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RELATING SERVICES AND FEATURES IN THE INTELLIGENT NETWORK

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ABSTRACT: *The services and features of the Intelligent Network Capability Set 1 are briefly introduced. The service-feature relationship is analysed and simplified. This leads to the synthesis of a new multi-level relationship between services and features, allowing a more consistent construction of services from their components.*

KEYWORDS: Capability Set, Feature, Intelligent Network, Service, Telecommunications

1 INTRODUCTION

The Intelligent Network (IN) is being standardised by ITU-T in the Q.12xy series of recommendations. The major goal of the IN is flexible service provision. IN Services are relatively low-level since they derive fairly directly from network capabilities. ITU-T emphasise the *construction* of services, not a *user* view (which is properly the concern of service providers). A telecommunications service generally means some network function that can be separately subscribed to and charged for. This interpretation of service is thus more operational than technical. A service feature (called a feature here for brevity) is one of the parts of a service. However, this is a rather loose distinction since features can be services in their own right. Indeed the IN recommendations to some extent blur the distinction between services and features.

To allow for evolution of the IN, ITU-T are phasing in the definition of service features. These are Capability Sets (CS), of which CS-1 [1] has been available for several years and CS-2 [2] has recently been finalised. Logically it would seem that a Service Plane document Q.12x2 should define the services (capability set), but curiously it seems that this information is given in a Principles document Q.12x1.

Since a CS may be very rich in services, the approach taken in the Global Functional Plane is to define a number of Service-Independent Building Blocks (SIBs) that are meant to realise these. The intention is that these building blocks be independent of any particular service or

feature and be independent of any particular network implementation. Global Service Logic is intended to control the execution of SIBs by sequencing them to achieve the desired service. Although the approach is laudable, there are considerable difficulties with its present definition.

The (fourteen) SIBs that are currently defined are somewhat *ad hoc*. Their level of abstraction also varies widely. It seems to have been anticipated that current SIBs may be insufficient for defining some services. Indeed, there is no systematic method for decomposing a service into a collection of SIBs. It is not at all clear that the current SIBs are necessary or sufficient to support even CS-1. Only one example of service construction has been seen by the author, claiming to support Universal Personal Telecommunications using these SIBs.

It is not clear what SIBs really are. Their description is a hybrid of state machine and procedure. The so-called logical start point seems to serve no purpose (except in the sense of the start state of a state machine). The so-called logical end points seem to be more like procedure results than final states of a state machine.

The relationship between SIBs and the Service Plane description is unclear. In particular, the exact functions to tie SIBs together appear to be undefined. The relationship between the Global and Distributed Functional Planes is also uncertain. The Distributed Functional Plane adopts a completely different approach – the Basic Call State Model. There is no direct mapping between the models in the two planes.

Although object-oriented approaches to telecommunications are of considerable interest [4], the Global Functional Plane model is not obviously object-oriented. A more natural approach would be to collect the functions required for services as methods inside objects.

CS-1 describes a number of services in terms of features. This is a potentially interesting relationship because it suggests re-use of features to build services. The goal of the work reported here was to investigate this relationship, concentrating on CS-1. The main aims were: to look more deeply at the service-feature relationship; to check for consistency and completeness of this relationship; to show by an example a method for analysing the service-feature relationship in CS-*N*; and to discover whether multiple levels of features might exist (i.e. services built out of intermediate features built out of low-level features).

The author believes that a better understanding of the service-feature relationship will help to highlight potential interactions among them. A better service architecture would also smooth the transition from services to features to SIBs. In [5], the author proposes a rigorous, user-oriented method for constructing services and features out of more elementary building blocks. [4] is an interesting comparison that describes an approach to constructing the Universal Personal Telecommunications service using SIBs in an object-oriented manner. [3] describes a way of constructing services using high-level building blocks.

2 SERVICES AND FEATURES IN CS-1

CS-1 claims to include services and features only for the purposes of defining the Q.121y recommendations; in fact it is explicitly stated that they are not to be used for service creation. The utility of the services and features is therefore unclear. The services (S) and features (F) of CS-1 are shown in table 1 for reference. In some cases, a service and feature share the same name (SF). For brevity the discussions that follow use the abbreviations in this table.

CS-1 includes a table that relates services to features. Some features are considered to be core to a service, i.e. they are required to make commercial sense of the service. Other features are regarded as optional enhancements to a service. This relationship is reproduced in table 2,

Abbr.	Service/Feature	Abbr.	Service/Feature
AAB	Automatic Alternative Billing (S)	ABD	Abbreviated Dialling (SF)
ACB	Automatic Call-Back (F)	ACC	Automatic Card Calling (S)
ATT	Attendant (F)	AUTC	Authentication (F)
AUTZ	Authorization Code (F)	CCBS	Completion of Call to Busy Subscriber (S)
CCC	Credit Card Calling (S)	CD	Call Distribution (SF)
CF	Call Forwarding (SF)	CFC	Call Forwarding on Busy Line/Don't Answer (F)
CHA	Call Hold with Announcement (F)	COC	Consultation Calling (F)
CON	Conference Calling (S)	CPM	Customer Profile Management (F)
CRA	Customized Recorded Announcement (F)	CRD	Call Rerouting Distribution (S)
CRG	Customized Ringing (F)	CUG	Closed User Group (F)
CW	Call Waiting (F)	DCR	Distribution Call Routing (S)
DUP	Destination User Prompter (F)	FMD	Follow-Me Diversion (SF)
FPH	Freephone (S)	GAP	Call Gapping (F)
LIM	Call Limiter (F)	LOG	Call Logging (F)
MAS	Mass Calling (SF)	MCI	Malicious Call Identification (S)
MMC	Meet-Me Conference (F)	MWC	Multi-Way Calling (F)
OCS	Originating Call Screening (SF)	ODR	Origin-Dependent Routing (F)
OFA	Off-Net Access (F)	ONC	Off-Net Calling (F)
ONE	One Number (F)	OUP	Originating User Prompter (F)
PN	Personal Numbering (F)	PNP	Private Numbering Plan (F)
PRM	Premium Rate (S)	PRMC	Premium Charging (F)
QUE	Call Queueing (F)	REVC	Reverse Charging (F)
SCF	Selective Call Forward on Busy/Don't Answer (S)	SEC	Security Screening (S)
SPL	Split Charging (S)	SPLC	Split Charging (F)
TCS	Terminating Call Screening (SF)	TDR	Time-Dependent Routing (F)
TRA	Call Transfer (F)	UAN	Universal Access Number (S)
UDR	User-Defined Routing (S)	UPT	Universal Personal Telecommunications (S)
VOT	Televoting (S)	VPN	Virtual Private Network (S)

Table 1. *CS-1 Services and Features*

listing core and optional features directly rather than relating services to features using a matrix as in CS-1.

3 ANALYSIS OF CS-1 SERVICE-FEATURE MAPPING

At first sight the mapping of services to features in CS-1 seems to reflect a deep relationship. However, a number of simplifications can be made to the mapping expressed in table 2.

The description of services and features in CS-1 is somewhat vague. In a number of cases alternative descriptions are given, but with a warning that these alternatives may not be consistent. Some services and features are named and described differently but seem to be rather similar. The description of services and features is at a broad functional level. The user perspective is not really described, and certainly not the user actions to invoke a service.

The table in CS-1 that relates services to features appears to be a functional decomposition. However, there is no evidence of the adequacy or appropriateness of this decomposition. There is no description of how features might actually be used as part of a service. In some cases, a feature is used for only one service. Similarly, a number of services are defined using a virtually matching feature. Such relationships could more usefully be shown in a separate table.

In some cases, the use of Destination User Prompter seems unlikely – specifically for Abbreviated Dialling, Freephone, Premium Rate and Universal Personal Telecommunications. In fact, Originating User Prompter would appear more appropriate than Destination User Prompter, so the latter has been removed from these services in what follows.

The Call Logging feature is an option for every service. This is hardly surprising, since virtually any service might require call logging. The Call Logging relationship is therefore uninteresting and has been removed from the table. Similarly the Customer Profile Management feature is an option for nearly every service. It is not hard to imagine a need for customers to manage their profiles for any service. The Customer Profile Management relationship is therefore uninteresting and has also been removed from the table.

The Mass Calling and Televoting services have identical combinations of features. This is to be expected as Televoting seems to be a special case of Mass Calling, so these should be combined in the table.

Freephone appears to be a special case of Universal Access Number; indeed the description of the latter includes Freephone as one of its possible uses. Although Freephone may optionally use Authentication, Mass Calling and Originating User Prompter, these are not mentioned for Universal Access Number. It would seem reasonable to allow the extra options of Freephone for Universal Access Number as well, enabling the two services to be grouped.

Automatic Card Calling and Credit Card Calling might be regarded as specialisations of a service that allows access via an account card. Their descriptions in CS-1 seem to differ arbitrarily. The key question is which account is debited (presumably with the telecommunications operator or credit card company as appropriate). Abbreviated Dialling is core for Automatic Card Calling but is an option for Credit Card Calling. It is not clear why Abbreviated Dialling should be core, nor even why it should be associated with either service. It would appear reasonable to combine Automatic Card Calling and Credit Card Calling, making Abbreviated Dialling optional. Automatic Alternative Billing resembles Automatic Card Calling and Credit Card Calling, the main differences being the account administrator and the means of entering the account code. The three services should thus be combined.

Malicious Call Identification is defined as using Originating Call Screening. In fact the CS-1

Service	Core Features	Optional Features
AAB	AUTZ, OUP	ABD, LOG
ABD	ABD	CPM, DUP, LOG
ACC	ABD, AUTZ, OUP	LOG
CCBS	ACB	CW, LOG
CCC	AUTZ, OUP	ABD, LOG
CD	CD, ONE	CPM, LOG, ODR, TDR
CF	CF	CPM, LOG
CON	MWC	COC, CPM, LOG, MMC
CRD	ONE	CFC, CPM, CRA, LIM, LOG, QUE
DCR	CD	CPM, LOG, ODR, TDR
FMD	FMD	CPM, LOG
FPH	ONE, REVC	AUTC, CD, CFC, CPM, CRA, CRG, DUP, GAP, LIM, LOG, MAS, OCS, ODR, OUP, QUE, TDR
MAS	MAS	CD, CPM, CRA, GAP, LIM, LOG, OCS, ODR, OUP, QUE, TDR
MCI	LOG, OCS	
OCS	OCS	CPM, LOG
PRM	ONE, PRMC	CD, CFC, CPM, CRA, CRG, DUP, GAP, LIM, LOG, OCS, ODR, QUE, TDR
SCF	CFC	CPM, LOG
SEC	AUTC	CPM, LOG
SPL	ONE	CD, CFC, CPM, CRA, CRG, DUP, GAP, LIM, LOG, OCS, ODR, QUE
TCS	TCS	CPM, LOG
UAN	ONE	CD, CFC, CPM, CRA, CRG, GAP, LIM, LOG, OCS, ODR, QUE, TDR
UDR		CPM, LOG, ODR, TDR
UPT	AUTZ, FMD, PN, SPLC	CPM, CRA, DUP, LOG, OUP, TDR
VOT	MAS	CD, CPM, CRA, GAP, LIM, LOG, OCS, ODR, OUP, QUE, TDR
VPN	PNP	ABD, ATT, AUTC, AUTZ, CD, CHA, COC, CPM, CRA, CRG, CUG, FMD, GAP, LIM, LOG, OFA, ONC, OUP, QUE, TDR, TRA

Table 2. *CS-1 Service to Feature Mapping*

description of Originating Call Screening is unsatisfactory and is more like Terminating Call Screening. Since Malicious Call Identification will almost certainly wish to block incoming calls from certain areas or numbers, it seems likely that it should use Terminating Call Screening instead.

User-Defined Routing is an unusual case because it has no core feature; it may be Origin-Dependent Routing or Time-Dependent Routing without an obvious preference.

The foregoing analysis results in a simplified relationship between services and features. It is now possible to use this to synthesise a richer mapping between services and features.

4 SYNTHESIS OF CS-1 SERVICE-FEATURE MAPPING

CS-1 has a single level of decomposition from services into features. In a number of cases a multi-level decomposition might have been followed, allowing intermediate features. This also hints at an object-oriented style with inheritance or aggregation, and so is desirable in its own right. This and other simplifications are used in the following synthesis of a new CS-1 service-feature mapping.

Automatic Alternative Billing, Automatic Card Calling and Credit Card Calling have already been combined; a new Charge to Account (CTA) service is introduced as the basis of all three. Mass Calling and Televoting have also already been combined; a new Mass Public Call (MPC) service is introduced as the basis of both.

Call Distribution, Call Rerouting Distribution and Distribution Call Routing seem to be rather similar services, but are described and built from features in different ways. Selective Call Forward on Busy is also similar. It is not clear why One Number is a core feature for Call Distribution and Call Rerouting Distribution; these services appear to be independent of this requirement, though it may be a common combination. It would have been sensible to define one common service for call rerouting. The criteria for rerouting would be a combination of those defined for Call Distribution, Call Rerouting Distribution, Distribution Call Routing and Selective Call Forward on Busy. A new Call Rerouting (CRR) service is introduced as the basis of all four, building on the existing features.

Split Charging seems to be a generalisation of Freephone in that only a defined portion of the call is free to the caller. Unlike Split Charging, Freephone includes Authentication, Mass Calling, Originating User Prompter, Call Queueing and Time-Dependent Routing. It could be argued that these features (with the possible exception of Mass Calling) should apply equally to Split Charging and Freephone; they have been included in the analysis here. Premium Rate also resembles Split Charging and Freephone, the difference being who pays for the call. Freephone allows for Authentication, Mass Calling, Originating User Prompter and Call Queueing. Authentication would presumably be a possibility for Premium Rate. It is conceivable that Mass Calling, Originating User Prompter and Call Queueing could be applicable, so this has been assumed.

The discussion of Freephone, Premium Rate, Split Charging and Universal Access Number has mentioned the similarities among them as well as some apparently unnecessary differences. It might have been possible to see these as specialisations of a generalised access mechanism, but this would require the charging algorithm to be unreasonably flexible. The four services might have shared a composite feature with One Number as core and Authentication, Call Distribution, Call Forwarding on Busy Line, Customized Recorded Announcement, Customized Ringing, Call Gapping, Call Limiter, Mass Calling, Originating Call Screening, Origin-Dependent Routing,

Originating User Prompter, Call Queueing and Time-Dependent Routing as options. According to CS-1, Split Charging includes Destination User Prompter as an option (perhaps to request the called party to accept the charge), and Premium Rate includes Premium Rate Charging as core. For a more general approach, a new Common Public Call (CPC) feature is introduced as an intermediary.

Common Public Call, Mass Public Call and Virtual Private Network share a group of features concerned with how calls are (re)routed. It seems sensible to identify a further level of commonality. It is thus appropriate to introduce a new Call Routing Criteria (CRC) feature that offers Call Distribution, Customized Recorded Announcement, Call Gapping, Call Limiter, Originating User Prompter, Call Queueing and Time-Dependent Routing.

These ideas have been used to restructure the interesting aspects of the CS-1 service-feature mapping. The end result is shown in figure 1. What this figure shows is the dependencies among services and features (decomposition, inheritance, specialisation, aggregation). The highest nodes in each branch are all services defined by CS-1. The lowest nodes in each branch are all features defined by CS-1. The intermediate nodes are the new features introduced during the synthesis in this section. Solid lines in the figures show core relationships, dashed lines show options.

5 EVALUATION

Having re-worked the service-feature mapping for CS-1, it is worthwhile reviewing what has been achieved. The analysis helped to discover mappings that were essentially uninteresting because they applied in (nearly) all cases or because the feature virtually equated to the service. The analysis also found services that were almost the same, were special cases of others, or shared a strong common basis. Finally, inconsistencies were found where services included features that seemed unlikely to be appropriate, or omitted features that seemed likely to be relevant. Such inconsistencies particularly stood out when comparing similar services. Some straightforward technical or editorial errors were also discovered.

The investigation showed that there were indeed possibilities for combining groups of features into intermediate features that were common to higher-level services. This introduced a multi-level structure into the mapping. The main reason for defining this was to identify commonalities. A further reason was to allow for some measure of inheritance or aggregation in the service-feature mapping.

However, one of the problems in creating a hierarchy is knowing what to group. It would certainly have been possible to create further intermediate features and levels in figure 1. Thus the service designer must exercise judgment. An intermediate group of features should make some kind of sense in itself, and not be merely a convenient artifact. A possible criterion is that such a grouping could serve as a service in future; intermediate features should thus perhaps be considered as intermediate services instead.

The results, in the form of figure 1, are at the same level of abstraction as CS-1. The figure shows only some high-level relationships among services and features. The definitions of services and features are only those of CS-1, so there is still imprecision in what these are. The nature of service composition from features is still undefined. The services and features are still somewhat arbitrary and lacking in user-oriented detail. To make them more concrete and meaningful, it would be necessary to consider the specific services offered by a particular provider. The author's work in [5] tries to solve some of these problems.

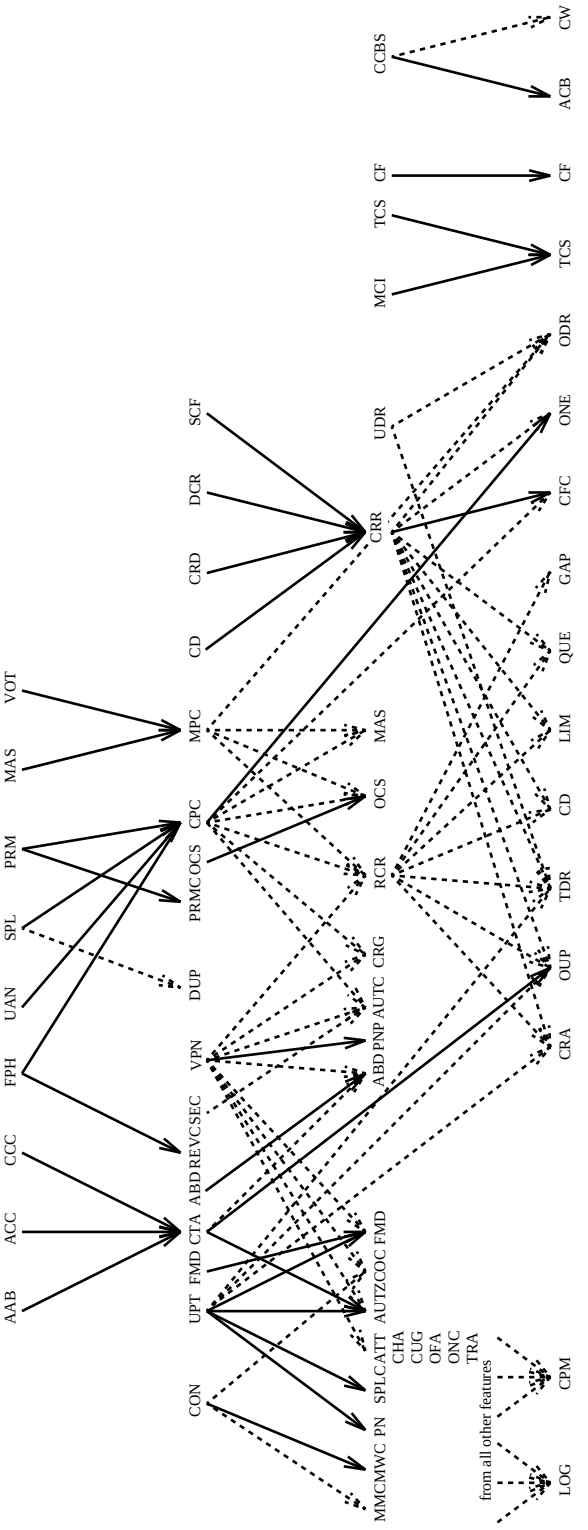

Figure 1. *Replacement CS-1 Service to Feature Mappings*

6 CONCLUSIONS

Although the goal of this work has been to structure services in terms of features, it appears in practice that services are conceived (and even implemented) largely in isolation. The IN approach does not appear to have had a strong influence on service provision. This is unfortunate since, as figure 1 shows, there is real opportunity to have re-usable service components.

The paper has concentrated on the service-feature relationship, but it is hoped that the approach can be extended to the feature-SIB relationship. In other words, it ought to be possible to establish a consistent evolution from services via features to SIBs as service components. Services and features would simply be higher level groupings of these components. A single composition mechanism might apply at all levels. This would clarify the nature of the service-feature and feature-SIB relationship.

The work has focused on CS-1 since CS-2 has only recently been stabilised. However the same conclusions apply to CS-2 since this is just an extension of CS-1, mainly to introduce multi-operator services. Interestingly it appears that the service-feature table in CS-1 did not find favour with the CS-2 developers. Hopefully the work reported in this paper suggests an effective way forward for structuring IN services.

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