offers true wide area coverage for entire "hot zones" ranging up to several kilometers.

As the inceptive WiMAX solution for stationary and nomadic usage, WiMAX 802.16-2004 offers a wireless alternative to cable and wired DSL broadband access. The CPE (customer premises equipment) is a standalone box designed for stationary deployment and allowing merely limited mobility.

WiMAX functionality will be implemented in PC processors to ensure the successor release WiMAX 802.16e also supports mobility. MNOs can opt for WiMAX 802.16e as an ancillary solution to furnish additional capacity in densely populated urban areas or in traffic hotspots where HSPA capacity no longer suffices to satisfy growing demand.

FNOs, in turn, can deploy WiMAX 802.16-2004 as a wireless last-mile solution in order to deliver mobile DSL services to rural and remote areas where cable or fiber services are infeasible due to economic or logistic constraints. WiMAX 802.16-2004 provides wireless broadband communications to fixed network users seeking Internet access. Backhauling, where WiMAX mimics microwave, is another conceivable usage scenario.

WayMAX@vantage, the Siemens WiMAX 802.16-2004 solution, was unveiled in the second half of 2005. In May of 2005 in Milan, Italy, a WayMAX@vantage test network transmitted data between a modem and a base station at top speeds of 12 megabits per second via the 3.5-MHz channel and the 3.5-GHz frequency spectrum. Apart from inceptive proprietary systems, these transmission rates are unmatched. Siemens is the first company worldwide to offer standard-compliant WiMAX 802.16-2004 radio networks, including CPE (customer premises equipment), to FNOs and MNOs.

Affording network operators the opportunity to market high-speed mobile data services, next-generation WiMAX 802.16e is also a cost-efficient solution for backhauling traffic in mobile scenarios. Next-generation PC processors will be CPE-enabled to facilitate connection in the given areas of coverage. Standardization of WiMAX 802.16e for mobile scenarios is underway; the first products are expected to be unveiled in 2007/08.

Standards and Technology

WiMAX belongs to the IEEE (Institution of Electrical and Electronic Engineers) 802 family of wireless technologies. Able to route higher data rates over greater distances, it outperforms WiFi. IEEE has approved the initial version 802.16-2004. Previously known as 802.16d, it supports stationary and nomadic services.

A step beyond fixed access, nomadic service enables end-users to gain broadband access from various locations in the operator's WiMAX network. This specification was extended to the 2-to-11 GHz frequency spectrum, thereby transcending the requirement for line-of-sight radio connections.

The WiMAX forum has proposed three frequency bands: 3.5 GHz, licensed almost worldwide; 2.5 GHz, licensed in North America and some Asian countries; and 5.8 GHz, which is unlicensed in many countries.

Slated for approval in the second half of 2005, the new standard 802.16e will enable portable WiMAX devices to send and receive data in transit among a cellular network base stations' coverage areas. Geared to support users traveling at speeds up to 120 km/h, the standard specifically targets the mobile users market.

3.3 FLASH-OFDM 450 MHz - Cost-efficient Wireless IP Data Service

FLASH-OFDM 450 MHz is certainly the first choice for operators with access to the 450-MHz spectrum. Engineered to perform at a "low" frequency, this technology delivers cost-efficient high-speed data services across a wide area of coverage. This makes it a compelling proposition for operators looking to bring mobile broadband services to subscribers in remote and rural regions. Courtesy of its large cells, it is also an excellent choice for applications such as railway backhauling, where passengers enjoy WLAN access in moving trains.
Purely IP-based and ultra low in latency (< 50 ms), FLASH-ODFM 450 MHz is ideally suited for every type of mobile data. It is the only 450 MHz system with built-in QoS enabling differentiated user classes.

Designed for wireless IP data, FLASH-OFDM 450 MHz provides high-speed connectivity with very low, DSL-like latency. Comprising an end-to-end, all-IP architecture, it utilizes standard IP components in the core network to deliver high performance and flexibility at low cost.

FLASH-OFDM 450 MHz is an outstanding option wherever high-speed mobility and service over a large area is a priority over high capacity, for example, when seeking to develop broadband markets in rural regions. Target user groups typically comprise mobile, nomadic and fixed residential wireless DSL subscribers in areas where wired DSL and mobile UMTS services are unavailable.

FLASH-OFDM 450 MHz is also the first choice for MNOs who operated analog networks and still own a 450 license. All the many other organizations and operators worldwide seeking to deliver last-mile, fixed wireless DSL service to areas where fixed-line penetration is low will find a suitable solution in FLASH-

OFDM 450 MHz. As an added benefit, it enables MNOs to serve mobile or nomadic customers via the same network - regulatory provisions allowing.

Standards and Technology

A non-standardized but fully mobile technology, FLASH-OFDM delivers typical data throughput rates ranging from 1 to 1.5 Mbit/s, with burst rates up to 3.2 Mbit/s in the downlink and 300 to 500 Kbit/s in the uplink, and with burst rates of 900 Kbit/s on a single carrier at a bandwidth of 1.25 MHz. Services can be rendered at these typical data throughput rates to users traveling at 250 km/h. Hence it can serve as a feeder/backhaul solution for moving WiFi hotspots such as high-speed trains. With sub-50 ms latency, this technology is eminently well-suited for interactive applications geared for business and gaming clientele.

FLASH-OFDM is currently the only wireless technology in the 450MHz arena, able to deliver data rates at DSL levels in both the uplink and downlink. High-latency technologies such as CDMA450 utilize radio resources for data services far less efficiently. Not only do they deliver lower effective data rates to end-users, they are far costlier to operate. The quality of the user experience for high-speed data throughput hinges on system latency. In fact, if latency is too high, the broadband experience will be disappointing, if not lacking altogether . Case in point: Many interactive mobile games necessitate fast response times for an engaging user experience.

Siemens partners with Flarion[1] Technologies to offer FLASH-OFDM 450 MHz. The end-to-end FLASH-OFDM 450 MHz solution was rolled out in August of 2005. Siemens also offers the integration and charging solutions IPS and WIP, an in-depth description of which will following in the ensuing chapter.

4 Integrating Alternative Access Technologies

Operators are challenged not only to choose the right access technologies for their business strategies, but also to connect and integrate them with legacy networks, retain subscribers' loyalty, and charge for services. Siemens provides the products mobile operators and fixed carriers need to rise to these challenges.

Siemens' Intelligent Packet Solution (IPS) leverages smart charging functions to put into operators' hands the features required to capitalize on mobile data services' revenue potential. The Wireless Integration Platform (WIP), in turn, leverages standard interfaces to enable easy, cost-effective integration of BWA technologies into the operator's legacy IT backend.

[1] Though Flarion has been sold to Qualcomm, the contract between Siemens and Flarion stands unaffected.

4.1. Intelligent Packet Solution (IPS)

With IPS, Siemens provides a flow-based charging functionality for the mobile packet core. This solution furnishes charging data with a richly detailed view of service and content. Given this capacity to analyze access on a granular scale, MNOs can implement pricing models with differentiation according to service, content and user to better satisfy demand and capitalize on subscribers' readiness to pay. Mobile users, in turn, benefit from sophisticated service offerings priced to scale.

Offering intelligent charging functions on top of a full-featured GGSN solution, IPS can be deployed in all GPRS and UMTS packet-switched core networks. The Content Service Gateway (CSG) is the key component; it inspects packets to analyze uplink and downlink traffic and generates charging data for prepaid and postpaid users. Designed to run on a high-performance router, the system readily adapts to BWA access networks such as WiMAX and FLASH-OFDM 450 MHz. IPS' greatest benefit is that it affords all types of access networks a common approach to service charging and control.

4.2. Wireless Integration Platform (WIP)

Developed to integrate new access technologies into legacy IP networks, WIP has proven its merits in various WiFi integration projects.

In HSPA scenarios, the feature set is part of legacy network elements such as HLR/VLR or GGSN/SGSN, which negates the need for WIP. However, network integration is a vital issue for other BWA technologies such as WiMAX and FLASH-OFDM 450 MHz. The majority of network operators' IP backend has evolved gradually and as a result is often dauntingly complex. Ill-advised attempts to integrate new access technologies may adversely impact the IT backend.

Factoring this complexity into the equation, WIP reuses many network elements such as authentication, authorization and accounting (AAA) functionalities. Beyond that, it affords MNOs tremendous flexibility in charging and billing. One-time password capability, where the user enters his mobile number, is another key feature. WIP authenticates the number and issues a one-off password, which is sent to the user via SMS. The platform also connects to credit card companies and authenticates SIM cards installed in laptops. And on operator demand, it also enables mobile IP-based roaming and session continuity.

WIP supports roaming traffic irrespective of the given roaming standard. WIP captures the accounting data for BWA users the legacy infrastructure is unable to account for, bringing true mobility to FNOs' customers. In addition, it operates in multi-vendor environments.

5 Why Siemens?

Siemens' comprehensive range of solutions and products runs the full gamut of technology, from fixed to mobile to all IP. A track record of 30 BWA contracts worldwide speaks for itself. Operators turn to Siemens for the most cost-effective BWA solutions, each tailored to suit the given MNO's locale and market.

Siemens introduced commercial HSDPA in Q3 of 2005. Siemens HSUPA enables operators to maximize their network uplinks' performance with minimum impact on legacy UTRAN hardware. Another key benefit is its low cost of implementation: HSDPA is deployed by simply upgrading the software in W-CDMA networks.

With WayMAX@vantage, Siemens was the first to roll out a standard-compliant WiMAX 802.16-2004 radio network, to include CPE. Courtesy of its high output power, WayMAX@vantage is the only system that collocates with W-CDMA base stations without requiring renewed site planning.

Engineered with proven technology, Siemens FLASH-OFDM 450 MHz is the first all-IP offering geared for deployment in the 450 MHz frequency band. Exclusively IP-based with ultra low, sub-50 ms latency, FLASH-ODFM 450 is ideally suited for every type of mobile data. No other 450 MHz system rivals its built-in QoS enabling differentiated user services.

Innovative, powerful and intelligent, IPS offers the smart charging functions operators need. And Siemens WIP facilitates cost-effective integration of BWA technologies such as WiMAX and FLASH-OFDM 450 MHz into the operator's legacy IT backend.