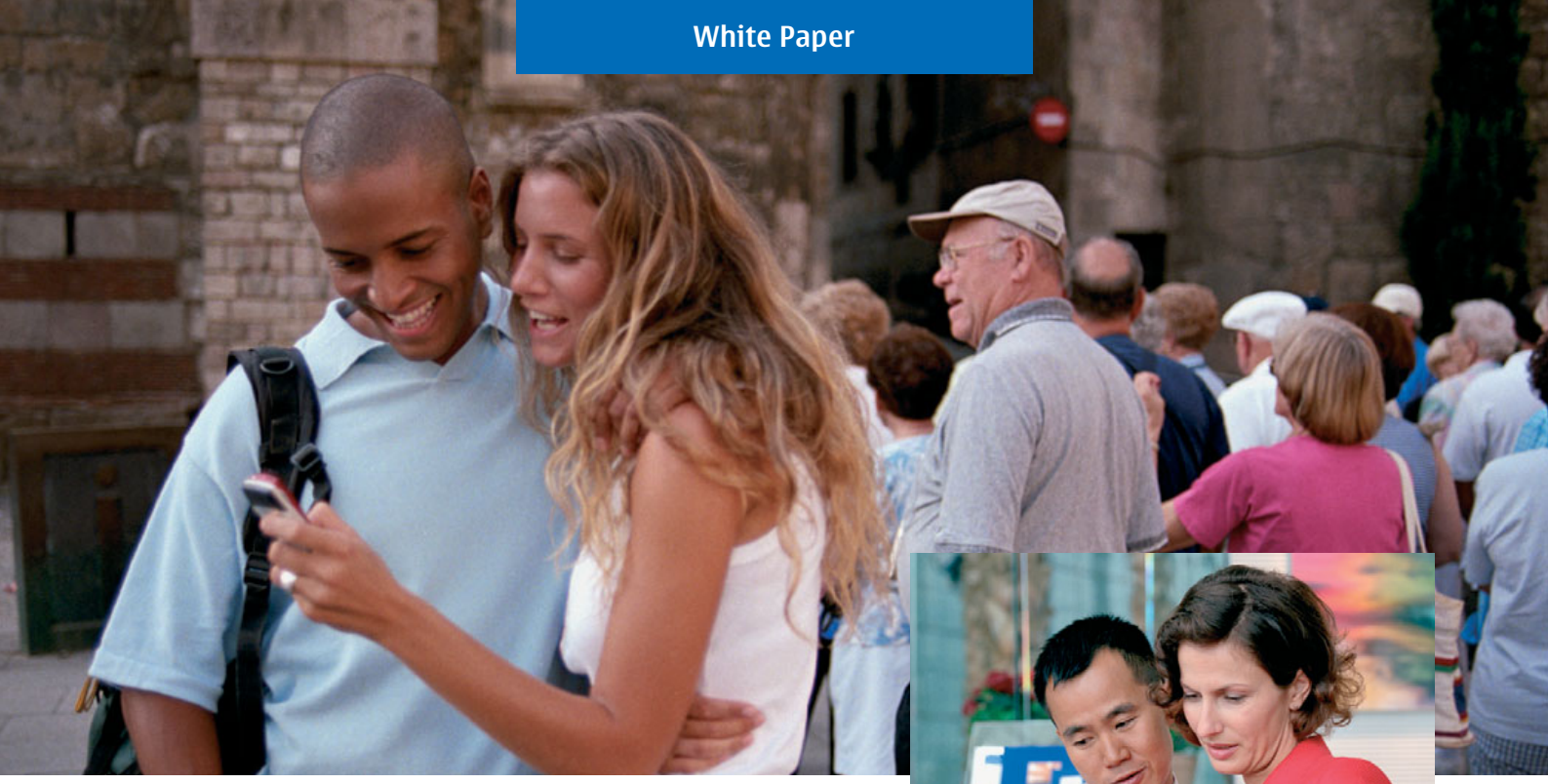
White Paper



Nokia HSDPA Solution

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CONNECTING PEOPLE

Contents

Executive summary

The volume of IP-based traffic has already exceeded that for circuit-switched traffic in most fixed networks. The same change will happen in mobile networks as new IP-based mobile services become available and are used by more people in their daily communications.

Current estimates show that, in advanced mobile communication markets, packet-switched traffic will overtake circuit-switched traffic in the near future. Delivery of digital content over mobile networks as well as IP-based person-to-person communication that combines different media and services into a single session, will generate additional traffic and revenue. The growth in data bits used in communications will exceed the growth in revenue, driving operators to optimize their networks to support the dominant traffic type.

HSDPA, High Speed Downlink Packet Access, offers breakthrough data speeds – up to five times (10 Mbps) higher than is possible in the most advanced 3G networks – as well as two-fold base station capacity. For end-users this means shorter service response times and less delay.

Meanwhile, operators will be able to offer advanced services at lower costs and with increased profitability. As the Nokia HSDPA solution is fully backwards compatible with current Nokia WCDMA networks, it is a cost-effective way to upgrade existing infrastructure. By providing higher quality and capacity it will help to drive up the consumption of data-intensive services, bringing operators more revenue. HSDPA offers by far the highest performance at the lowest cost, enabling real mass-market mobile IP multimedia.

HSDPA is based on WCDMA evolution, standardized as part of 3GPP Release 5 WCDMA specifications. The new modulation method of HSDPA greatly improves the peak data rate and throughput, which enhances spectral efficiency. In addition to these benefits, users will perceive faster connections to services through shorter round trip times.

As a result of these enhancements, operators using HSDPA will be able to support considerably higher numbers of high data rate users on a single radio carrier than is possible with any existing 3G technology.

HSDPA air interface, a major evolutionary step

The WCDMA air interface has been standardized by the 3rd Generation Partnership Project (3GPP) as a radio transport medium for global mobile communication systems.

Consequently, the first versions of the 3GPP air interface specifications enabled superior user data rates and system throughput capacities compared to any 2nd generation mobile communication standard. The WCDMA system's adaptability enables a new and significant evolutionary step in packet data access: the Nokia HSDPA Solution. HSDPA is standardized in 3GPP Release 5.

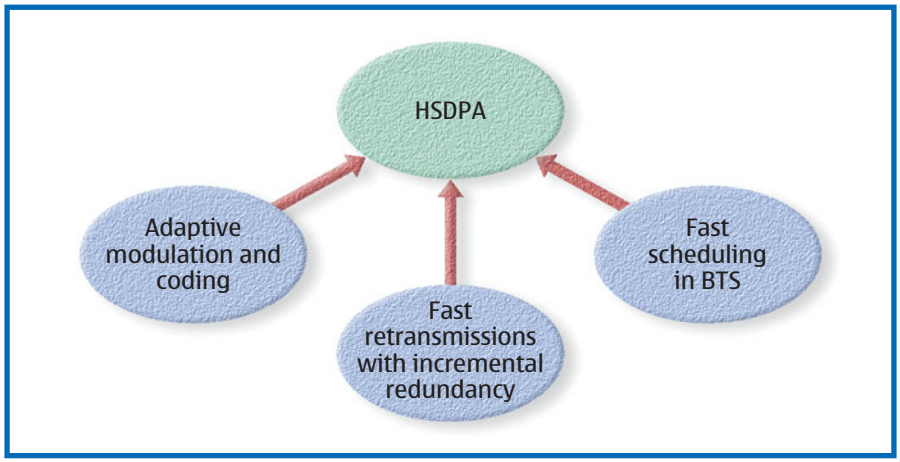

Figure 1. HSDPA

HSDPA enhanced data rates and spectrum efficiency

HSDPA improves system capacity and increases user data rates in the downlink direction, that is, transmission from the radio access network to the mobile terminal. This improved performance is based on:

1) adaptive modulation and coding
2) a fast scheduling function, which is controlled in the base station (BTS), rather than by the radio network controller (RNC).
3) fast retransmissions with soft combining and incremental redundancy

Adaptive Modulation and Coding

Link adaptation in HSDPA is the ability to adapt the modulation scheme and coding according to the quality of the radio link. The spreading factor remains fixed, but the coding rate can vary between 1/4 and 3/4. The HSDPA specification supports the use of 5, 10 or 15 multicodes. Link adaptation ensures the highest possible data rate is achieved both for users with good signal quality (higher coding rate), typically close to the base station, and for more distant users at the cell edge (lower coding rate).

Fast scheduling

Scheduling of the transmission of data packets over the air interface is performed in the base station based on information about the channel quality, terminal capability, QoS class and power/code availability. Scheduling is fast because it is performed as close to the air interface as possible and because a short frame length is used.

Fast retransmissions

Should link errors occur, caused for example by interference, the mobile terminal rapidly requests retransmission of the data packets. In current WCDMA networks, these requests are processed by the RNC. In HSDPA, the request is processed in the base station, providing the fastest possible response. In addition to fast retransmissions, incremental redundancy is also used. This technique selects correctly transmitted bits from the original transmission and the retransmission to minimize the need for further repeat requests when multiple errors occur in transmitted signals.

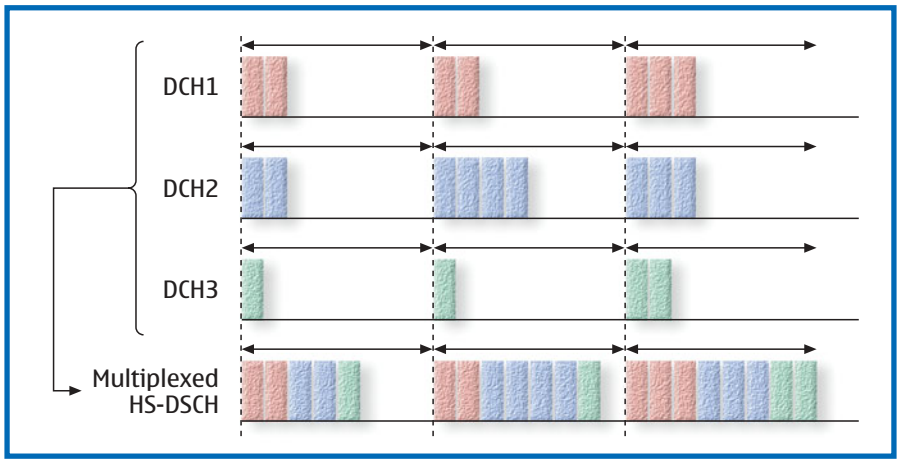

Figure 2. Channel sharing

Time Multiplexed Channel for efficient radio resource utilization

The WCDMA system normally carries user data over dedicated transport channels, or DCHs, which brings maximum system performance with continuous user data. The DCHs are code multiplexed onto one RF carrier. In the future, user applications are likely to involve the transport of large volumes of data that will be bursty in nature and require high bit rates.

HSDPA introduces a new transport channel type, High Speed Downlink Shared Channel (HS-DSCH) that makes efficient use of valuable radio frequency resources and takes into account bursty packet data.

This new transport channel shares multiple access codes, transmission power and use of infrastructure hardware between several users. The radio network resources can be used efficiently to serve a large number of users who are accessing bursty data. To illustrate this, when one user has sent a data packet over the network, another user gets access to the resources and so forth. In other words, several users can be time multiplexed so that during silent periods, the resources are available to other users. Figure 2 shows a simplified explanation of the principle of sharing a common transport channel.

HSDPA Performance

HSDPA offers maximum peak rates of up to 10 Mbps in a 5 MHz channel. However, more important than the peak rate is the packet data throughput capacity, which is improved significantly. This increases the number of users that can be supported at higher data rates on a single radio carrier.

Another important characteristic of HSDPA is the reduced variance in downlink transmission delay. A guaranteed short delay time is important for many applications such as interactive games. In general, HSDPA's enhancements can be used to implement efficiently the 'interactive' and 'background' Quality of Service (QoS) classes standardized by 3GPP. HSDPA's high data rates also improve the use of streaming applications on shared packet channels, while the shortened roundtrip time will benefit web-browsing applications.

Nokia HSDPA system implementation

A key attribute of Nokia's WCDMA infrastructure is its flexibility for future upgrades. New features, some of which were in the earliest stages of standardization at the time of the system specification, have been taken into account in the Radio Access Network architecture and system design. This proactive approach enables Nokia to implement HSDPA with simple upgrades to its current RAN platforms.

The Nokia HSDPA Solution is also fully backwards compatible with 3GPP release '99 WCDMA, allowing HSDPA to be introduced into networks gradually. Both release '99 and HSDPA capable terminals can share the same radio carriers.

Key benefits of the Nokia HSDPA solution

HSDPA will optimize the network to enable lower production cost per bit

Nokia HSDPA Solution will:

- improve the WCDMA network's packet data capacity
- enhance spectral efficiency
- use RAN hardware efficiently
- enable cost-effective network implementation

Consequently, network operators that implement HSDPA will achieve a lower delivery cost per bit.

HSDPA will improve the perceived value of user services

For the user, the Nokia HSDPA solution means:

- higher data rates
- shorter service response time
- better availability of services

Consequently, users will experience better quality of service.

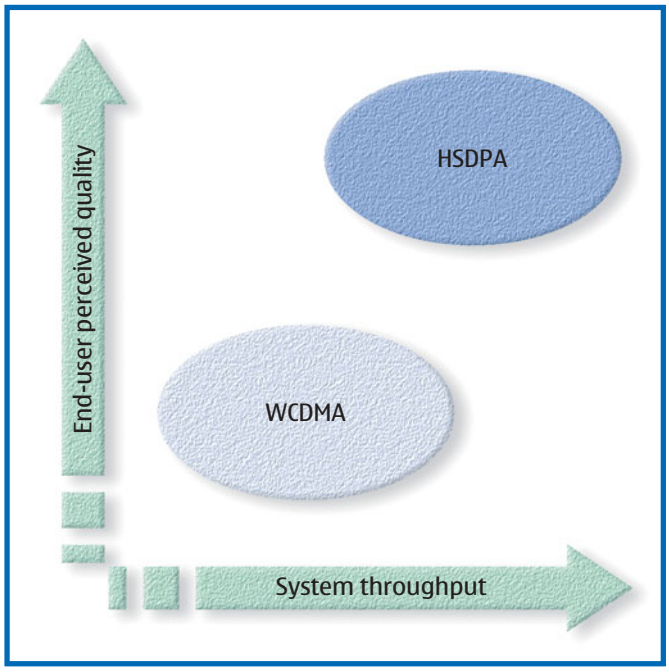

Figure 3. HSDPA benefits

Glossary

3GPP	Third Generation Partnership Project
BTS	Base Station
DCH	Dedicated Channel (transport channel)
HS-DSCH	High Speed Downlink Shared Channel
HSDPA	High Speed Downlink Packet Access
HW	Hardware
IP	Internet Protocol
MS	Mobile Station
PS	Packet Switched
QoS	Quality of Service
RAN	Radio Access Network
RNC	Radio Network Controller
SW	Software
WCDMA	Wideband Code Division Multiple Access

NOKIA CORPORATION
Nokia Networks
P.O. Box 300
FIN-00045 NOKIA GROUP, Finland
Phone: +358 (0) 7180 08000
www.nokia.com

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Nokia code: 11115
0403 Libris