White paper

Simplified network architecture delivers superior mobile broadband

Nokia Siemens Networks

Profitable wireless broadband with Internet-HSPA

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Executive Summary

The common design principle for future mobile broadband networks is flat architecture. The Third Generation Partnership Project (3GPP) consortium, already working for today's 3G networks, has standardized a flat, IP-centric architecture that eliminates the need for Radio Network Controllers (RNC).

Why do future technologies have this common design approach? The answer lays in the rapidly growing demand for data services at ever lower costs.

Mobile broadband with High Speed Packet Access (HSPA) provides a similar user experience to that delivered by fixed Digital Subscriber Line (DSL) access. Meanwhile, flat fee pricing is giving users predictable data costs. On the positive side this has led to higher data Average Revenue Per User (ARPU) for communications service providers (CSP). However, as advanced data services are adopted at an increasing pace, rising data traffic threatens to overload existing infrastructure. The volume of data traffic in mobile networks globally has already exceeded the levels of voice traffic.

The pressure from rising data service demand is being met by flat network architecture. I-HSPA (Internet-HSPA) is the first flat, fully 3GPP-standardized architecture for wireless 3G networks.

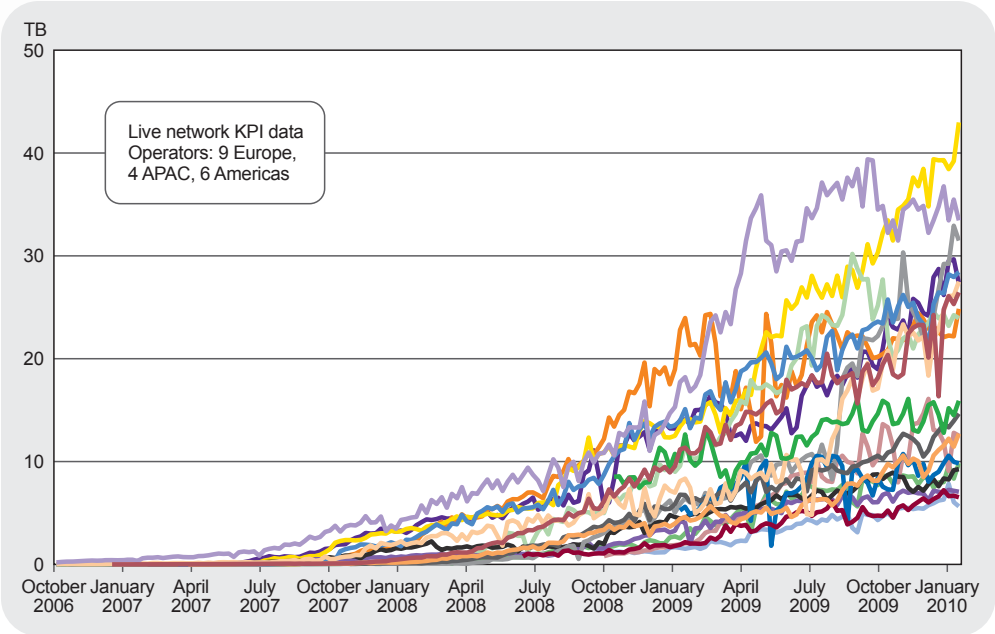

Figure 1. Data traffic growth is rising rapidly worldwide. Source: Nokia Siemens Networks analysis.

Mobile data traffic is growing strongly

Wireless data traffic has grown strongly since the introduction of HSPA in 2005.

Today, 98% of the world's WCDMA networks have been upgraded to HSPA, according to the Global mobile Suppliers Association (GSA). Offering peak data rates up to one hundred times greater than early WCDMA implementations, HSPA has brought the fixed xDSL experience to mobile subscribers.

The transition to HSPA evolution (HSPA+) and Long Term Evolution (LTE) will result in further growth, creating greater numbers of end users accessing true broadband speeds and advanced services via their smart mobile devices.

Nokia Siemens Networks has predicted that the data traffic generated by smart devices will increase 10,000% by 2015.

Future networks are flat

Flat network architecture is a key technology for providing cost-effective mobile broadband services. Flat architecture enables networks to be scaled up as data traffic increases. End users benefit from improved service continuity and attractive data prices which translate into increased loyalty and improved business for service providers. The first 3GPP-standardized commercial implementation of flat architecture is I-HSPA.

I-HSPA is built on simplified two-node architecture: a base station with integrated RNC functionality and a Serving GPRS Support Node (SGSN) supporting the Direct Tunnel. Data traffic goes directly from the base station (BTS) to the gateway GPRS support node (GGSN), by-passing the SGSN. The Internet BTS (I-BTS) is connected directly to the Mobile Soft-Switching (MSS) system to handle circuit switched (CS) traffic.

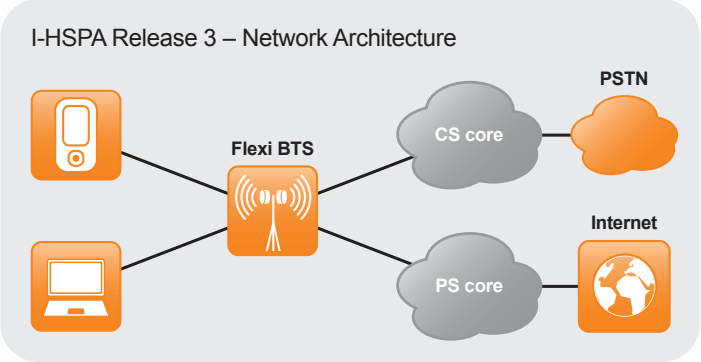

Figure 2. I-HSPA Release 3 further simplifies network architecture

The benefits of this flat network architecture have been recognized widely by the communications industry, particularly for the development of future broadband technologies. For its part, Nokia Siemens Networks has invested significantly in innovating and driving both the standardization and deployment of flat architecture networks.

With 3GPP Release 4, the CS core network architecture has been flattened, while the introduction of Direct Tunnel technology has simplified the packet switched core. More recently, the radio access network has been transformed by I-HSPA technology, collapsing RNC functionalities onto the base station. The result is an end-to-end flat architecture for 3G and LTE.

Higher network connectivity and availability

With I-HSPA and Direct Tunnel, investments in SGSN and RNC throughput capacity are no longer necessary.

Figure 3 shows a typical I-HSPA network with 1,500 BTSs. The radio interface capacity is 21 Mbps in the downlink, which can be boosted to 42 Mbps per cell with Dual Carrier and up to 168 Mbps according to the HSPA evolution standard. It is this radio interface that ultimately limits the end-to-end network capacity in a mobile broadband network. As radio technology evolves towards LTE, the radio interface will rise to even higher peak rates.

Flat network architecture with Direct Tunnel supports IP over Ethernet to sustain these high rates. Not only does this eliminate the risk of RNC capacity investments becoming obsolete when upgrading to LTE, but it enables CSPs to flexibly increase HSPA carriers and BTS without laborious RNC, CS core and SGSN re-dimensioning. Avoiding these upgrades also helps to improve network availability for end users.

It is important to note that I-HSPA technology has the same throughput development as that planned for HSPA+ that will enable today's base stations to support up 168 Mbps transfer rate, in the future.

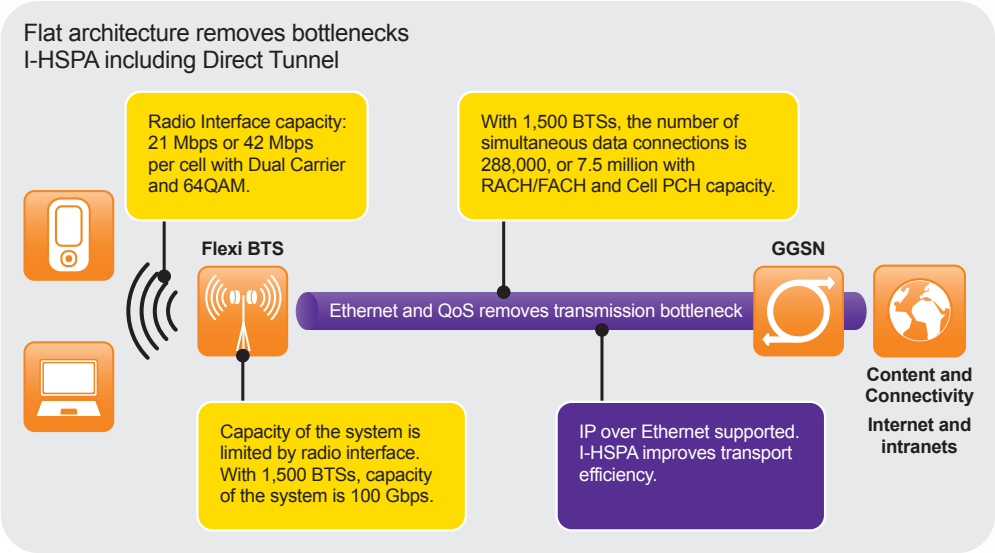

Figure 3. Flat network architecture improves connectivity.

Reduced transport costs

A further benefit of IP over Ethernet support is reduced transport costs. I-HSPA reduces the backhaul load by terminating RNC protocols at the BTS. The Iub interface between the RNC and BTS becomes an internal IP interface within the base station itself. This can reduce backhaul load by up to 28%.

I-HSPA helps CSPs to achieve a smooth transition from traditional E1 leased lines towards Gigabit Ethernet based backhaul.

Standardized for mobile networks

Flat network architecture is standardized by the 3GPP Consortium in 3GPP Release 7 for WCDMA and in 3GPP Release 8 for LTE. Standardization brings a wealth of benefits, from competitive markets and diversity in end-user equipment, to interoperable solutions and roaming.

I-HSPA is standardized as 'Direct Tunnel with collapsed RNC', which ensures interoperability with existing WCDMA core networks and 3GPP terminals. The Direct Tunnel functionality is an SGSN feature that does not affect the specification for existing GGSN platforms. Furthermore, neither I-HSPA nor Direct Tunnel functionality have any impact on the air interface and user terminals, so all I-HSPA implementations will support today's widely deployed 3GPP terminals. I-HSPA flat architecture will work fully with the improved air interface performance of HSPA evolution as standardized in 3GPP Releases 7 and 8. The higher the traffic volumes and data rates, the greater the economic benefit of I-HSPA.

Nokia Siemens Networks has completed interoperability tests between the I-BTS and all the other major vendors' core network elements. I-BTS can be connected both with and without Direct Tunnel to any packet core.

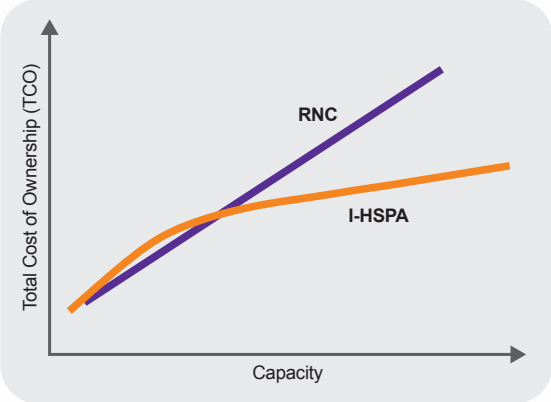

Figure 4. I-HSPA provides cost-effective mobile broadband

Simplified step to LTE

HSPA uses identical network architecture as LTE, which is standardized in 3GPP Release 8. These similarities smooth network evolution to LTE, which offers even higher data rates and increased spectral efficiency that will further drive down the cost per delivered bit.

Furthermore, Nokia Siemens Networks Flexi Multiradio BTS is LTE ready so that an I-HSPA network can be upgraded to LTE merely by a software upgrade.

Affordable mobile broadband becomes a reality for end users

For end users, the introduction of I-HSPA is all positive – they can enjoy a better experience through reliable, high performance access to services using existing mobile devices. Furthermore, end users gain these advantages with the affordability they are used to with fixed line access and its flat-rate charging tariffs.

Reduced latency

Considering that 80% of Internet applications are more sensitive to latency than throughput, lowering latency increases user satisfaction and potentially reduces churn. With fewer network elements, I-HSPA can reduce the round trip time to 20–50 ms, compared to 30–70 ms in 3GPP Release 6 HSPA. In addition, by moving RNC functionality into the BTS, even faster call setup time for a real-time experience can be achieved, strengthening the I-HSPA solution even further.

Networks with the BTS and RNC connected through a microwave router can also benefit from the low latency that flat architecture creates. Latency improves considerably when the Iub interface becomes an internal IP node, as is the case with I-HSPA.

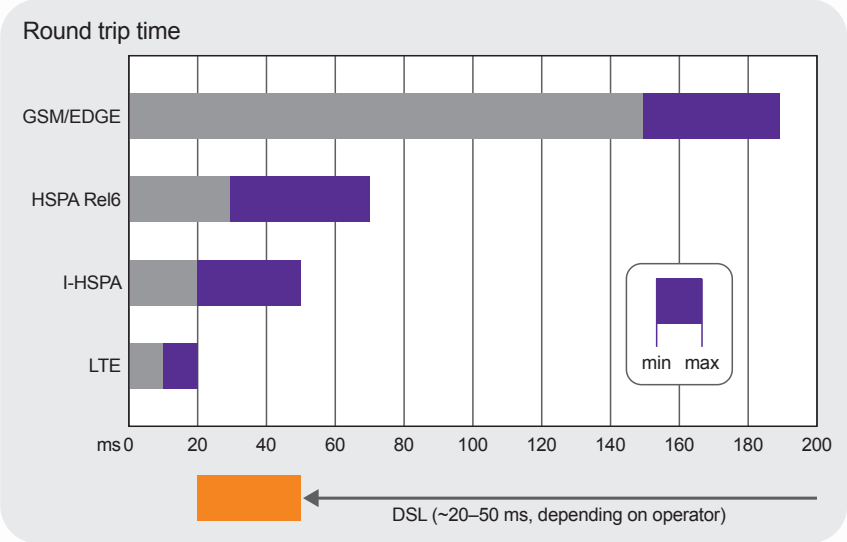

Figure 5. Fewer nodes obstructing the path of data traffic improves latency

First to market with mobile broadband

Evolving to flat network architecture by implementing I-HSPA enables service providers to offer affordable and scalable wireless broadband to capture market share and achieve differentiation. Many business models and technologies fight for the broadband share of business campuses and densely populated areas, leaving a huge untapped potential in residential and rural areas for mobile broadband. Delivering profitable data services for these areas demands lower cost per bit per square kilometer.

I-HSPA provides improved service continuity when extending HSPA into residential and rural areas. This is important for users with portable computers fitted with data cards. The early experience of attractively priced mobile data packages shows a more than 30% revenue growth in mobile data. The largest revenue rise comes from service providers with the highest traffic growth, accelerated by lower than average data prices.

Upgrading to I-HSPA for all service provider businesses

I-HSPA is independent of the traditional access hierarchy and provides efficient voice and data handovers between I-HSPA, 3GPP Release 99, 2G and LTE. Service providers with ongoing 2G/3G operations can introduce the technology as a smooth and cost effective upgrade that works with existing service provisioning. Seamless service continuity is guaranteed when moving across the network.

Upgrade costs can be minimized by gradually introducing I-HSPA to cell sites or areas where traditional capacity upgrades would also require RNC and SGSN upgrades.

I-HSPA is frequency independent so it can be applied to any available WCDMA frequency. With I-HSPA deployed in new HSPA spectrum using the 900 MHz band, broadband services can be brought to rural areas more cost effectively than with any other technology. The latest release of I-HSPA supports both CS and PS services natively, connecting the BTS directly to the MSS. With I-HSPA, fixed broadband service providers, Internet Service Providers and cable service providers can achieve excellent service continuity from fixed to mobile, improving the user experience and differentiating from their competitors. I-HSPA is also easy to integrate with existing PS and CS backbone networks.

Meanwhile, 2G operators offering primarily voice, with limited capacity data services, can deploy I-HSPA as a mobile broadband overlay, provided that suitable spectrum is available.

With the option of smooth evolution to LTE at a later stage, I-HSPA provides a fast time to market for efficient, flat architecture mobile broadband.

The Nokia Siemens Networks I-HSPA Solution

I-HSPA can be introduced as an upgrade to existing networks as well as initial rollout for new CSPs and providers that want to migrate to HSPA from other wireless technologies. With the Nokia Siemens Networks Flexi BTS, an upgrade to I-HSPA involves minimum cost and impact on existing sites. Existing radio hardware, including feeders, mast head amplifiers and antennas, can be re-used. The technology can also be upgraded smoothly to LTE.

For wireless Greenfield CSPs and those migrating from different technologies (for example iDEN), I-HSPA has the advantage of high scalability, and fast and easy rollout. It is also future proof, having the same hardware and architectural requirements as LTE and other technologies. The typical capital and operational expenditure investments required by classical network architecture can be avoided from day one. At the same time, a smooth evolution path to LTE can be carved out, enabled by just a software upgrade for most CSPs.

When looking for a complete mobile broadband network package, Nokia Siemens Networks I-HSPA is a highly cost effective choice. The end-to-end offering includes a complete portfolio of services and infrastructure comprising BTS, PS optimized core network, Operations Support Systems (OSS) and transport.

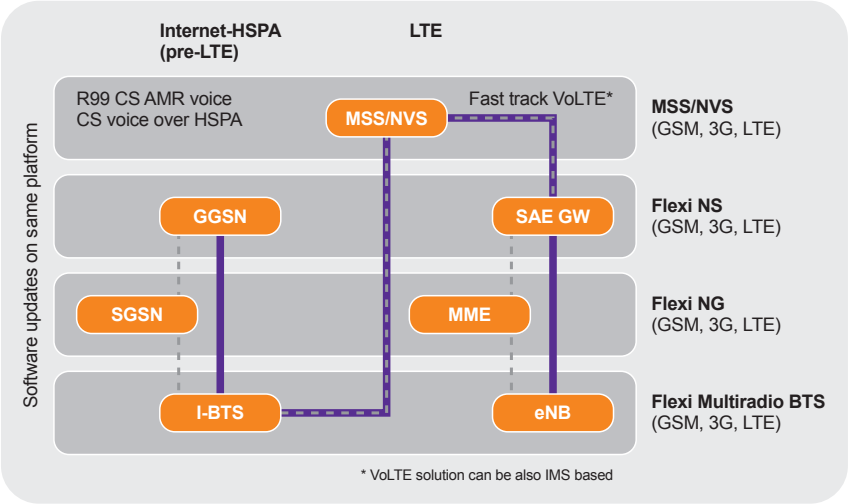

Figure 6. Common hardware platform concept for end to end flat architecture

With Nokia Siemens Networks core network solution, CSPs can flexibly implement controlled flat rate charging plans while keeping traffic volumes under control. Traffic can be managed, for example, according to allowed monthly data volume or maximum allowed bandwidth per subscriber. Bandwidth limitations can also be set to different Internet applications ensuring that all customers can enjoy good service during busy hours.

Nokia Siemens Networks has long systems integration experience with proven methodology and an ecosystem of partners that helps to achieve rapid time to market with low total cost of ownership. Nokia Siemens Networks has one of the world's largest services networks and most experienced services teams, committed to working with service providers to meet the opportunities of their converging world.

I-HSPA Flexi base stations are IP-based units that are simply plugged in, reducing the number of network elements that need to be re-configured whenever a new base station is added. The flexible Iu and RNCs built into the BTS (effectively creating RNC functionality distributed across the network) also provide full network-level resiliency. Time-consuming RNC re-homing work is eliminated, enabling I-HSPA technology to support the needs of fast-changing networks.

I-HSPA is a smart device-friendly technology. The RNC-less architecture guarantees high capacity and dedicated RNC functionality installed within each BTS ensuring the highest performance even when there is a high penetration of smart phones. I-HSPA supports virtually an unlimited number of connected smart devices and with paging channel, the so-called cell-PCH state, further decreases the signaling load by a factor three.

Conclusion

Start today with the move to flat network architecture

Data optimized fixed and mobile networks, including DSL and LTE, all feature flat architecture.

3G service providers can already start to achieve the cost and performance benefits of flat network architecture by deploying 3GPP standardized I-HSPA technology. I-HSPA meets the voice and data demands of today with flat WCDMA architecture that can evolve to the LTE requirements of tomorrow as the ecosystem matures. This evolution is possible through software upgrades alone, which, together with the fact that I-HSPA works with all technologies, protects today's investments far into the future. Furthermore, as I-HSPA uses the same network topology as LTE, the future transition to LTE will be less costly and faster.

CSPs deploying I-HSPA can exploit the full potential of HSPA technology. I-HSPA provides the means to more than double mobile broadband penetration and increase the return on HSPA investments by a factor of two. The similar characteristics of WCDMA and LTE have enabled Nokia Siemens Networks to optimize technology platforms for common use by GSM, WCDMA/HSPA and LTE, thus protecting early service provider flat architecture investments.

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