



# Enhanced Data Rates for GSM Evolution EDGE

Nokia's vision for a service platform  
supporting high-speed data applications

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# Executive summary

The business of wireless data is expected to grow in the region of 100–200 % per annum and the mobile communications industry agrees that wireless data services will form the foundation for future business. The enormous success of short messaging in many countries proves that people accept the benefits of non-voice services.

We are now facing the introduction of Wireless Application Protocol (WAP) as well as the higher transmission speeds of High Speed Circuit Switched Data (HSCSD), soon to be joined by the convenience of “always on-line” direct internet connections with General Packet Radio Service (GPRS). These standards will enable greater sophistication as end-user services move towards personal multimedia. A new technology, Enhanced Data Rates for GSM Evolution (EDGE) will be introduced to boost network capacity and data rates of both circuit switching (HSCSD) and packet switching (GPRS), to meet the demands of wireless multimedia applications and mass market deployment.

Many wireless data applications today can be implemented with 9.6 kbit/s data. However, bandwidth-hungry fixed line

data applications – Web browsing, access to corporate data bases, and so on – would benefit from higher transmission speeds when used over the mobile network. HSCSD will significantly improve performance, especially for time-critical applications. GPRS will enable cost-effective wireless access to applications that rely upon data bursts, adding packet switching to GSM with a packet-based air interface on top of the current circuit switched mode of operation. GPRS will provide the connectivity needed in packet-switched data networks such as the Internet.

EDGE, a new radio interface technology with enhanced modulation, increases the HSCSD and GPRS data rates by up to three fold. EDGE modulation will increase the data throughput provided by the packet switched service even over 400 kbit/s per carrier. Similarly, the data rates of circuit switched data can be increased, or existing data rates can be achieved using fewer timeslots, saving capacity. Accordingly, these higher speed data services are referred to as EGPRS (Enhanced GPRS) and ECSD (Enhanced Circuit Switched Data).

EDGE, expected to be deployed in 2000–2001, is a major improvement in GSM phase 2+. As a modification to existing GSM networks, EDGE does not require new network elements.

EDGE is especially attractive to GSM 900, GSM 1800 and GSM 1900 operators that do not have a licence for UMTS, but still wish to offer competitive personal multimedia applications utilising the existing band allocation. Also, EDGE can co-exist with UMTS, for instance to provide high speed services for wide-area coverage while UMTS is deployed in urban hot spots.

In the US, EDGE is part of the IS-136 High Speed concept which is one of the third generation RTT (Radio Transmission Technology) proposals from TR45. EDGE will be also standardised in US which makes possible to achieve a global mobile radio system with many services characteristic to third generation systems.

Nokia is dedicated to supporting GSM operators with wireless data solutions that help them create value in the market place, both now and in the future. Wireless data is steady evolution, not revolution. With Nokia’s experience, the operator starting today with wireless data can accumulate the skills and know-how to build a strong market position, all the way to third generation systems and the personal multimedia era. This White Paper describes Nokia’s understanding of the role and benefits of EDGE as wireless data evolves towards personal multimedia.

# EDGE

The GSM standard is being developed to support mobile services with radio interface data rates even over 400 kbit/s. This work is being performed under the ETSI work item EDGE (Enhanced Data Rates for GSM Evolution).

The major change in the GSM standard to support higher data rates is the new modulation system, known as 8PSK (Phase Shift Keying). This will not replace but rather co-exist with the existing GMSK (Gaussian Minimum Shift Keying) modulation. With 8PSK, it is possible to provide higher data rates with a somewhat reduced coverage, whereas GMSK will be used as a robust mode for a wide area coverage.

## EDGE brings more speed and capacity when needed

In mature GSM markets, cellular data penetration is forecast to increase exponentially during the early 2000's. New wireless data applications and innovative terminal types will generate completely new markets: aggressive GSM operators can expect to obtain up to 30 % of their airtime and revenue from wireless data by year 2000.

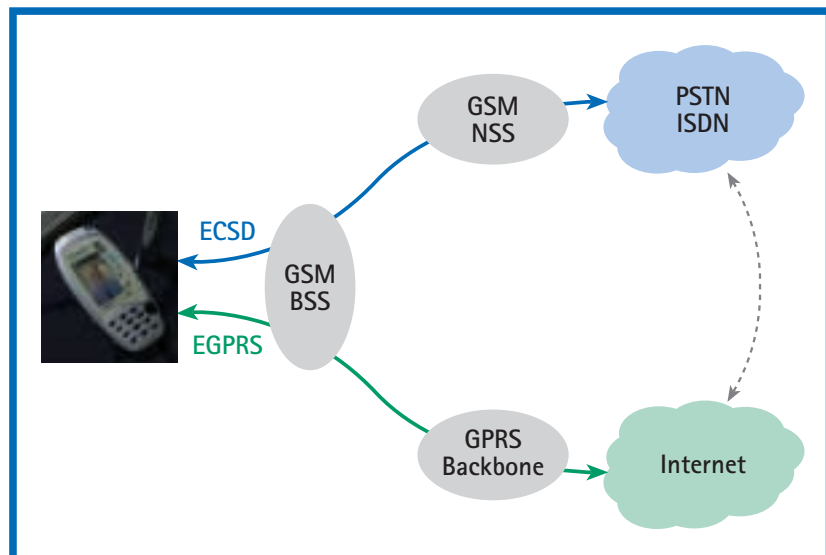
HSCSD (High Speed Circuit Switched Data) and GPRS (General Packet Radio Service), introduced to GSM in 1998 and 1999 respectively, will enable cellular operators to offer higher than 9.6 kbit/s data rates to their subscribers for new data applications.

Cellular operators that have invested in HSCSD and GPRS expect to be able to offer higher data rates without building too many new sites. The ECSD (Enhanced Circuit Switched Data) and EGPRS (Enhanced General Packet Radio System) solutions offer data services comparable to 3rd generation levels with considerably fewer radio resources than in

standard GSM. This means that EDGE TRXs (transceivers) carry more data per time slot, decreasing the need for new TRXs/frequencies. In addition, end user response times decrease, ensuring good service levels as data usage increases.

It could be possible for EDGE Phase 2 to provide a voice service using AMR (Adaptive Multirate Codec) type of solution. EDGE TRXs would then be capable of carrying multiple speech calls per time slot, increasing voice capacity. Also, high quality codecs, e.g 32 kbit/s, would be feasible. EDGE as a voice solution looks especially interesting for indoor systems because of its scalable capacity.

Figure 1. EGPRS and ECSD, enhanced packet and circuit switched services in GSM network



## EDGE boosts data rates

The Phase 1 EDGE standard, scheduled to be complete in the third quarter of 1999, will contain both EGPRS and ECSD services. EGPRS will be based on the footprint of GPRS, whereas ECSD will enhance the data rates of HSCSD. It is expected that packet data will dominate circuit switched data in future GSM data networks, calling for EGPRS solutions with high flexibility and spectral efficiency. Also, the high data rate real time services provided with ECSD are seen as important for applications such as video retrieval and video telephony.

EDGE will provide significantly higher data rates on the current 200 kHz GSM carrier. The data rates being specified by ETSI would bring ECSD rates up to 38.4 kbit/s/timeslot and EGPRS rates up to 60 kbit/s/timeslot. The data throughput per carrier increases even over 400 kbit/s. For ECSD, it is possible to support a 64 kbit/s real time service with a low bit error ratio (BER) by allocating two time slots of 32 kbit/s each. The enhanced modulation will adapt to radio circumstances and hence offer the highest data rates in good propagation conditions, whilst ensuring wider area coverage at lower data speeds per timeslot.

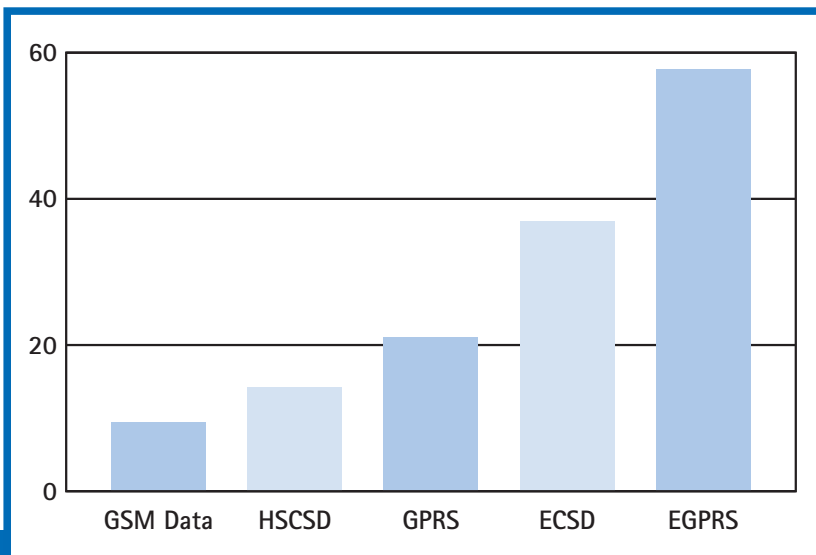
## EDGE complements UMTS

EDGE will allow operators without a UMTS (Universal Mobile Telephone System) licence stay competitive in wireless data markets. However, UMTS operators can also use EDGE for gradual rollout of high-speed data services and for wide area coverage where UMTS would be used for urban areas.

## EDGE builds on existing GSM network

Due to the new air interface modulation and the greatly increased data rates, some software and hardware changes will be required to make a network EDGE capable and new mobile terminals are required for enhanced services. However, EDGE will not require any new network elements and will be able to support older mobile terminals with GMSK modulation.

Figure 2. Data rate evolution, throughput in kbit/s per single radio timeslot



## EDGE data applications

With EDGE, GSM goes personal multimedia. EDGE will boost all existing circuit and packet switched services and enable completely new high-speed data applications.

### Enhanced General Packet Radio Service

The dominant data networking protocol, on which most data network applications are running, is TCP/IP, the Internet Protocol. All Web applications are run on some form of TCP/IP, which is by nature a protocol family for packet switched networks. This means that (E)GPRS is an ideal bearer for any packet switched application such as an Internet connection. From the end user's point of view, the (E)GPRS network is an Internet sub-network that has wireless access. Internet addressing is used and Internet services can be accessed. A new number, the IP address number, is introduced with the telephone number. From the Internet's point of view, the (E)GPRS network is just one sub-network among many others.

Typical EGPRS applications are:

- On-line E-mail
- Web
- Enhanced short messages
- Wireless imaging with instant pictures
- Video services
- Document and information sharing
- Surveillance
- Voice over Internet
- Broadcasting.

### Enhanced Circuit Switched Data

Some applications, such as fax and video, require a transparent service (constant bit rates), while other applications (the Web, e-mail) can work well with non-transparent services.

Typical ECSD applications are:

- E-mail download and upload
- Bandwidth-secure mobile high speed LAN access
- File transfer
- Vertical applications such as batch-type field sales information or document transfer
- Real-time applications demanding a constant bit rate and transmission delay
- Time-critical wireless imaging
- Mobile videophony
- Video on demand
- Live video streaming.

## Market potential

Gradually, non-voice services will account for one third or more of GSM traffic and revenues. This will not happen overnight, however, as wireless data is an evolution, not a revolution. Thus a step-by-step approach to educating the market and introducing more sophisticated services is vital. EDGE provides a boost to data speeds using the existing GSM network, allowing the operator to offer personal multimedia applications before the introduction of UMTS. The time between EDGE and UMTS introduction clearly improves the business case for UMTS and may prove to be instrumental in gaining a long term advantage over competitors.

As wireless data becomes available to all subscribers and they demand a full set of high-speed services and shorter response times, EDGE will provide an operator with a competitive advantage. EDGE also enables data capacity to be deployed when and where demand dictates, minimising the investment required.

# Added benefits with EDGE

## For the operator

### **Migration to wireless multimedia services**

The operator can increase data revenues by offering attractive new types applications to end users.

### **Improved customer satisfaction**

Increased data capacity and higher data throughput will decrease response times for all data services, thus keeping end users satisfied and connected.

### **Possibility of early market deployment of third generation type applications**

EDGE networks are expected to emerge in year 2001, when mature markets are likely to start demanding multimedia applications.

### **Quick network implementation**

EDGE will not require new network elements and EDGE capability can be introduced gradually to the network.

### **Optimised network investment as GSM enhancement**

Flexible data capacity deployment where the demand is.

## For the end user

### **Improved quality of service**

Increased data capacity and higher data throughput will decrease response times for all data services, thus keeping end users satisfied and connected.

### **Personal multimedia services**

Attractive new types of applications and terminals will become available.

### **Potentially lower price per bit**

Lower cost of data capacity for high-speed data applications gives the operator flexibility in pricing.

# Conclusions

EDGE will provide the solution for operators wanting to offer personal multimedia services early and who need to increase the data capacity in their GSM network prior to UMTS deployment. EDGE is especially valuable for operators that do not deploy UMTS.

EDGE will not replace existing investments or services but will upgrade them to a highly competitive level through gradual investment.

EDGE rollout can satisfy increased data demand and produce increased revenues by first launching EDGE service in urban and office environments for business users and then providing wider area coverage as private usage takes off.

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