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SERIES Q: SWITCHING AND SIGNALLING

Signalling requirements and protocols for IMT-2000

Long-term vision of network aspects for systems beyond IMT-2000

ITU-T Recommendation Q.1702

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ITU-T Recommendation Q.1702

Long-term vision of network aspects for systems beyond IMT-2000

Summary

This Recommendation addresses the envisaged network environment, network design objectives, and architecture concepts of Systems Beyond IMT-2000. This Recommendation, together with a draft ITU-R Recommendation which covers the radio aspects, form the ITU long-term vision for Systems Beyond IMT-2000.

Source

ITU-T Recommendation Q.1702 was prepared by ITU-T SSG (2001-2004) and approved under the WTSA Resolution 1 procedure on 29 June 2002.

Keywords

Long-Term Vision, Network Aspects, Systems Beyond IMT-2000

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Introduction

The ITU-T and ITU-R have collaborated to develop a single ITU vision of Systems Beyond IMT-2000 targeted for initial deployment around the year 2010, subject to market considerations. This common ITU Vision is the nucleus and foundation for the development of related Recommendations in both the Telecommunication Standardization Sector and the Radiocommunication Sector. This relationship is responsive to ITU-T Resolution 38 and ITU-R Resolution 50 which require the development of roadmaps on IMT-2000 in an independent, but well-coordinated manner.

There is a definite trend towards integration of access networks (e.g., cellular, wireless local area network, personal area wireless network, satellite systems, and Internet.) Based on this trend, it is envisioned that the network environment of Systems Beyond IMT-2000 will consist of packet-based network infrastructure offering a plethora of converged services.

ITU-T Recommendation Q.1702

Long-term vision of network aspects for systems beyond IMT-2000

1 Scope

The scope of this Recommendation is to provide a long-term vision (around the year 2010) for the network aspects of Systems Beyond IMT-2000. The further development of existing IMT-2000 systems is not addressed by this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation X.233 (1997) *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification*.

[2] ITU-T Recommendation I.113 (1997) *Vocabulary of terms for broadband aspects of ISDN*.

[3] ITU-T Recommendation H.323 (2000) *Packet-based multimedia communications systems*.

[4] ITU-R Recommendation M.687-2 (1997) *International Mobile Telecommunications-2000 (IMT-2000)*.

[5] ITU-R Recommendation M.1311 (1997) *Framework for modularity and radio commonality within IMT-2000*.

3 Definitions

This Recommendation defines the following terms:

3.1 converged services: The integration of Internet, multimedia, e-mail, presence, instant messaging, m-commerce, etc., services with voice service.

3.2 mobility: The ability to provide services irrespective of changes that may occur by user/terminal's activities.

3.3 multicast: Data transmission to one or more destinations in a selected group in a single service invocation. [1]

3.4 multimedia: The combination of multiple forms of media such as audio, video, text, graphics, fax, and telephony in the communication of information.

3.5 multimedia service: A service in which the interchanged information consists of more than one type, such as text, graphics, sound, image and video. [2]

3.6 seamless service: Seamless Service will prevent users from experiencing any service disruptions while maintaining mobility or portability.

3.7 session continuity: The ability of the user to maintain continuity of ongoing sessions while changing between terminal devices and across various access and core networks. For example, the user of a mobile terminal may wish to switch from his mobile equipment attached to a wireless network to a laptop connected to a wire-line or Digital Subscriber Line connection. This should be

supported without any session discontinuity.

3.8 **unicast**: A process of transmitting messages from one source to one destination. [3]

3.9 **virtual reality services**: The ability for users to access the sights and sounds of remotely located complex systems in real-time.

4 Abbreviations

Thsi Recomendation uses the following abbreviations:

API	Application Programming Interface
ASP	Application Service Provider
IMT	International Mobile Telecommunications
IP	Internet Protocol
Mbps	Mega bits per second
OAM&P	Operations, Administration, Maintenance and Provisioning
PAN	Personal Access Network
QoS	Quality of Service
WLAN	Wireless Local Area Network

5 Envisaged network environment around the year 2010

The following network environment around the year 2010 is envisaged to facilitate the identification of future needs of users, service capabilities, and network capabilities at that time.

5.1 Market trends

- High-speed data connection is a norm in accessing multimedia services and Internet services, even in the wireless environment, due to additional spectrum, efficient spectrum utilization, and advanced radio technologies. Because of these advancements, "Virtual Reality Services" becomes widely available.
- The core network is fully Internet Protocol (IP)-based and service provisioning is distributed around the core network. Wireless access is just one of the access methods to the IP-based core network, services, and applications.
- There exist many complementary wireless networks for voice and data applications in addition to International Mobile Telecommunications-2000 (IMT-2000) terrestrial and satellite-based systems. Some examples are Bluetooth and Wireless Local Area Network (WLAN). A limited integration among these wireless networks and IMT-2000 systems exists.
- Digital TV with data service capability is ubiquitous.
- The number of users around the year 2010 could grow to more than 1700 million wireless subscribers with a great number of them having several different terminals for communications. A majority of the user populations is computer proficient and quick to adopt of advanced technologies to enhance quality of life and productivity.
- There exist Application Service Providers (ASPs) utilizing mobile networks as a means to offer unique services taking advantage of mobile terminal capabilities and location information.
- Large numbers of users move internationally wanting to use their services anytime anywhere with their personal terminals.

- Services are the driver: the role of technology is to enable provision of services (and capacities) that the users are willing to pay for.

5.2 Technology trends

- Software-defined radio technology has become a main element in the wireless infrastructure and handset implementations. Because of this technology, new and advanced radio technologies are easily introduced and deployed by the Network operators and Service providers to differentiate their services.
- Mobile terminals may form a closed network, or an *ad hoc* network, which enables direct communications between them. Transmission speed could be independent between an uplink and a downlink. Systems Beyond IMT-2000 are expected to act as platforms to effectively deliver traffic within and between the *ad hoc* networks and to offer additional values to them, such as advanced mobility management techniques.
- Mobility management will be more than supporting higher speed objects such as vehicles. It will be needed to support applications with very large IP multimedia traffic needs, and with diversified communications including person-to-person, machine-to-machine, machine-to-person and vice versa.
- The concept of seamless services will be extended beyond handover and roaming services.
- Diverse end-users' individual needs will require flexibility to deal with their preferences or contexts.
- The following network security environment around the year 2010 is envisaged:
  - Highly efficient security mechanisms are available in a multimedia environment to process high-speed and high volume information flows.
  - There exist user transparent access authentication and authorization mechanisms to provide protection in different access environments.
  - The security infrastructure is supported across service providers.
  - The capacity of security servers is scaled to provide service for massive network usage.
  - Seamless security is available to maintain the same security strength with unreduced performance in handover procedures.

6 Key long-term network design objectives

The set of network capabilities existing for current IMT-2000 Family Member Systems should be included for Systems Beyond IMT-2000, as needed. The key long-term network design objectives for Systems Beyond IMT-2000 are listed in the following subclauses.

6.1 Broadband and multiple bearer service capability

- Access is based on advanced radio access technologies that can enable transmission speeds well beyond the current IMT-2000 radio access target speeds of 2 Mega bits per second (Mbps).
- Access support includes the ability to handle the diverse Quality of Service (QoS) needs of future applications, including considerations for:
  - non-real-time / best effort service,
  - quasi-real-time (such as streaming) service, and
  - real-time service (such as voice and video telephony)
- Cooperation with broadcast networks (hybrid networks) is included to open up new applications (e.g., navigation, traffic information, interactive multimedia services.)

6.2 Service expandability and application service support

- Encourages appearances of diversified ASPs by supporting their services and offering additional values to them.
- Provides multiple service combination capabilities with appropriate mechanisms to handle service interaction and service invocation.
  - Traditional telecommunications service invoking methods are mostly based on service Application Programming Interface (API) and its capabilities. In service provisioning components, the objective is changed to provide flexible service provisioning based on trigger objects, which will enable automatic interaction and invoking of a series of service logic instances that might be fully distributed in different elements.
  - Service interactions will support variable exchange of information element types.
  - Service combinations may be created dynamically, based on a user's profile/situation selections that best fit the user's present usage environment. Users can also build a situation profile in a real-time fashion.
  - The service combination capability should support backward compatibility with existing service platforms.
- Supports modularized service control and open service architecture.
- Simplifies service expansion and dynamic creation of multi-facet services at session level.
- Supports flexibility for adoption of new services.
- Provides seamless service capabilities across networks.

6.3 Security support

Provides seamless security protection in Systems Beyond IMT-2000 networks.

6.4 User platform support

- Mobile users may form a closed *ad hoc* network and communicate directly with each other within that *ad hoc* network. In addition, these users may also wish to communicate normally for conventional communication. Such access requirements must be supported.
- A group of users may move collectively with respect to a core network (e.g., users in a train, aeroplane, ship, etc.) Such a group may be open or closed. Systems beyond IMT-2000 should accommodate the access requirements of such users. [4]
- User platforms should provide a natural communication-oriented man-machine interface.

6.5 High performance and system efficiency

- Efficient handling of very large IP multimedia traffic with various predefined service parameters.
- Support of a wide range of traffic ratios within the network, including unicast, multicast, broadcast and bursty traffic.
- Distributing service provisioning according to provider's resource control policy.

6.6 System flexibility

- Support Moving Networks:
  - A Moving Network is a network that can move in the same manner as a terminal in mobile systems. For example, a Moving Network could be in a train, ship or aeroplane, etc.
- Accommodate diverse access technologies/schemes.

- A key long-term network design objective for Systems Beyond IMT-2000 should be its flexibility to accommodate diverse access technologies/schemes.
- Future mobile devices are expected to support numerous access technologies (including a variety of wireless and/or wire-line choices.) A key network design goal should be to facilitate a judicious choice of appropriate access technology for a particular usage environment. The choice should be based on:
  a) availability of access technologies at the mobile user location,
  b) speed and QoS requirements of the user application,
  c) cost of using the access technology, etc.

• Separate control and transport functions.
- Control functions in the IP-based network platform should be open to support various existing and future evolution signalling systems, and its function will be more focused on signalling processing.
- Transport functions should fully utilize IP transport capability to direct user traffic flows to their proper destinations.
- The interface between control and transport functions should be open and standardized.
- When the control and transport functions are implemented in the same physical equipment, the interface(s) between them still should be opened.

• Facilitate support of multiple switching control methods, signalling at different layers and their combinations.
- Switching components in the IP-based network platform may provide multiple switching control methods, and may also provide interoperation among these methods.
- Switching control methods may be implemented according to their service support requirements, and thus, may be functioning at different internetworking layers.
- The usage of IP transport for various switching control signalling should be used according to service requirements.

• Support open interface for roaming and handover among various networks.

• Automatically manage the access means (including both wired access and wireless access) based on user defined criteria such as cost, speed, QoS, privacy, applications, etc.

• Have flexible, efficient, and integrated mobility management, i.e., flexibility to support advanced mobility management schemes including:
- Location Management:
  - Location Registration;
  - Paging.
- Routing Management:
  - Handover.
- Session Continuity:
  - Seamless Session Transfer;
  - Diversity Handover across access and core networks;
  - Having a flexible, efficient, and integrated mobility management, i.e., flexibility to support advanced mobility management.
- Support an efficient and adaptive combination of location registration and IP paging functions.
- Support dynamic network capacity changes.

6.7 System scalability

Systems Beyond IMT-2000 are expected to handle very large amounts of multimedia traffic to/from a large number of mobile users. The multimedia applications run by the mobile users will have diverse traffic and performance/QoS requirements. Advanced mobility management techniques are needed to handle the QoS requirements (e.g., satisfying QoS requirements of a mobile application during a sequence of handovers.) The system must also take into consideration all the access technology choices the user may have in a particular network environment. Advanced mobility management schemes are needed to handle multicast and broadcast requirements of geographically dispersed mobile multimedia users.

6.8 System interoperability

- Support global standards, e.g., standardized interfaces between networks.
- Effective and user-friendly Operations, Administration, Maintenance and Provisioning (OAM&P) facilities.
- Interoperability with existing third generation mobile networks. Interoperability in this case means the availability of well-defined gateway points and functions between both networks.
- Integration/inter-operation with alternative networks, e.g., a Personal Access Network (PAN), a WLAN.

6.9 System robustness

Provide network security among heterogeneous inter-connected networks. The security objectives shall include the following aspects:

- Comprehensive and cross-provider security infrastructure support.
- Well-defined and conducted routine system risk analysis.
- Robust system intrusion monitoring and response system to control damage.
- Low overhead security protocols to accommodate wireless bandwidth limitation.
- Provide seamless security across heterogeneous access technologies.

7 Long-term network architecture concepts

The network part of Systems Beyond IMT-2000 will be flexible, versatile and new services will be easy-to-deploy. Systems Beyond IMT-2000 are likely to be realized according to the following general principles:

- Network architecture based on IP technology;
- Modular construction using expandable components; and
- Open interfaces between various systems.

An IP-based network concept is likely to be used for future development and standardization efforts.

The high-level architecture of Systems Beyond IMT-2000 may be envisaged to include user platform, IP-based network platform, and service provisioning platform. The IP-based network platform includes two types of components: access network components and core network components.

The user platform allows a user to gain access to services in conjunction with the access and core networks. User platform can be subdivided into a number of components.

Access network components are access technology dependent. They include multiple wireless and wire-line access technologies. Core network components are access technology independent. They

include functional components such as control functions and transport functions.

It is anticipated that radio access components of Systems Beyond IMT-2000 can dynamically support various radio transmission requirements. In addition to these radio access components, other access components to provide interconnection with other fixed networks are also needed in the IP-based network platform. [5]

Core network components will provide control functions and transport functions.

It is envisaged that a service provisioning mechanism that can dynamically provide user-defined combined multiple media services at a session level is needed. The service provisioning platform supports such a multiple service combination capability.

Service provisioning mechanisms in Systems Beyond IMT-2000 are envisaged to become more flexible in a multi-stage distributed manner. Such a distributed service provisioning platform is expected to help explore the network service potential of Systems Beyond IMT-2000.

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