Methodological Introduction of Context Awareness in the Design of 3GPP Conversational Services
François Toutain, Ahmed Bouabdallah, Radim Zemek, Claude Daloz

To cite this version:

HAL Id: hal-00924479
https://hal.archives-ouvertes.fr/hal-00924479
Submitted on 6 Jan 2014

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Methodological Introduction of Context Awareness in the Design of 3GPP Conversational Services

François Toutain
Orange Labs Lannion
France Telecom R&D
Lannion, France
francois.toutain@orange.com

Ahmed Bouabdallah
Telecom Bretagne
Institut Mines-Telecom
Cesson-Sévigné, France
ahmed.bouabdallah@telecom-bretagne.eu

Radim Zemek
Orange Labs Tokyo
France Telecom R&D
Tokyo, Japan
radim.zemek@orange.com

Claude Daloz
Orange Labs Lannion
France Telecom R&D
Lannion, France
claude.daloz@orange.com

Abstract—By complementing basic call services, supplementary services totalling nowadays more than twenty different functions, have a long history crossing the main areas of telecommunications from ISDN via ETSI GSM, ETSI TISPAN to finally end at 3GPP and GSMA. They are commonly used in professional settings while their usage is somewhat less developed in mass market situations. They suffer in fact from serious drawbacks preventing them to be massively adopted. We believe however that the attention toward supplementary services may significantly increase due to the exceptional concomitance of two main trends. The first one concerns the current interest boasted by the introduction of next generation networks, such as 4G/IMS through the MMTEL specification efforts. The second trend is determined by the unprecedented levels reached by the mass market penetration of smartphones putting within reach of majority, the enhanced capabilities of these powerful terminals, able to completely renew the end user experience. We claim that context awareness could be the right catalyst allowing a fruitful combination of these two long-term directions of the telecommunication domain. To work towards this goal, we introduce in this paper a methodology allowing the systematic and comprehensive introduction of context-awareness in conversational services. Our methodology involves four main building blocks, we illustrate through various examples drawn from supplementary services. A taxonomy of conversational services is defined and applied to supplementary services. Pending issues complete the analysis of the methodology.

Keywords : Context Awareness, Multimedia Telephony, Supplementary Service, Methodology, Taxonomy.

I. INTRODUCTION

Supplementary services such as Call Forwarding on No Reply (CFNR), Call Waiting (CW), or Closed User Group (CUG) complement basic call services [1] and are commonly used in professional settings while their usage is somewhat less developed in mass market situations. Totalling nowadays more than twenty different functions, supplementary services have a long history, coming from legacy ISDN (Integrated Services Digital Networks) [2], ETSI (European Telecommunications Standards Institute) quickly introduced them in GSM [3] and in the same vein 3GPP (Third Generation Partnership Project) adopted them for the UMTS architectures without major evolution until Release 6. Adaptation of these features to IMS (IP Multimedia Subsystem) and NGN (Next Generation Network) was first pioneered by ETSI TISPAN (Telecom and Internet Converged Services and Protocols for Advanced Networks) [4]. 3GPP taken up part of ETSI works began in Release 7 the development of MMTEL (Multimedia Telephony service) [5]. 3GPP has afterwards been entrusted the mission to continue the unified and coherent development of MMTEL together with common IMS. Last but not least supplementary services held also attention of GSMA (GSM Association) which introduces part of them in its work concerning the definition of an IMS Profile for Voice and SMS [6].

It is no surprise that these services have been specified through a large standardization body. Indeed, standardization processes are of critical importance for interoperability issues and consistent behaviour leading to wide adoption. That’s why basic telecommunication services benefited of such a huge standardization effort. But, although they are very widely known, supplementary services are not really massively adopted as it has been the case for example about SMS (Short Message Service) or mobility, except for the professional area where the specific needs of large and small businesses have led to a marginally wider use. The reasons of such a situation may be quite complex; it appears however that the poor quality of experience emerging from the usage of these supplementary services, constitutes one of its main explanatory factor. Let’s first remark that past implementations of these features as well as current ones offer very mediocre dial-based interfaces, which make them difficult and awkward to use [7]. They exhibit very limited and rigid behaviour. And due finally to the “walled-garden networks” principle governing network operators’ policies, these features are devoid of any customization capability. Last but not least, the feature interaction problem, which is a quite complicated matter far from being completely solved, often precludes the simultaneous use of these various service elements [8].

With all these drawbacks, it is no surprise that network operators around the world have hardly promoted the majority of supplementary services, and have fallen back on simple strategies such as default provisioning within packaged subscription plans. However, we believe that the attention toward supplementary services may soon increase significantly. Indeed, there is a current interest boasted by the introduction of next generation networks, such as 4G/IMS (IP Multimedia Subsystem), through the MMTEL specification efforts [5]. We can also quote as a recent trend the RCS
initiative (Rich Communication Suite) which aimed at large
audiences, and was however reduced later on to the RCS-e [9]
(basically because of cost structures and thus a requirement to
reduce the introduction cost of these new technologies). In
addition, the mass market penetration of smartphones is
reaching unprecedented levels, and these powerful terminals,
equipped with large screens are beginning to offer renewed
basic services, taking advantage of the smartphone capabilities,
such as the visual voicemail feature (provided eg. on Apple’s
iPhone or Android-based mobile terminals).

Our thesis in this paper is that these increased capabilities,
available on smartphone-class terminals for an increasing
number of subscribers, are an opportunity to provide
supplementary services which will be easier to configure and
use. Indeed, these capabilities are key to offer a better user
experience, and so far, this has been almost exclusively the
case for over-the-top services, implemented by third parties
having nothing in common with network operators, while the
classical communication services have been kept to a very
basic level of functionality. This evolution has leaded to the
current situation, where there is a clear dichotomy between
advanced services which benefit from capabilities of new
platforms but are not standardized, leading to fragmentation,
and classical services, standardized but lacking from improved
user experience.

In an attempt to improve the situation without restricting
the market to high end terminals, the RCS initiative considered
ambitious features such as an enhanced phonebook, enriched
communications with content sharing capabilities, and
enhanced messaging services. It was however reduced to RCS-
e which focuses on capability sharing, and basically ignored
classical supplementary services [9]. MMTEL which could
appear as the standard side of RCS, relies on the NGN ‘s
generalized conversational session between mobile or/and
fixed users involving various media (speech, video, text, …);
like RCS-e MMTEL introduces sharing capabilities but
differently from it, authorizes an enrichment of a session
through the execution of updated versions of supplementary
services [5][10] deployed in dedicated SIP application server
called TAS (Telephony Application Server) [11].

One interesting approach close to RCS/MMTEL initiatives
is that of context awareness. Indeed, context could be one of
the ways to make services flexible and adaptive. Context aware
systems are defined as ones which can adapt their behaviour
depending on changing user situations (context adaptation),
and also as systems able to explicitly present context data to the
users (context presentation) [12]. Context-awareness has been
studied for many years, with strong results, and already some
independent services being deployed (e.g. GrandCentral aka
Google Voice, OneNumber). We believe that now is the proper
time to bring context to core services, because, although these
are well-known services, context awareness could well enhance
the subscribers’ willingness to use them. We also advocate that
it is an important matter to push this approach to
standardization.

In this paper we analyze existing supplementary services,
and we introduce a methodology allowing us to produce
context-aware versions of those services. Usage of such
context-aware services is illustrated by some use cases. A
global taxonomy of conversational services applied to
supplementary services concludes the paper together with the
analysis of the methodology and the pending issues.

II. PRESENTATION OF THE METHODOLOGY

Before exposing our methodology for adding context-
awareness to communication services, we must introduce some
technical definitions. In this paper, context is defined as soft
real-time information pieces related to a user situation, be it
some physical measurement, logical status, or a combination of
several such data [12]. Context is usually acquired through
some low-level systems, e.g. sensors, and/or derived from
logical information. Low-level context data may further be
processed into higher level information, using a variety of
techniques such as logical inference or data fusion. Examples
of context data include weather condition, localization, user’s
availability, current agenda slot, number of people around user,
etc.

Our focus in this paper is to define context-aware
conversational/interpersonal services, starting from classically
defined call services in 3GPP or equivalently communication
services in the MMTEL standardization effort. These services
obey a well-defined life-cycle, by which [13]:

- a user subscribes to service S ;
- upon approval, the service operator provisions S, using
some predefined data coming in part from the user and in
part from the operator itself (these parameters being
operator embedded data, freely chosen within the
standards constraints in order to match a specified service
level) ;
- depending on the service, activation can be performed by
the operator after which they are always-on services, or
activation can be done bit by bit by the user herself ;
- invocation can be implicit (for always-on services), or
explicit by the user. In the latter case she can provide some
parameters during invocation ;
- deactivation can be performed for some services ;
- withdrawal of the service is the last step.

These services specifically target operator networks,
meaning that all the operations occurring in the network are
strictly and closely controlled by the operator [14].

Studying the addition of context-awareness to these
services can be done in a systematic manner. This is the
purpose of the following methodology.
must activate the CD service and provide a target identification for the potential bouncing calls. In a context-aware version of this service, users’ activity, e.g. driving a car, can be automatically used to infer that users are busy, and the service can be autonomously activated. Conversely, the service triggering can also be inhibited due to context conditions. An example is an emergency call that could get through the CD service.

Trend 3 is about unifying several services when they can relate to one another thanks to adding some shared context awareness. Indeed, several classical services are very similar except for a specific condition which is explicit in the standards. By relaxing these static condition definitions into a more general context condition, we can unify the services into one, more general, context-aware service. It is interesting to point out that 3GPP began to apply this same trend when defining in MMTEL a family of features named Communication Diversion (CDIV) [5] [15] bringing the various forwarding features (Unconditional (CFU), on Busy (CFB), on No Reply (CFNR), on Subscriber Not Reachable (CFNRc), on Not Logged-in (CFNL)) together with the Deflection one (CD). It is however worth noting that even if this regrouping is intuitively well-founded, solid arguments firmly founding it, are still missing. We argue in fact that context awareness can provide the right angle to formally define such unification. We will expand this point more thoroughly in the next section.

Trend 4, finally, relates to relaxing even more the original specifications, and allowing ourselves to “re-think” the services with context-awareness in mind. One example of this trend could be an enhanced Multi Level Precedence and Preemption service (eMLPP), which is traditionally specified as an always-on service allowing to preserve a priori defined, important calls, in times of resource scarcity or network congestion [16]. By relaxing this assumption, we can imagine a dynamic service which, by acquiring a context information pertaining to the subject of the call, by way of word recognition for instance, would be able to classify the call importance dynamically, thus preserving truly important calls instead of predefined ones. Obviously such a service would raise some privacy concerns, as is often the case with context-aware systems [17].

III. METHODOLOGY AT WORK

The main point of trend 1 concerns the contextual derivation of static and/or dynamic parameters used during the invocation of the feature. Let’s take CFNR and suppose it has been activated (this is usually the default case in mobile networks [15]). Its main characteristics concerns the ringing duration controlled by a timer, the value of which, instead of being statically fixed by the operator, could be dynamically decreased/increased according to the context situation. We illustrate this point through various use cases associated to specific contextual situations:

- the context allows us to know that the terminal is not in a reasonable proximity to the callee to let the latter answer the call; a predefined ringing will be useless and we can therefore reduce the timer value to its minimum value (to preserve the integrity of the call log, it is necessary that the callee terminal rings at least once). Proximity between the
callees and their terminals can be inferred from various sources which must be combined: accelerometer data from the mobile phone sensor can indicate if the user is currently carrying it; location of the terminal associated with user agenda could reveal that they don’t share the same place, … .

- The context allows us to know that due to her activity, the user is unable to answer the call, because for instance she is currently driving. In this case, the velocity of the terminal can be obtained from the GPS sensor, allowing to deduce that the user is currently moving at a certain speed. This information is not sufficient and must be combined with additional sources, coming in our example from the car system, which may identify the current driver [18], and consolidated e.g. with map matching, in order to compare the user trajectory with known roads.

- The context allows us to know that the caller is in distress [19], and that her call is implicitly an urgent call. It therefore makes sense, in this case, to extend the ringing duration by increasing the value of the associated timer. A prolonged ringing will be a clear indication to the callelee that the call is a special one.

The previous examples manage context information associated to the caller or to the callelee. It is interesting to note that when combining both, we may have a service interaction which could be easily solved through priority. Suppose that a caller in distress makes a call to a buddy currently driving. It is reasonable to require that in such a case the no-answer timer duration must be increased (priority to caller situation), to allow the callelee to park her car and answer the call.

Trend 2 concerns the dynamical activation of a feature due to specific contextual situation. Suppose the user does not want to be disturbed by a phone call because she is for example at the theater and the context allows us to know this information. It is quite natural when receiving the call, to activate a call deflection feature which will transfer the incoming call to a new address. In our use case, an indoor location system could be used to deduce in an accurate way the right location of the callelee; but this information is insufficient and must be combined at least with the exact schedule of the program, to deduce the right location of the caller. A prolonged ringing will be a clear indication to the callelee that the call is a special one.

The previous examples manage context information associated to the caller or to the callelee. It is interesting to note that when combining both, we may have a service interaction which could be easily solved through priority. Suppose that a caller in distress makes a call to a buddy currently driving. It is reasonable to require that in such a case the no-answer timer duration must be increased (priority to caller situation), to allow the callelee to park her car and answer the call.

Trend 2 concerns the dynamical activation of a feature due to specific contextual situation. Suppose the user does not want to be disturbed by a phone call because she is for example at the theater and the context allows us to know this information. It is quite natural when receiving the call, to activate a call deflection feature which will transfer the incoming call to a new address. In our use case, an indoor location system could be used to deduce in an accurate way the right location of the callelee; but this information is insufficient and must be combined at least with the exact schedule of the program, to deduce the right location of the caller. A prolonged ringing will be a clear indication to the callelee that the call is a special one.

The methodology introduced above, can be applied to any general conversational service. We however target in this paper the well-known supplementary services which as indicated in the introduction, have a long history crossing the main areas of telecommunications from ISDN via ETSI GSM, ETSI TISPAN to finally end at 3GPP and GSMA. We may in fact consider two main versions of these features depending on whether they are grafted on a CS-based or IP-based telephony service. These two versions are generally close, but they don’t necessarily superpose and they furthermore present occasionally tricky semantic differences justifying their distinction [10]. For the sake of clarity, we will in what follows use the term “feature” or “supplementary service” when the underlying bearer doesn’t import, and in the other cases:

- “CS-SS” to identify the ones determined by the direct descendants of the initial ISDN supplementary services [1]
- “IMS-SS” to name the ones arising from the adaptation of supplementary services to IMS and NGN [5][20]

Our methodology helped us to develop a comprehensive and systematic introduction of context awareness in all these features. The complete work will deserve by its own a dedicated publication. We identified however during this work a global and structured taxonomy of these features which could be of interest.

A conversational service has the following fundamental characteristics:

- it is structured in three main temporally sequential steps: the establishment, the execution and the release
- it involves at least two principals one of which is the initiator; we name participants the other ones
We can organize the existing features in three main functions:

- **Presentation** concerns the various ways informations can be exchanged (input/output) between a principal and the conversational service through her device.

- **Authorization** identifies various conditions to be met in order to allow or interrupt a particular step of the service together with the verifying process of these conditions and its reporting.

- **Leg handling** determines the different ways to influence the exchange of signaling information between the service and a principal during the three steps.

We can identify the main characteristics of the existing features as indicated in the table below. Usually supplementary services are often expressed with standardized acronyms. Due to lack of place, we cannot provide the associated glossary; when necessary we advise the reader to consult respectively the two following references: CS-SS [1] and IMS-SS [5].

<table>
<thead>
<tr>
<th></th>
<th>Establishment</th>
<th>Execution</th>
<th>Release</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Presentation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS-SS</td>
<td>CLIR</td>
<td>OIR</td>
<td>AoCI</td>
</tr>
<tr>
<td></td>
<td>COLP</td>
<td>TIP</td>
<td>AoCC</td>
</tr>
<tr>
<td></td>
<td>COLR</td>
<td>OIP</td>
<td>AOC</td>
</tr>
<tr>
<td></td>
<td>CNA P</td>
<td>TIR</td>
<td>AoC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AOC</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CRS</td>
<td>AoCI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AOC</td>
</tr>
<tr>
<td><strong>Authorization</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS-SS</td>
<td>CUG</td>
<td>OCB</td>
<td>3PTY</td>
</tr>
<tr>
<td></td>
<td>BAOC</td>
<td>MCID</td>
<td>MCID</td>
</tr>
<tr>
<td></td>
<td>BOIC</td>
<td>ACR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>BOIC-Room</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>exHIC</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Leg Handling</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS-SS</td>
<td>eMLPP</td>
<td>CCBS</td>
<td>CW</td>
</tr>
<tr>
<td></td>
<td>CD</td>
<td>CONF</td>
<td>HOLD</td>
</tr>
<tr>
<td></td>
<td>CFU</td>
<td>CCNR</td>
<td>ECT</td>
</tr>
<tr>
<td></td>
<td>CFB</td>
<td>CFNR</td>
<td>MPTY</td>
</tr>
<tr>
<td></td>
<td>CFNRc</td>
<td>CD</td>
<td>UUS</td>
</tr>
<tr>
<td></td>
<td>UUS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMS-SS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is now clear, based on the variety of service ideas and use-cases exemplified in the previous section, that adding context awareness to communication services can vastly improve their usefulness as well as their ease of use. Nonetheless, several issues are raised by this new approach, including privacy issues, architectural choices, implementation within an operator network of context data processing facilities, or standardization issues.

Privacy is a very real concern to take into account when dealing with context aware services and applications. Besides somewhat idealistic voices which denounce the “big brother syndrome”, there is indeed a growing awareness among users that their private life is more and more made transparent to private corporations, with no clear rules to ensure basic rights are respected. As a consequence, for any context aware service to become widely used, its provider has to make considerable effort to ensure and demonstrate its benefits on the one hand, and its rules of play with respect to private data on the other hand. It is understood that some context data are more sensitive to privacy concerns, and that some application classes are better perceived than others. Besides, telecom operators, having a long standing commercial relationships with their subscribers, may be in a good position to act as a trusted party with respect to context data, and they must focus on how to nurture this relationship and how to increase this trust. It is generally accepted that these goals are best reached by providing valuable services in return, and by allowing users to explicitly control their data within the services. Control includes granting access, controlling the level of accuracy, sharing patterns and withdrawal policies [12].

An important aspect of deploying context aware services is related to architecture of the context management system. Many research efforts have been made in this area [12], and we envision that a hybrid approach is a viable one [14], i.e. one where some components are embedded within the core operator network while others can be deployed at the edges, even within the mobile terminals. Some well-known service enablers have already received extensive scrutiny, and they are now widely deployed components, e.g. location management, availability & presence enablers. There is now a requirement to generalize the management of situational data in a carefully
designed way. This is specially the case for next generation mobile networks (4G / LTE) where the low latency combined with the high throughputs offered make it eventually possible to gather real-time, multi-dimensional, contextual data about almost any user registered within the network. We are convinced now is the proper time to design a comprehensive context management scheme dedicated to such a mobile network, which is a very important issue for the relevant standardization bodies.

The origin and nature of the context data is also a matter for careful thinking and implementation choices. Actually, two broad categories of contextual data may be thought of: one is "raw data" coming from physical sensors or low-level monitoring services, and the other is "high-level data" resulting from advanced computation such as automated learning, inference or multiple sources consolidation [18]. Depending on the service, data from one category or the other may be required, and this has a strong impact on the feasibility of the related service, since sophisticated data may not be easily available for any user at any time (due to processing costs, required infrastructure, but also in some times because of the time it may take to gradually construct the data, as is the case for automated learning or collaborative filtering techniques).

V. CONCLUSION

In this paper, we have proposed to revisit classical telecommunication services by exploring the context awareness dimension. Doing so, we have shown a great potential for renewed services, which become more efficient, more personalized, probably easier to use and more consistent. However, actually implementing these services is a matter for further thinking, because some implementation choices such as service architecture or GUI are of paramount importance for the actual rendering and deserve a lot of attention. The user interface for instance is a critical point for the acceptability of the services, and recent advances such as voice interaction (e.g. Apple’s SIRI) may well be key to more natural modes of operation, taking into account that the contextual dimension may well add complexity to the service command.

A similar axis for further work is to adopt the point of view of the operator when designing context-aware services. In the previous sections, we have developed a restrictive view, completely focused on the improvement of the quality of experience of the user, without taking into account the impact of our approach: the resource occupation ratio which has consequences on the financial aspects of the services. But a different study needs to be done which must clearly show the benefits and the cost of introducing context in the business model of such services.

On another level, we argue that the whole lifecycle of the services can be the object of context-aware redesign, and that network management processes, from the point of view of the operator, should be revisited using context. Extrapolating on our approach, we suggest that the methodology exposed in this paper is general enough to be implemented when designing new context-aware services. A possible approach could be to iterate on a novel service specification, by taking into account trends one to four, in turns, as a way to aid injecting context awareness within the service specification.

Finally, having based our work on standards from the 3GPP consortium, we are considering contributing back to the standardization process, by advocating to turn to context awareness as a major exploration opportunity, for the next evolution steps of the telecommunication services.

REFERENCES

[1] 3GPP TS 22.004 - General on supplementary services - V11.0.0 – 2011.
[16] 3GPP TS 23.067 - enhanced Multi-Level Precedence and Pre-emption service (eMLPP) - V10.0.0 - 2011.