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Performance analysis of a prototypal multimedia service in an intelligent broadband network

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Abstract

Advanced multimedia multiparty services call for sophisticated signalling systems able to manage multiple parties and media in broadband environments. In this paper we dealt with the support of multimedia applications in an Intelligent Broadband Network (IBN), where the Intelligent Network, in a closed interaction with the B-ISDN, furnishes control functionality to handle complex service configuration.

Some different options for an IN/B-ISDN interaction are discussed starting from the results of the INSIGNIA project (carried out in the framework of the European Union ACTS program) where a prototypal IBN system has been specified and developed in a field trial.

Two main architectural solutions are discussed and a generic modelling methodology for the performance analysis of the control plane is presented. The objective of this modelling methodology is to provide insights into the behaviour of the system under dynamic conditions and to capture the influence of alternative functional settings. The proposed model is applied to the evaluation of the support of the Broadband Video Conference service in the prototypal system as well as to compare the performance of alternative architectural solutions for the IBN.

Keywords: B-ISDN signalling; Multimedia services; Intelligent networks; Performance evaluation

1. Introduction

The provision of advanced multimedia and multiparty services represents a very attractive goal for the telecommunication industry. These sophisticated services require a wide range of capabilities both in the transport and in the control plane of the network.

In this paper we dealt with the integration of the Intelligent Network (IN) paradigm with the B-ISDN as a possible solution for the support multimedia–multiparty services. The proposed approach, indicated as Intelligent Broadband Network (IBN), has been investigated in the framework of the European ACTS project named INSIGNIA [1,2] (*IN and B-ISDN Signalling Integration on AMT platforms*) where a complete architectural solution has been defined, implemented and validated in field trials over a PAN-European ATM network.

In the IBN system the Asynchronous Transfer Mode fulfils the customer requirements at the broadband transport level while the Intelligent Network provide a powerful signalling system able to control and co-ordinate the multiplicity of B-ISDN calls required to build the whole service configurations. The INSIGNIA architectural model is based on the concept of "Session" and it allows the IN to manage multiple parties and bearer connections and to realise sophisticated Service Logics for the deployment of broadband multimedia applications.

The advantage of the proposed approach resides mainly in the flexible service creation environment offered by the IN and in the opportunity to introduce, in a very short term and with a high degree of transparency with respect to the underlying signalling platform, new telecommunication services. This flexibility allows network operators to upgrade their systems easily and in a cost-effective manner by taking advantage of the ability to allocate, without restrictions, control functionality and resources within the network.

In this paper we describe the support of the Broadband Video Conference (B-VC) service in an IBN system and we present two different functionality settings that allow the handling of a fully meshed interconnection among multiple parties for the exchange of audio and video flows [2–4]. The first setting refers to the architecture defined in the INSIGNIA project while the second one enhances such architecture by introducing the capability to realise multi-sessions services.

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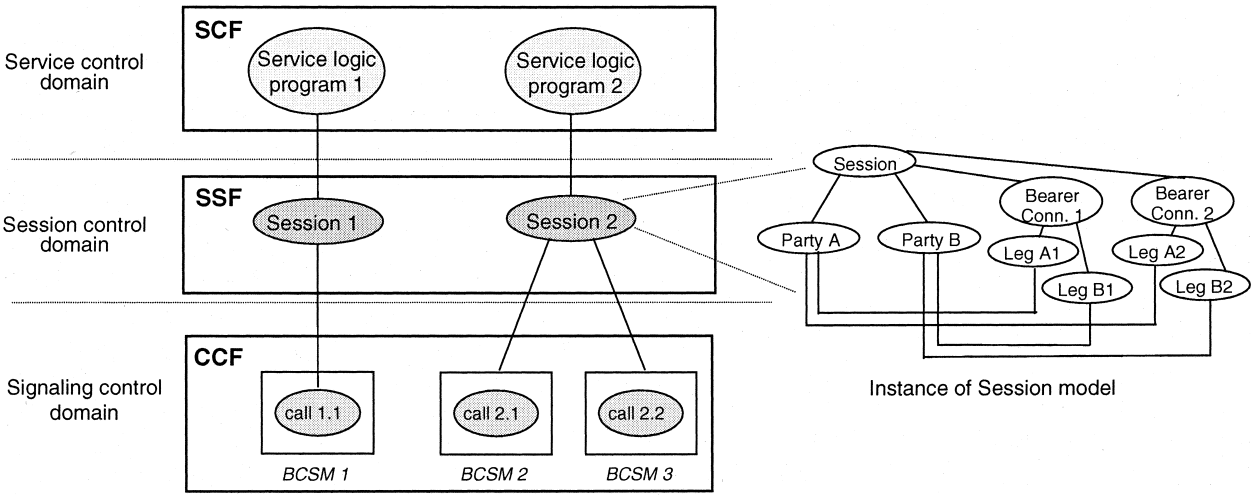

Fig. 1. Control domains in the intelligent broadband network and session modelling.

In the IN/B-ISDN environment, services, like the B-VC one, are described by a set of distinctive characteristics that are implemented by different functional entities distributed in various network elements. Therefore the functional entities of network elements serve more than one service and one service is served by more than one functional entity. As a consequence a suitable realisation of the IN functionality into different architectural settings becomes a dominant factor to allow the most efficient operation of the system itself.

We propose here an analytical and simulative modelling tool that allows to:

- evaluate the system performance in a wide set of conditions;
- dimension the system parameters so as to achieve a suitable load balancing that, by avoiding bottlenecks, improves the overall efficiency and the user perceived performance;
- highlight the key performance pros and cons of different architectural alternatives.

The performance evaluation is focused on the derivation of design guidelines to engineer the "intelligent level" of the network to reach efficient resource utilisation and to guarantee the quality of service parameters required by the users [5–7].

The proposed model captures the main aspects related to the complexity of the service realisation by exploiting signalling interactions at both the IN and B-ISDN level. The overall performance methodology is applied to the evaluation of the prototypal signalling system developed in the context of the INSIGNIA project by showing the impact on that system of the proposed architectural alternatives.

One of the main results of the analysis is the processing times dimensioning so as to achieve uniform resource utilisation of the system functional entities. Moreover, the analysis of the selected performance metrics allows a comparison among alternative architectures by highlighting the system bottlenecks and the most critical performance parameters such as the delay encountered in each functional entity and the overall service set-up and tear down delay perceived by end-users.

The organisation of this paper is the following: Section 2 gives a brief overview of the IBN concept as defined in the INSIGNIA project. In Section 3 we present two architectural solutions for the IN/B-ISDN integration. In Section 4 we describe how to deliver a Video Conference service in an IBN system and the relevant Information Flows among network functional entities. The model for the performance evaluation of the IBN system is introduced in Section 5 and applied to the performance analysis of the prototypal system (Sections 6.1 and 6.2) and to the comparison of alternative architectural solutions (Section 6.3). Section 7 derives the conclusions and indicates guidelines for the design of an Intelligent Broadband Network.

2. The IBN functional model

The fundamental innovation introduced in the framework of the INSIGNIA project for the design of an IBN architecture lies in the fact that different basic B-ISDN calls/connections are co-ordinated in the IN domain to provide the required user plane configuration [2].

As a result, the functional architecture is structured in three control domains [2]. Following a bottom–up description: (i) the *Signalling control domain* where the B-ISDN functionality to control each single call are realised; (ii) the *Session control domain*, where the association of different B-ISDN calls for the realisation of a single IN service is handled; (iii) the *Service control domain*, where the IN Service Logic is performed.