Push to Talk over Cellular –
Real-time always-on voice service

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Contents

Executive summary

Push to Talk over Cellular (PoC) introduces a direct one-to-one and one-to-many voice communication service in the cellular network. It makes a popular two-way radio service available through attractive cellular phones, thus enhancing cellular services and bringing new business opportunities in the domain of real-time voice communications. It will give operators opportunities to acquire new users and to increase the Average Revenue Per User in a profitable way.

Figure 1. Direct one-to-one and one-to-many voice service

The principle of communication behind the service is simple – just push to talk. Thanks to the 'always-on'[1] connection, calls can be started to both individuals and talk groups with just a push of a key. The call connection is almost instantaneous and the receiver doesn't have to answer the call. Push to Talk service users are typically engaged in some other activity than a telephone call, and they listen to the group traffic during their activity. A user can be contacted by name, or he may occasionally want to say something to the group. Half-duplex traffic is ideal for such use cases.

The users can also form talk groups on an 'ad hoc' basis without having to contact their service providers, which facilitates spontaneous and flexible group communication. This simple, real-time direct communication serves the diverse needs of both business and private users ranging from controlled team management to spontaneous sharing of experiences and pure fun.
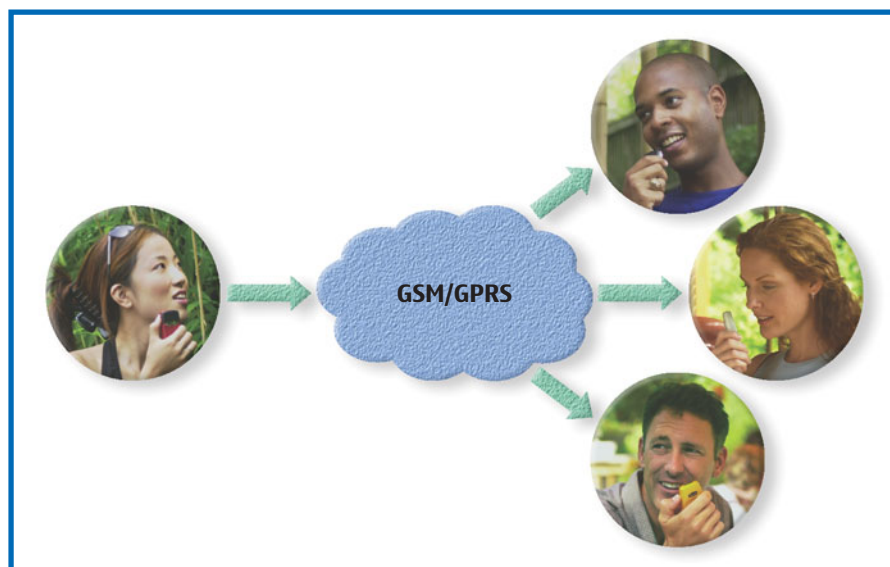
Push to Talk service is a genuine differentiated voice service, because it is not a substitute for any existing cellular services. It gives operators an opportunity to develop their voice service offering without having to change conventional voice services.

The Push to Talk over Cellular solution is based on half duplex VoIP (Voice over IP) technology over the 2nd generation GSM/GPRS network. Building the service over the existing GSM/GPRS network will enable fast service roll-out, reduce the needed investments and it will have a natural growth path towards 3G. The Push to Talk service is an integral part of the IP Multimedia communication portfolio envisioned by Nokia, and a part of the service offering in IP Multimedia Subsystem (IMS). It can be used to enrich different IP Multimedia communication sessions like interactive gaming.

Thanks to the IP technology, the Push to Talk service is 'always-on' and uses cellular access and radio resources more efficiently than circuit-switched cellular services. Network resources are thereby reserved only one-way for the duration of talk spurts instead of two-way for an entire call session. Among the many benefits of this solution over two-way radio systems are the coverage provided by the cellular network and the simple and fast creation of talk groups and group calls. One should note, however, that this solution does not meet the stringent emergency public safety requirements.

One of the main goals of the Push to Talk over Cellular solution is to bring the Push to Talk facility to cellular phones. The solution offers terminal manufacturers an opportunity to implement the Push to Talk facility across GSM mobile phone categories, and end-users can choose the products that best meet their communication needs. The Push to Talk client server interface specifications will be made open to other manufacturers.

1) 'Always-on' means that a subscriber has typically direct access to the service after the subscription to it without additional measures (such as dial-up) provided that the cellular network supports the service, is available and is not overloaded.

Addressing the demands of the Push to Talk communication world

We live in a world where our business and personal lifestyles are changing ever faster and shaping our communication styles and needs. In our business lives, we have learned to value services that allow us to be easily reachable and to reach other people quickly. Business requires quick decisions and efficient sharing of timely information between several people. Organized team management and task allocation are a key to success in the tough and rapidly changing business environment.

In our personal lives, our ways of communicating are becoming ever more spontaneous. Simple and direct sharing of momentary experiences and feelings with our friends and family are important elements in building and maintaining our relationships. Awareness of unexpected changes in the daily routines of the people we are close to helps to create a feeling of security.

Push to Talk over Cellular meets the demands of the direct communication world that cannot be met with conventional voice calls. It facilitates and supports our personal and business routines by making an easy-to-use and flexible direct voice communication service available through conventional mobile phones. The solution serves our needs for direct, one-to-one and one-to-many voice communication, delivering tangible benefits to both private and business users, and network operators.

The Push to Talk facility can be integrated in cellular phones. This gives terminal manufacturers an opportunity to implement the facility across GSM phone categories and to offer end-users the combinations of Push to Talk and cellular features that best meet their communication needs.

Push to Talk service

The principle of communication behind Push to Talk over Cellular is simple – just push to talk. Users can select the person or talk group they wish to talk to from their phone books, and then press the Push to Talk key to start talking. The call connection is almost instantaneous.

Push to Talk calls are one-way communication: while one person speaks, the other(s) listen. The turns to speak are granted by pressing the Push to Talk key on a first come, first served basis. Push to Talk calls are usually connected without the recipient(s) answering and they are typically received through the phone's built-in loudspeaker. In case more privacy is needed, the calls can also be listened to through the earphone or a headset.

For one-to-many communication, users can create talk groups on an ad hoc basis. This happens simply by sending invitations to the desired group members to join the talk group. Talk groups can also be preconfigured for the use of a specific group of people.

In addition to real-time voice communication, Push to Talk over Cellular supports text chat between the active members of a talk group. This feature will help users to change textual information, like addresses, within the talk group.

Benefits of Push to Talk over Cellular

Adaptable to a wide range of purposes, the Push to Talk over Cellular solution will deliver benefits to both end-users and network operators.

Benefits to end-users

The Push to Talk service is a completely new voice service complementing the rich service portfolio of GSM/GPRS networks. It is also a key service enriching IP Multimedia communication sessions like interactive gaming. One of the starting points of Push to Talk over Cellular – and also a fundamental difference between Push to Talk and conventional phone calls – is the 'always-on' connection between two people and within a group of people. While setting up a conference call, for example, requires several phone calls to be made, the 'always-on' connection provided by Push to Talk over Cellular allows talk group members to start conversation almost instantly, with just a press of a key. The direct connection enforces efficient and spontaneous communication, especially when there is a need to be in contact with a certain group of people frequently during a longer period of time, such as a working day.

Compared with traditional two-way radio systems, such as Land Mobile Radio (LMR) and Professional Mobile Radio (PMR), as well as the Family Radio Service (FRS), one of the most obvious advantages of Push to Talk over Cellular is perhaps the coverage area provided by the GSM/GPRS network. It allows users to make Push to Talk calls between two people and within a group of people over nationwide networks and across regional borders. Another clear advantage is flexible and spontaneous group communication in terms of quick and simple talk group creation and activation.

The combination of Push to Talk and GSM services in the same handset provides users with a truly multifunctional handset. Users are no longer faced with the decision of whether to invest in two-way radios or cellular phones, or both, to be able to enjoy the advantages of direct voice communication and cellular services – one handset can deliver the advantages of both.

As Push to Talk over Cellular benefits a wide range of users, there are many ways to identify user segments for it. Based on communication needs and behavior, the following segments, for example, can be recognised: small businesses; leisure groups and communities; families, teenagers and social groups; and corporate users. The concept may also interest the most demanding LMR/PMR users, but it does not aim to fulfill the stringent requirements of public safety for critical emergency communication.

Typical business users
- Service and repair
- Hotels
- Retail, distribution
- Couriers
- Taxi, limousine services
- Car rental
- Public transportation
- Airlines, airports
- Harbors
- Manufacturing
- Industrial plants
- Hospitals
- Utilities
- Construction companies
- Private entrepreneurs

Small businesses

Smooth and efficient running of everyday business in small companies such as courier services, direct sale groups, hotels, taxi and transport services, and repair and security services relies heavily on efficient team communication. Currently, many small businesses use professional land-mobile-radio services. This user segment places a high value on a communication system that facilitates continuous and flexible group communication. Push to Talk over Cellular responds to this requirement by offering an 'always-on' communication channel that supports both individual and group communication.

Leisure groups and communities

Push to Talk over Cellular brings high value to leisure groups and communities engaged in the most diverse activities like sports and outdoor activities. Direct sharing of information between two people and especially within a group of people is important for these users when they organize and perform their activities. It can also strengthen their feeling of security. Leisure groups and communities are also expected to be active users of other cellular services and to value handsets that combine the Push to Talk facility with other cellular functions.

Families, teenagers and social groups

Families, teenagers and social groups can find more diverse uses for the Push to Talk service than can be predicted today, as this user segment is currently not served by any comparable system technology. The introduction of Push to Talk calls, and especially group calls, in cellular phones opens enormous new opportunities for natural and spontaneous communication, sharing of experiences and information, and sheer fun. Imagine a group of teenagers making plans on where to meet tonight and sharing their thoughts and feelings within their special talk group. Or a family discussing unexpected changes in the evening's plans within its own talk group.

Corporate users

In the fast changing business environment, companies performing demanding tasks in the field, plants and factories, need an advanced, group communication system to successfully manage their special tasks and everyday routines. Push to Talk over Cellular offers companies operating in areas such as gas, energy, utilities, transport, wholesale, retail and manufacturing an efficient and flexible communication system for both internal communication and external communication with the company's direct interest groups. It allows companies to carry out communication in closed user groups, which offers advanced group management functions, such as the programming of talk groups for the company's special purposes, and information security.
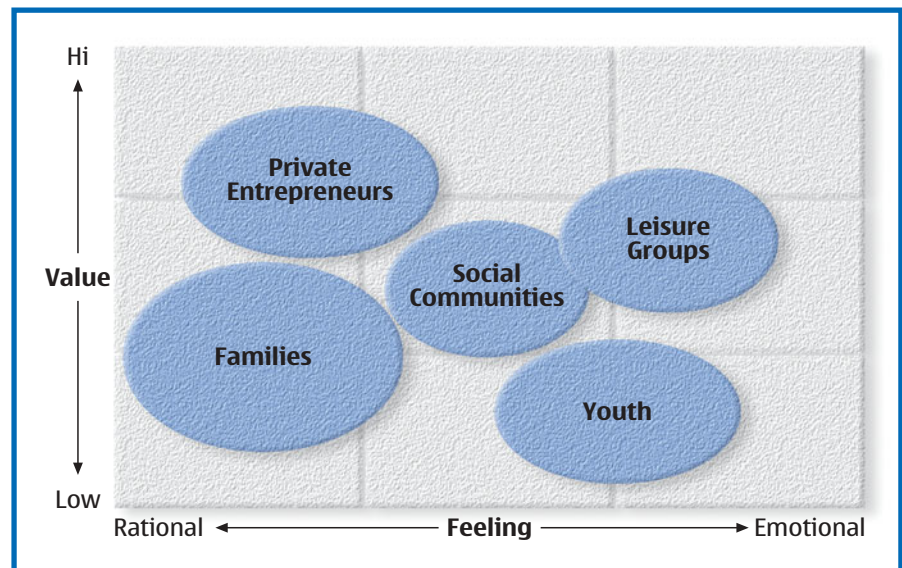

Figure 2. Potential PoC private user segments and phone selection criteria

Benefits to cellular operators

Push to Talk service is a genuinely differentiated voice service because it is not a substitute of existing cellular services. It gives the operator an opportunity to develop voice service offering without having to change conventional voice services. The Push to Talk solution also offers cellular operators an excellent opportunity to compete with existing Push to Talk services in the area they know best. The benefits like attractive GSM terminals and simple and fast creation of talk groups are obvious and the solution clearly enhances current cellular voice services. This will give opportunities for operators not only to increase the number of subscribers, but also to increase the Average Revenue Per User (ARPU).

Push to Talk over Cellular offers several possibilities for service charging. Charging can be based on a fixed monthly fee, real usage in an active talk group (talk minutes or GPRS Mb), active group membership (listened talk minutes) or other group functions such as group creation and group attachment. It is also possible to bundle Push to Talk charging into that of other cellular services.

Push to Talk over Cellular is a forerunner of IP Multimedia applications, providing operators with a future-proof platform for direct voice communication services. Based on IP technology, the Push to Talk solution uses network resources efficiently, reserving them only for the duration of talk spurts instead of for an entire call session. This enables a profitable implementation of the service over the GSM network. The IP architecture also allows operators to differentiate the service to correspond to the most diverse requirements of the various user segments and to implement it across GSM phone categories, leading to opportunities for an increased number of subscribers and improved customer loyalty.

The technology behind the solution

Real-time Push to Talk communication has proven popular ever since the introduction of two-way radios and LMR/PMR networks. However, in the past, the provisioning of a competitive Push to Talk service has not been possible as the implementation of a direct voice service over circuit-switched cellular networks (CDMA, TDMA and GSM) would have excessively wasted radio and network resources, thus making the service unprofitable.

The GPRS-enabled packet IP technology will bring a new era in direct voice communication. This technology enables an efficient implementation of the Push to Talk service based on standard IETF and 3GPP protocols via digital cellular packet data access. As talk spurts can be initiated almost instantly, radio and transmission resources are reserved only for the duration of talk spurts instead of for the entire call session, as in conventional telephony (see Figure 3). Based on IP technology, the Push to Talk over Cellular solution dramatically improves efficiency in network resource usage in situations where a group of people needs to communicate with each other repeatedly but occasionally.
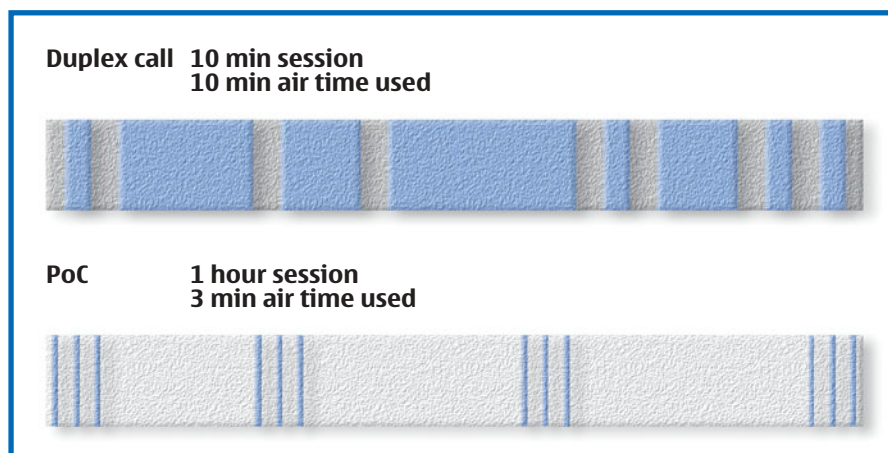

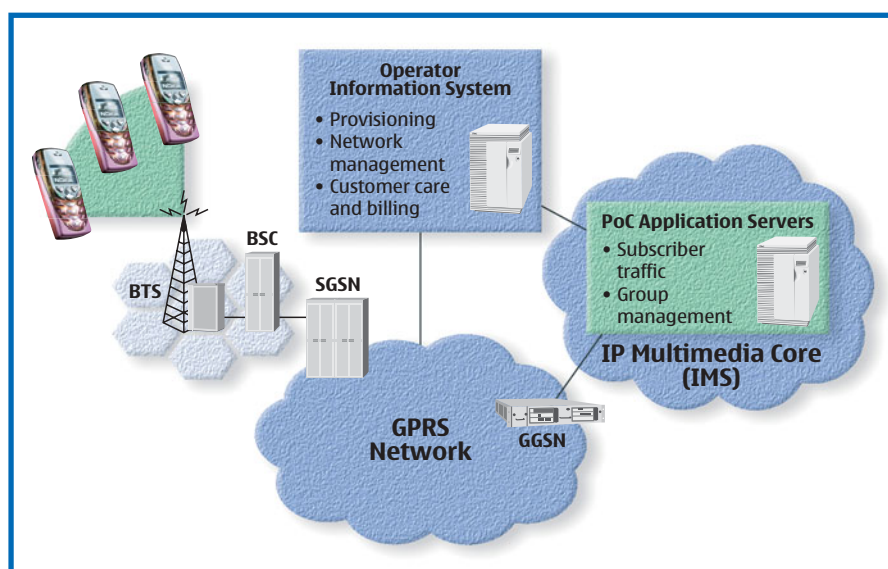Figure 3. Example of conventional telephony call and Push to Talk session

Figure 4. Network architecture of the Push to Talk over Cellular solution

Network architecture

The Push to Talk service is implemented using Push to Talk application servers in the IP Multimedia Subsystem (IMS) frame (see Figure 4). The servers handle call set-up signaling for Push to Talk calls, reservation of talk spurts for one speaker at a time and real-time routing of IP packets, carrying talk spurts to the recipients. They also provide interfaces to the operator's provisioning and network management systems and create charging detail records (CDRs), which can be used as a basis for billing. The Push to Talk solution scales to multimillion user networks with several networked Push to Talk application servers.

The Push to Talk user database contains provisioned users, their access rights, authentication information and preconfigured group memberships. The users and talk groups can be arranged in the database in organization-specific closed user groups.

The Push to Talk service is based on multi-unicasting. Each sending handset sends packet data traffic to a dedicated Push to Talk server and in case of a group call, the server then duplicates the traffic to all the recipients (see Figure 5). No multicasting is performed either in the GPRS access network or over the radio access network. This is why the Push to Talk solution works transparently over the GPRS network. Mobility is also provided by a standard GPRS network.

Group creation and attachment control are based on the IETF-defined Session Initiation Protocol (SIP), and voice traffic is carried out through an RTP streaming bearer. Mobility is handled through GPRS: mobility and wide area roaming support of GSM are used. The Push to Talk over Cellular solution protocol stack is shown in Figure 6.

The first implementations of R97/98-based GPRS networks have focused on near-real-time packet data services like WAP, MMS and corporate data. An optimized Push to Talk service implementation, however, requires a 3GPP R99 upgraded GPRS or E-GPRS access network, which supports header compression and streaming traffic class Quality of Service (QoS).

The main elements of the PoC solution:
• PoC-enabled terminal
  – PoC client, user interface and integrated hands-free
  – SIP and RTP implementation
• Core network
  – PoC application servers
  – integration to existing information systems
• Recommended features for GPRS
  – always-on GPRS
  – 3GPP R99 streaming class QoS-support
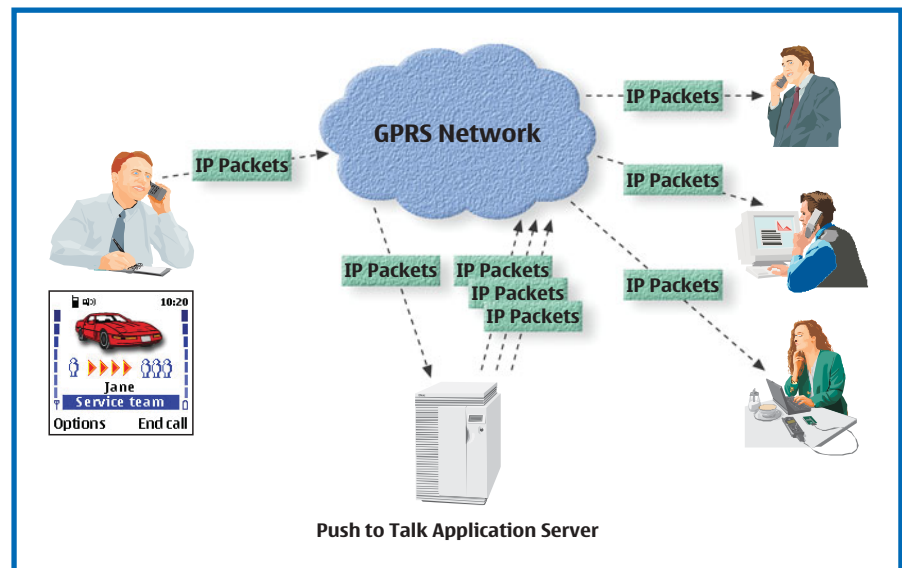 – Degermark IP header compression.

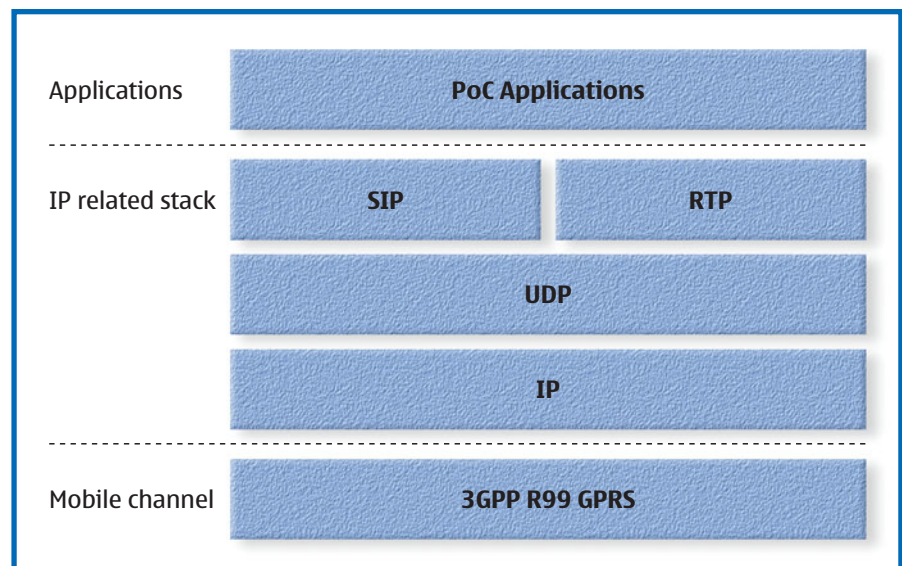Figure 5. Basic principle of the Push to Talk over Cellular solution

Figure 6. Protocol stack of the Push to Talk over Cellular solution

Network dimensioning

It is important to consider the implementation of the Push to Talk over Cellular solution in the early stages of GPRS network dimensioning and coverage planning.

Push to Talk over Cellular uses AMR (e.g. 5.15 kbit/s) coded IP voice, which is highly tolerant of bit and frame errors. In order to fit the service into one time slot in the air interface, a number of voice packets are packed into one IP packet as shown in Figure 7. The exact number of packets depends on used IP version and header compression. Real-time Transport Protocol (RTP) is used in the GPRS access and core network. The Push to Talk service requires a certain carrier to interference ratio (C/I) and an early planning of the solution is important to guarantee the quality of service in the cell boundaries.

Because the Push to Talk service is dimensioned to fit into one time slot, the data rate over the radio interface will be set to around 8 kbit/s. The corresponding data rate in GPRS core is around 12 kbit/s depending on IP version and used header compression. The capacity of SGSN and GGSN elements in the GPRS core and channels for packet data in the BSS radio access should be dimensioned accordingly.
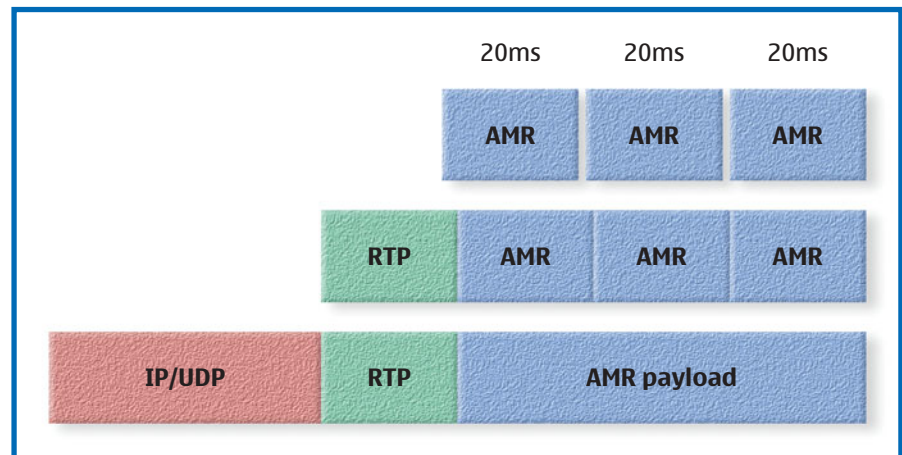

Figure 7. Mapping of PoC voice packets to IP/UDP frames

Standardisation

Nokia is actively participating in 3GPP and other standardisation forums and promoting new services in mobile networks. Nokia believes that the Push to Talk service must be based on open standards to enable interoperability between different terminals and services. This offers terminal manufacturers an opportunity to implement the Push to Talk facility across many GSM mobile phone categories.

Nokia has participated in an industry initiative on the Push to Talk over Cellular solution and adapted it to the GSM/GPRS environment. The solution will be open to other manufacturers and Nokia's current plan is to adapt the solution in the next phase to the 3G environment. Nokia believes that Push to Talk service will become a successful, open IP standards-based service, complementing other IP multimedia communication services enabled by the 3GPP Release 5 IP Multimedia Subsystem (IMS).

As a natural evolution, the Push to Talk solution can be integrated with presence and messaging applications and services. These services will provide synergies like advanced presence information of individuals or group members.

Conclusions

Push to Talk over Cellular introduces a new, direct one-to-one and one-to-many voice communication service in the cellular network. Thanks to the 'always-on' connection, calls to both individuals and talk groups can be started with just a push of a key. This simple, real-time direct communication serves the diverse needs of both business and private users ranging from controlled team management to spontaneous sharing of experiences and pure fun.

Push to Talk users are typically engaged in some other activity than a telephone call, and they listen to the group traffic during their activity. A user can be contacted by the name, or he may occasionally want to say something to the group. Push to Talk service is a genuine differentiated voice service, because it is not a substitute of any existing cellular services. It gives operators an opportunity to develop their voice service offering without having to change conventional voice services.

The Push to Talk over Cellular solution offers cellular operators an excellent opportunity to compete with existing Push to Talk services in the area they know best. The benefits like attractive GSM terminals and simple and fast creation of talk groups are obvious.

The Push to Talk over Cellular solution is based on Voice over IP technology over the GSM/GPRS network. Thanks to the IP technology, the Push to Talk service uses cellular access and radio resources efficiently reserving network resources only for the duration of talk spurts. Building the service over the existing GSM/GPRS network will also reduce the needed investments by the operator and it will have a natural growth path to 3G.

Push to Talk over Cellular offers:
- Convenience with a direct 'always-on' voice connection
- Dynamic group creation without operator involvement
- Nationwide service capabilities
- One single handset for cellular and Push to Talk calls
- Familiar user interface
- Evolution path to 3G.

One of the main goals of Push to Talk over Cellular is to bring the Push to Talk facility to cellular phones. Nokia is driving the industry towards open standards to enable interoperability between different terminals. This gives end-users more freedom to choose the products that best meet their communication needs.

Abbreviations

3GPP
Third Generation Partnership Project. 3GPP's organizational partners have agreed to cooperate in the formulation of technical specifications for third generation mobile systems based on further evolved GSM core networks and radio access technologies.

BSS
Base Station Subsystem. Part of a mobile network consisting of base stations (BSs) and base station controllers (BSCs).

IMS
IP Multimedia Subsystem. 3GPP-specified IP Multimedia Subsystem providing peer-to-peer session control. Enables direct IP connectivity between terminals.

IP
Internet Protocol. A communication protocol commonly utilized by communication hardware comprising the Internet. Specified by the Internet Engineering Task Force (IETF).

GPRS
General Packet Radio Service. GPRS will provide packet-switched data primarily for GSM-based mobile networks. GPRS network elements consist of two main elements: Service GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN).

RTP
Real-time Transport Protocol. One of the Internet protocols designed to provide end-to-end network transport functions for applications transmitting real-time data like voice and video.

SIP
Session Initiation Protocol is a text-based client-server protocol designed to establish, modify and terminate multimedia sessions or calls.

VoIP
Voice over IP. Technology to carry voice communication over a data network based on the Internet protocol.

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

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