

An Optimal Timer for Push to Talk Controller

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INTRODUCTION

The push-to-talk over cellular (PoC) application allows point-to-point or point-to-multipoint voice communication between mobile network users (Balaz, 2004). The communication is strictly unidirectional, where at any point of time only one of the participants may talk (talker), and all other participants are listeners. In order to get the right to speak, listeners must first push a “talk” button on their mobile terminals. Floor control mechanisms ensure that the “right to speak” is arbitrated correctly between participants. The PoC application may become a highly popular service for the mobile telecommunications market if its responsiveness and voice quality meet end-user expectations. In the autumn of 2003, Ericsson, Motorola, Nokia, and Siemens submitted their jointly defined PoC specifications to the Open Mobile Alliance (OMA, 2005) to facilitate multi-vendor interoperability for push-to-talk products. The specification is based on the Third Generation Partnership Project’s (3GPP’s) IP Multimedia Subsystem (IMS) architecture (3GPP, 2005); PoC is to bring the first commercial implementations of the IMS architecture into mobile networks. A discussion on strategic actions related to standardization, system architecture, and service diffusion of PoC has been discussed by Vehmas and Luukkainen (2005). An exploratory study of college-age students using two-way PoC cellular radios has been shown by Woodruff and Aoki (2003).

One wireless carrier, Nextel Communications (2002), provides mobile phones with conventional features such as voice telephony and voicemail; the same network and handsets also support a two-way, push-to-talk service called Direct Connect™. This service is very popular, having 10 million subscribers and supporting nearly 50 billion Direct Connect calls in 2001, predominantly for business use (according to a report of Nextel Communications, 2002). Competitors are attempting to introduce similar services based on packet (IP) networking; the top four U.S. carriers have all announced plans for similar services in the very near future, and separate service providers such as fast-mobile (www.fastmobile.com) are also appearing, particularly in Europe.

“Equally important is the fact that push-to-talk is a forerunner to peer-to-peer services over IP, for which IMS provides the capabilities and foundation. PoC is the first commercial application based on IMS” (Northstream, 2004). The driving forces behind the operators’ push-to-talk initiatives are the search for new revenue opportunities and finding

ways to increase subscriber acquisition and reduce churn. In this article, we depict some of the potential problem areas of a PoC server and provide an analytic model to ameliorate dimensioning of a PoC controller.

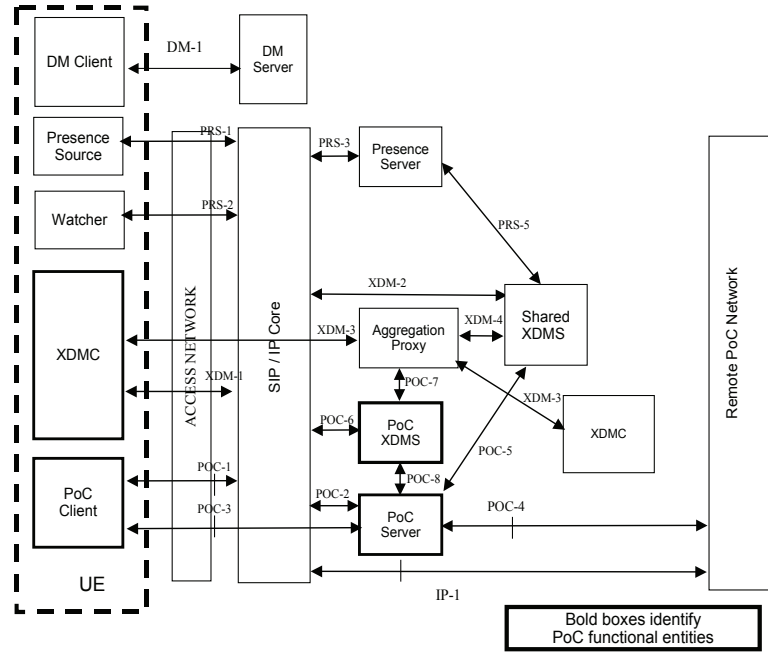
BACKGROUND

PoC is a warm topic today for the researchers. An architecture for enabling PoC services in 3GPP networks has been furnished by Raktale (2005). Similar work is reported by Parthasarathy (2005). The design of a PoC service operated over a GPRS/UMTS (general packet radio service/universal mobile telecommunications system) network is also depicted by Kim, Balazs, Broek, Kieselmann, and Bohm (2005). The basic architecture of PoC is provided in Figure 1. The common terms related to PoC have been furnished in the Key Terms section. The PoC server implements the application-level network functionality for the PoC service. It performs a controlling PoC function and/or participating PoC function (OMA, 2005). The controlling PoC function and participating PoC function are different roles of the PoC server.

The determination of the PoC server role (controlling PoC function and participating PoC function) takes place during the PoC session setup and lasts for the duration of the whole PoC session. In case of *1-1 PoC session* and *ad-hoc PoC group session*, the PoC server of the inviting *user* performs the controlling PoC function. In case of the *chat PoC group* and *pre-arranged group session*, the PoC server owning/hosting the *group identity* performs the controlling PoC function. The PoC server performing the controlling PoC function has N number of SIP (session initiation protocol) sessions and media and talk burst control communication paths in one PoC session, where N is number of participants in the PoC session. The PoC server performing the controlling PoC function will have no direct communication to the PoC client for PoC session signaling, but will interact with the PoC client via the PoC server performing the participating functioning for the PoC client.

The PoC server performing the controlling PoC function normally also routes media and media-related signaling such as talk burst control messages to the PoC client via the PoC server performing the participating PoC functioning for the PoC client. However, local policy in the PoC server performing the participating PoC function may allow the PoC server performing the controlling PoC function to have

Figure 1. PoC architecture (OMA, 2005)



a direct communication path for media and media-related signaling to each PoC client. A PoC server performing the participating PoC function always has a direct communication path with a PoC client and a direct communication path with the PoC server performing the controlling PoC function for PoC session signaling.

The basic challenges that affect the end-to-end service performance for PoC are:

1. network configuration and *dimensioning*;
2. timer settings in terminals and networks;
3. traffic handling priorities used; and
4. service option choices such as early media session establishment.

In this short article, we focus on the issue of *optimized lifetime* of a session provided by the PoC controller. The lifetime of a session is crucial since the server capacity is always fixed. Thus, the lifetime of a session must be set carefully based on the available resources, number of clients willing to talk, network topology, and so forth.

PROPOSED OPTIMAL TIME

Dimensioning and optimizing networks is a mature topic today (Ghaderi & Boutaba, 2006; Vacirca, Vendicits, & Baiocchi, 2006). An optimal design for a multi-rate ATM

loss network is provided by Mitra, Morrison, and Ramakrishnan (1996). We use the square root dimensioning method to compute the optimized timeframe for a session of PoC controller. The mechanism is based on the mean service rate of the controller, number of current sessions, and the controller capacity. Let, T_i be the average session time encountered by a job i and C_i the capacity allotted for session i . Also, let λ , λ_i , and μ be the total PoC session arrival rate, arrival rate of specific session PoC i , and mean service rate of PoC sessions respectively.

If the stability condition $\lambda_i < \mu C_i$ for $i=1,2,...,N$ holds, then:

$$T_i = \frac{1}{\mu C_i - \lambda_i} \quad \forall i = 1, 2, \dots, N \quad (1)$$

Thus the average PoC session time of a PoC messages

i is (assuming $\rho_i = \frac{\lambda_i}{\mu}$):

$$T_i = \sum_{i=1}^N \frac{\lambda_i}{\lambda} \left(\frac{1}{\mu C_i - \lambda_i} \right) = \frac{1}{\lambda} \sum_{i=1}^N \frac{\rho_i}{C_i - \rho_i} \quad (2)$$

The stability condition now reads $\rho_i < C_i$ for $i=1,...,N$. Therefore, our threshold timeframe problem reduces to:

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