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Push-to-talk Over Wireless

Is the time right for Push-to-talk? Does it work over GPRS?

Conclusions

Push-to-talk is a "walkie-talkie-type" service implemented over mobile networks. US operator NexTel first introduced the service on their iDen network almost ten years ago. The service has since its introduction steadily grown in popularity and has created quite a buzz in the industry.

So far, European mobile operators have offered no such service, and there has been scepticism regarding the feasibility of providing Push-to-talk over GPRS networks.

When Push-to-talk solutions are compared and evaluated, it is important to use strict and comparable terminology and concepts, and to keep in mind the inherent characteristics of packet radio. GPRS, WCDMA and CDMA2000 networks can all, if tuned correctly, meet the PoC technical demands. However, end-to-end expertise for tuning the individual parts of the service execution chain is the critical step to success.

Northstream sees clear advantages with Push-to-talk solutions based on the evolving OMA specifications since these will enable:

- Interoperability between terminals and networks
- Interoperability between operators
- Native client support in terminals
- Synergies in terminals and networks with other future IMS based services
- The possibility to use performance boosters such as SIGCOMP for SIP signalling and Header Compression mechanisms for RTP frames carrying speech samples

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About Northstream

Northstream provides strategic technology and business advice to the global wireless industry. Northstream has assembled a multinational team with some of the world's best experts and analysts on wireless communication business and technology. Northstream's list of clients includes several of the world's leading operators and system suppliers as well as some of the leading investment banks and financial institutions.

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This white paper takes a look at the Push-to-talk phenomenon and tries to answer the question whether Push-to-talk solutions can be deployed in GPRS networks with characteristics acceptable to end users.

Introduction

Push-to-talk is a "walkie-talkie-type" service implemented over cellular networks. US operator NexTel first introduced it on their iDen network almost ten years ago based on a proprietary solution that only works in their network. The service has since its introduction steadily grown in popularity and other operators are now interested in launching push-to-talk services.

In the autumn of 2003, Ericsson, Motorola, Nokia and Siemens submitted their jointly defined PoC[1] (Push-to-talk Over Cellular) specifications to OMA to facilitate multi-vendor interoperability for Push To Talk products. The specification is based on 3GPP's IMS architecture and PoC will bring the first commercial implementations of the IMS architecture into mobile networks.

Push-to-talk terminals have a push-to-talk button that a user presses to start a conversation. A conversation can be a person-to-person conversation or different types of group conversations. Only one person can talk at a time while the other participants listen, i.e. PoC works in simplex mode and the service can somewhat simplified be seen as a streaming service where the speaker streams information to other participants in a call.

One obvious target user segment for Push-to-talk is the "blue-collar" workers that today use LMR/PMR radio to communicate. Advantages speaking in favour of PoC based solutions are the coverage provided by GSM/UMTS networks, roaming support and the convenience of having just one handset for all types of communication. But also other user segments such as friends, communities, families and corporate users are probable PoC users .

Why Push-To-Talk?

User Aspects

Push-to-talk is characterized by quick, short and spontaneous communication.
To some extent, it is similar to a multi-party conference call, but there are also many differences.
A Push-to-talk call can be established for a very long time, and still users only pay for the resources consumed e.g. measured in number of bits transferred carrying talk bursts. In a traditional circuit switched call the resources consumed would correspond to the length of the call, and result in high costs[2]. Once the Push-to-talk call has been established the participants can communicate immediately without set up delays. That is at least the idea, and we will come back to actual delays in networks where Push-to-talk has been implemented later in this document.

[1] PoC is used as a term for Push-to-talk systems and terminals based on the evolving OMA specifications.
[2] From an end-user perspective but also from a resource point of view.

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Push-to-talk conversations can also be much more sporadic and informal, and almost take the characteristics of a messaging service with a message sent every now and then, not necessarily requiring a reply from other participants of a call. When Push-to-talk is implemented over packet networks, users are still reachable for traditional circuit switched calls.

Mobile Operator Aspects

Push-to-talk is a new type of service with distinctive features. Many times, Push-to-talk is marketed or regarded in the press as a cheaper telephony replacement. Northstream agrees that Push-to-talk has the potential to attract many users, but not as a replacement for traditional voice telephony. Push-to-talk should rather be regarded as an add-on to existing service portfolios that offers new ways to communicate. Like SMS, Push-to-talk has the potential to boost the traffic per user and not cannibalise on other available services.

The characteristics of Push-to-talk makes it very suitable for packet networks[3], and it has the potential to significantly increase the GPRS traffic in today's networks. It is also a forerunner to the peer-to-peer services over IP for which the IMS architecture provides the capabilities and foundation.

Standardisation

The first Push-talk-talk implementations in cellular networks were proprietary. OMA is working on a set of specifications for PoC based on a joint input from an industry consortium consisting of Ericsson, Motorola, Nokia and Siemens. OMA specifications are however still not frozen and work will continue throughout 2004. Currently available specifications prioritise terminal to network interfaces and interoperability, before server-to-server interfaces. Companies are already developing products based on these available specifications.

The consortium however continues to work in parallel with OMA and additions such as NNI (Network-to-Network Interfaces) for calls between users belonging to different operators, and server-to-server interfaces to facilitate vendor interoperability inside in the operators' domains[4] are expected before the specifications will be finally frozen.

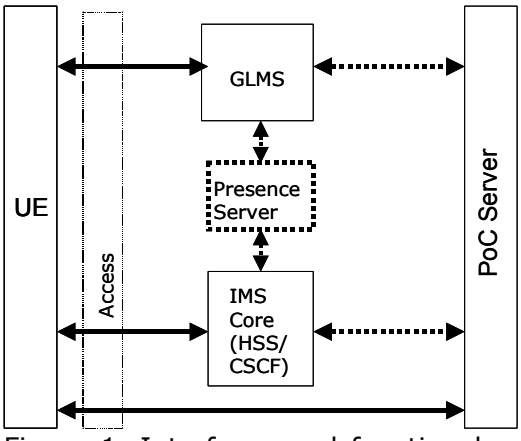

Figure 1. Interfaces and functional entities defined by OMA[5]. Optional interfaces and functional entities are marked with a dashed line.

[3] "Always connected", streaming characteristics instead of conversational, messaging flavour, etc.

[4] For instance to Presence Servers.

[5] Figure 1 does not show the individual functional entities of the IMS core, i.e. HSS, P-CSCF, S-CSCF, etc.

The architecture and solution relies on 3GPP's IMS architecture for session establishment and registration. IMS provides a standardized architecture for peer-to-peer communication applications over IP, suitable for PoC and many other services.

Synergies gained by using the IMS architecture for PoC and other applications include common principles and procedures such as:

- SIP for session establishment and registration procedures
- SDP to describe session requirements
- SIGCOMP as a compression technique for SIP signalling
- RTP to transfer the user plane payload

The unspecified interfaces in OMA's first specification release may lead to vendor proprietary solutions jeopardizing interoperability. Consequently, the degree of openness will vary between different vendor offerings.

Implementations that to a large extent are based on PoC specifications and the IMS architecture provide more openness and are considered by Northstream to be a better choice due to future expansion possibilities and integration with other services based on the IMS architecture.

Northstream expects that PoC service launches based on OMA specifications will take place during the second part of 2004. PoC calls between users belonging to different operators and multi-vendor systems on the network side will come later.

Ericsson recently announced that they have expanded their multi-vendor terminal verification program to include Push-to-talk terminals based on the evolving OMA specifications. Other large vendors are expected to follow with similar activities. Activities like these are important when new services that are highly dependent on terminal support and multi vendor interoperability are introduced.

Technical aspects

Performance Gains

It is suitable to implement Push-to-talk over packet network such as GPRS. Comparing a PoC implementation with traditional voice telephony shows that PoC has lower QoS requirements. Telephony requires a bearer with a conversational QoS traffic class, when PoC due to its simplex characteristics works over streaming, interactive or even best effort traffic classes. The OMA specifications recommend the streaming traffic class for talk bursts and the interactive traffic class for signalling, but GPRS with pure best effort characteristics may also be used if the other traffic classes are not available.

Other performances gains come from the use of acknowledged mode radio that provides fast and efficient retransmission of speech frames, and the use of AMR half-rate as speech codec.

Which Type of Packet Network?

PoC is defined to be radio network agnostic and can be implemented over a variety of access networks, such as:

- GPRS according to 3GPP Release 97/98
- EGPRS according to 3GPP Release 99 or later releases
- UMTS according to Release 99 or later
- CDMA and CDMA 2000 networks.

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According to Ericsson Research, their Instant Talk PoC system shows an equal performance over GPRS, WCDMA and CDMA2000 networks.
From this, one can conclude that the radio technology used is not the determining factor for a successful deployment. Tuning the service from an end-to-end perspective is. Deployment requires expertise in the entire service delivery chain including service networks, core networks, radio networks, terminals and the PoC service itself.

Examples of factors that will affect the end-to-end service performance of PoC are:

- GPRS Radio network configuration and dimensioning
- Timer settings in terminals and networks
- Traffic handling priorities and Traffic Classes (QoS) used
- The use of performance boosters such as SIGCOMP for SIP signalling and Header Compression mechanisms for speech payload
- PoC client implementations on the terminals native operating systems
- PoC service option choices such as whether to use early media and or early session establishment.

Push-to-talk performance figures

The US operators Sprint and Verizon launched their version of Push-to-talk in the autumn of 2003. Reports and comparisons with Nextel's Push-to-talk service have been published e.g. by New York Times. Sprint and Verizon have according to these sources much longer push-to-tone and talk-to receiver times than Nextel. Nextel is reported to be almost instantaneous whereas the two others have a push-to-tone time in the 5-6 sec interval and a talk-to-receiver delay in the 4-5 sec interval. None of these deployments is however based on the OMA specifications, which makes it difficult to draw any conclusions about the performance of PoC compliant implementations.

Ericsson Research has provided Northstream the following performance figures for their PoC compliant Instant Talk system, based on measurements in labs and live networks.

Delay performance characteristics - One-to-One call with Auto answer - Set-up procedure - Early media	**GSM/GPRS Time**
Delay, initialising a session	
- Push to tone (from button pushed to start talking) ***, *****	1-2 second
- Media delay (from start talking to voice heard by recipient) ******	~ 1 second
Delay, during a session	
- Push to tone	< 1 second
- Media delay ******	~ 1 second

* Depends on the SigComp compression ratio used
** Jitter buffering could add delay to this value.
*** No paging assumed. Paging would add some seconds, depending on the paging group assigned to the mobile.

Figure 2. Ericsson performance figures for a One-to-One call with Auto answer, using the early media set-up procedure over a GPRS (Release –99) network.

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The figures are promising and comparable with Nextel's PoC service. They are also fulfilling the OMA stated requirements[6]. But it should be noted that the figures are based on measurements for mobiles that are in states where paging is not required. When a mobile does not send or receive packets, it is considered to be in an "inactive" state. This requires paging of the mobile before data such as Push-to-talk traffic, can be delivered to it. Paging would add another 2-3 seconds to the "Initial Push-to-tone" and "During call Push-to-talk" times.

Note that the figures are published to show that it is possible to meet user requirements with systems based on OMA specifications and available networks. Ericsson's performance figures serve as an example of this. Other vendors can offer similar solutions and characteristics.

Conclusion

Push-to-talk will attract users from many user segments due to its characteristics inherited from other popular services (telephony, messaging, and "walkie-talkie") and the simplicity in using and understanding the service.

When Push-to-talk solutions are compared and evaluated, it is important to use strict and comparable terminology and concepts, and to keep in mind the inherent characteristics of packet radio. GPRS, WCDMA and CDMA2000 networks can all, if tuned correctly, meet the PoC technical demands.
However, end-to-end expertise for tuning the individual parts of the service execution chain is the critical step to success.

Northstream sees clear advantages with Push-to-talk solutions based on the evolving OMA specifications since these will enable:

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Contact:

Northstream has studied technical, commercial and product aspects of Push-to-talk and is well suited to help mobile operators and others on how and when they best can benefit from this opportunity.

Please contact us if you would like to find out more about this or about our company and the services we provide: E-mail us at info@northstream.se or call +46 8 564 84 800.

[6] Measurements for WCDMA and CDMA2000 networks show an equal performance for these.

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Annex

Push-To-Talk Concepts used in the evolving OMA specifications

Instant Personal Talk:
Instant Personal Talk provides person-to-person voice communication where one person talks at a time. It may operate in auto answer mode, which means that the called user will immediately hear the calling user, or in manual answer mode similar to answering a phone call.

PoC Call (Session) Establishment:
Sessions can be established by selecting recipients from a contact list, or by typing their addresses.
Allowed address formats are:

- SIP URIs, sip:joe.doe@operator.net or
- E.164 Telephone Numbers (MSISDNs), +467091234567

Floor Control:
Since only one person can talk at a time, a user must "request the floor" before he or she is entitled to talk. These procedures are called Floor Control. The floor is normally requested by pressing a phone's Push-to-talk button.

PoC Group Talk Features:
OMA defines the following variants of group talk:

1. Instant Group Talk
   An Instant Group Talk is PoC session between users in a pre-defined group. This group is always a restricted group identified by a persistent identity.

2. Ad-hoc Instant Group Talk
   Ad-hoc Instant Group Talks are created on the fly.
   A user invites selected users to an ad-hoc group talk session by selecting them from a contact list or by typing their addresses.

3. Chat group talk
   A Chat Group can be open or restricted. Any user can join an open group, whereas authorized members can only join a restricted group.
   In Instant Group Talk, all the members will be invited by the PoC Server immediately at call establishment. In Chat Group Talk, users can join the group at any time as they wish.

Personal Alert:
A Personal Alert is a request to a recipient user already busy in a PoC call, to call the originator of the alert at a later stage. An instant personal alert may carry a text message but should not be confused with Instant Messaging (IM).

Early Session Establishment:
This means that a PoC call is partly established even though no one is going to talk at that particular moment. The early session establishment normally takes place directly after initial registration to the system, and its purpose is to shorten the session establishment signalling at talk time.

Early Media Establishment:
Early Media Establishment is a PoC Server feature that allows a calling user to start talking even though the sessions to other participants have not been established. The PoC server buffers the talk bursts until the sessions have been established and then transmits them.

Functional Entities of the PoC Architecture:

- **GLMS** (Group List Management Server) manages groups, contact lists and access lists.
- The **PoC Server** is:
  - The End-point for SIP signalling for calling and recipient users
  - The End-point for RTP and RTCP signalling for calling and recipient users, and responsible for the Floor Control.
  - Responsible for transferring talk bursts to all participants in PoC calls, and buffering of talk bursts when early media handling is used.
  - The Policy controller for access to groups & individual users
- The **Presence Server** manages presence information uploaded by Presence Clients in terminals.

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Definitions and Inherent Characteristics of Packet Radio

Two useful definitions for performance evaluations of Push-to-talk implementations are:

- **Push-to-tone:** The time it takes to establish a session from the moment that an originating user selects a recipient to start a Push-to-talk conversation with. When the originator is allowed to talk, an announcement such as a tone will be heard. This is the time it takes to perform the SIP/SDP (session establishment) and RTCP (floor handling) sequences.
  The OMA specifications state that this time should not be more than 4 seconds[1] .
- **Talk-to-receiver:** The time it takes to transfer speech frames from the originator to the receiver.
  The OMA specifications state that this time should not be more than 1,6 seconds.

Packet radio is based on the principle of sharing available common resources. Resources are scheduled and allocated to terminals when information is to be transferred to or sent from these. When one terminal does not send or receive data, it does not consume any of the available resources. Even terminals with established PDP contexts may after a certain time period be regarded as "inactive"[1] on radio resource and/or mobility management level. When this happens, the network will have to page the MS before PoC speech frames can be delivered to a recipient, even if a PoC session already exists. This affects performance measurements for PoC negatively.