

## (5) Trends in Standardization and Harmonization of IP-based Networks Technical Studies

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*This article reviews the standardization and the harmonization of technical studies on the architecture and various technologies for the migration of mobile communication networks towards IP-based networks as reported in this Special Article, the prospective trends in future studies and the matters presumed to be addressed with reference to the overview and state of relevant organizations.*

### 1. Introduction

In 1993, studies and standardization efforts on network technologies for 3rd Generation (3G) mobile communications referred to as International Mobile Telecommunications-2000 (IMT-2000) were initiated on a full scale [1]. In 2001, the world's first commercial service based on the 3G system was launched, called Freedom Of Mobile multimedia Access (FOMA) [2]. Network Laboratories proposes the IP-based IMT network Platform (IP<sup>2</sup>) as the subject of research on future networks succeeding to studies on 3G systems [3], and primarily studies the future networks configuration, the configuration technologies in various future networks in terms of core competence, and matters that have been reported in this special article so far in regard to their systemization.

Considering that they will actually be harnessed in networks in the future—including the interconnection of networks, international roaming and multi-vendors—and studies on individual elemental technologies will be systemized, NTT DoCoMo should heed the international standardization of technologies subject to research and development and additions/modifications to existing technologies.

In this article, Chapter 2 summarizes the trends, correlation and positioning of various standardization bodies and organizations concerned with the future progress of the technologies

standardization relating to the system architecture reported in this special article on the network front, with reference to the Association of Radio Industries and Businesses (ARIB), the Telecommunications Technology Committee (TTC), the International Telecommunication Union-Telecommunication standardization sector (ITU-T), the 3rd Generation Partnership Project (3GPP), and the Internet Engineering Task Force (IETF). Also, in regard to the trends in the harmonization of technical studies, Chapter 3 discusses the international harmonization trends led by the Wireless World Research Forum (WWRF) and Wireless World Initiative (WWI). Chapter 4 describes the matters anticipated to be addressed (contribution to and harmonization of standardization activities), and Chapter 5 summarizes the prospective trends in future studies.

### 2. Study Trends, Correlation and Positioning of Relevant Organizations

**Figure 1** shows the history of standardization up to 3G and the projected standardization roadmap in the future. **Figure 2** shows the correlation with standardization bodies and organizations relating to IP<sup>2</sup>, and the currently contributing entity within NTT DoCoMo.

IMT-2000 stems from the studies of the Future Public Land Mobile Telecommunication System (FPLMTS) in ITU. Currently, the recommendations referred to in **Table 1** including Q.1711 (functional model) are recognized as the recommendations in force, or the pre-published recommendations in ITU-T.

Discussions on the direction beyond IMT-2000 are also making progress. Q.1702 (Table 1), which had been discussed as Preliminary Draft New Recommendations (PDNRs), was adopted as an ITU-T recommendation, and the Vision framework and overall objectives of the future development of IMT-2000 and of systems beyond IMT-2000 was completed at the Working Party 8F (WP8F) of the International Telecommunication Union-Radio communication sector (ITU-R) and submitted as a draft recommendation to Study Group 8 (SG8). These recommendations (draft recommendations) of ITU will serve as guidelines for the directions of future studies and high-level requirements of standardization bodies and organizations.

The following is a summary of the correlation, study trends and positioning of standardization bodies and organizations based on Figure 2.

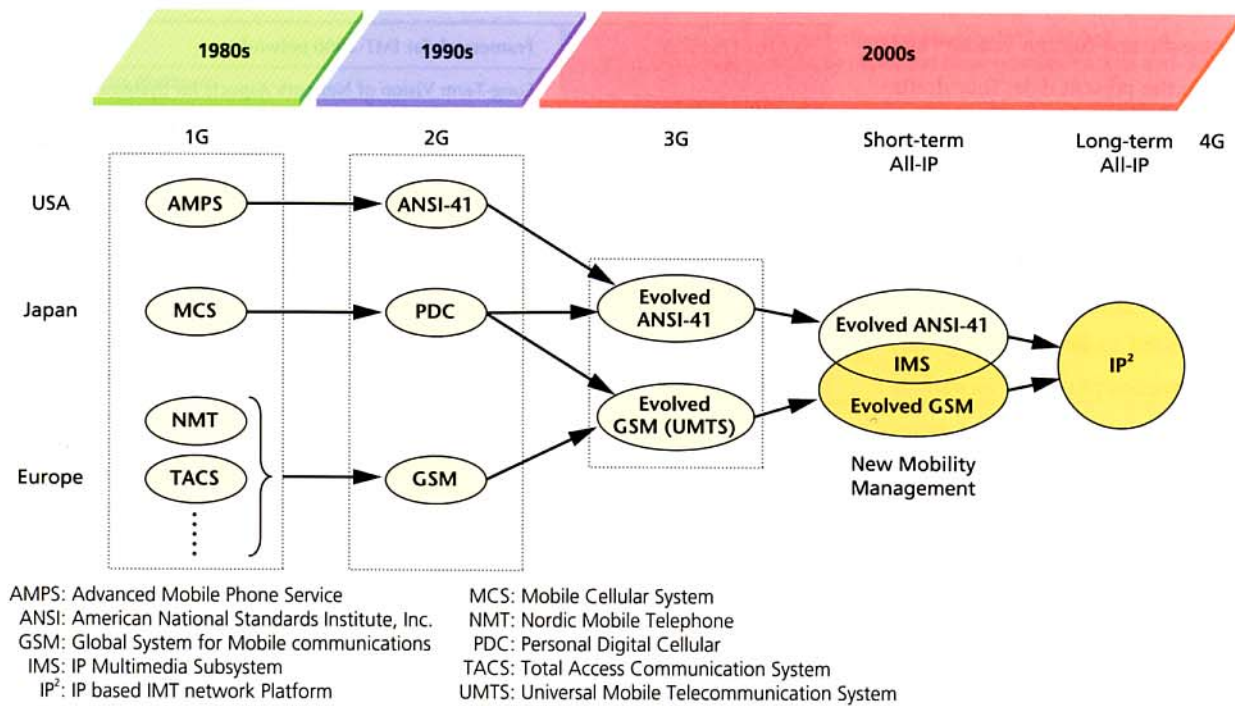


Figure 1 Standardization Roadmap

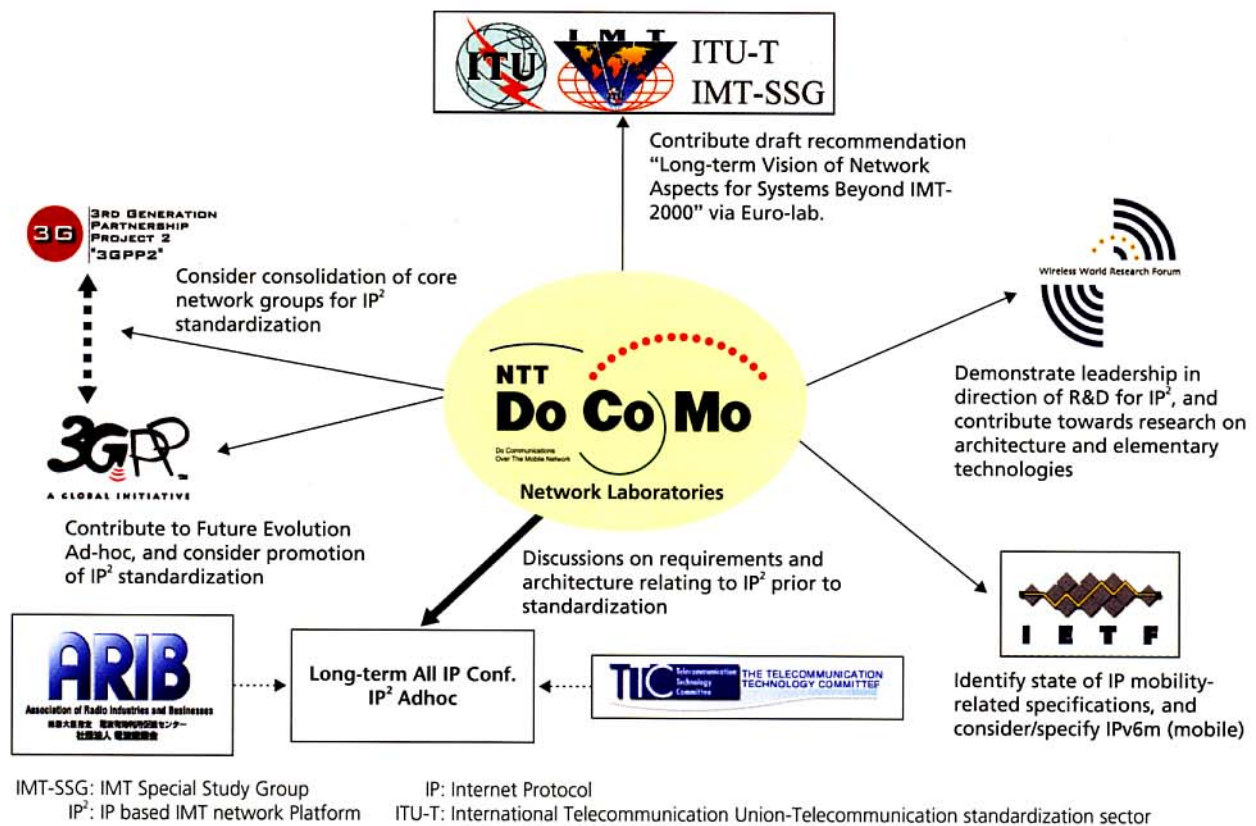


Figure 2 Correlation with Standardization Bodies and Organizations relating to IP² and Contributing Entities in NTT DoCoMo

## 2.1 ARIB and TTC

ARIB and TTC jointly established the Long Term All-IP Conference last year. Under the Conference, the IP-based IMT

Platform adhoc has been placed as a gathering place for wireless and network experts to talk about the technical requirements, design concept and architecture since last year (chaired

by NTT DoCoMo), with the participation of both domestic and foreign vendors and operators. To the present date, four drafts have been submitted to the Conference, covering technical requirements and network architecture.

In addition to cross-sectional studies within Japan, the IP-based IMT Platform adhoc is expected to internationally harmonize the direction of studies on various requirements, design concepts and architecture through contributions to WWRF referred to in Chapter 3, and serve as a place where a consensus can be formed domestically in regard to the approach to 3GPP systems. Active efforts are already being made in the area concerning WWRF, as it affects the direction of research. The details will be described in Chapter 4.

## 2.2 3GPP/3GPP2

Studies on IP Multimedia Subsystem (IMS) and Multi-Media Domain (MMD) have been conducted to date at 3GPP and 3GPP2, respectively, in the first stage towards All-IP. These studies are distinctive in that the transport used is the derivative of the evolved version of 3G systems. 3GPP specifies session control and location management taking extensions into account such as bandwidth management on Air-channel required in mobile networks based on the Session Initiation Protocol (SIP) set forth by IETF. Such extensions are gradually becoming incorporated in the Request For Comments (RFC) of IETF based on 3GPP's liaising with IETF. However, it consists of matters that have not been considered in the past as far as the SIP system is concerned, such as calling line identification unique to the Public Switched Telephone Network (PSTN). As 3GPP2 also adopts the Internet standards, workshops have been held aimed at the harmonization of All-IP systems since 2001 by participants to 3GPP and 3GPP2. Harmonization based on IMS has been confirmed in regard to:

- Open Service Architecture (OSA) / Application Programming Interfaces (APIs) for Parlay based services;
- Ensuring interoperability and roaming between 3GPP and 3GPP2-IMS; and
- No dependence on access and IP transport (under progress).

In addition to these trends, 3GPP establishes the Future

**Table 1 Q1700 Series Recommendations (in force and pre-publish)**

<b>Q.1701 (1999/3)</b>	<b>Framework for IMT-2000 networks</b>
<b>Q.1702 (2002/6)</b>	<b>Long-Term Vision of Network Aspects for Systems Beyond IMT-2000</b>
<b>Q.1711 (1999/3)</b>	<b>Network functional model for IMT-2000</b>
<b>Q.1721 (2000/6)</b>	<b>Information flows for IMT-2000 capability set 1</b>
<b>Q.1731 (2000/6)</b>	<b>Radio-technology independent requirements for IMT-2000 layer 2 radio interface</b>
<b>Q.1741.1 (2002/4) (pre-publish)</b>	<b>IMT-2000 references to release 1999 of GSM evolved UMTS core network with UTRAN access network</b>
<b>Q.1751 (2000/6)</b>	<b>Internetwork signaling requirements for IMT-2000 capability set 1</b>

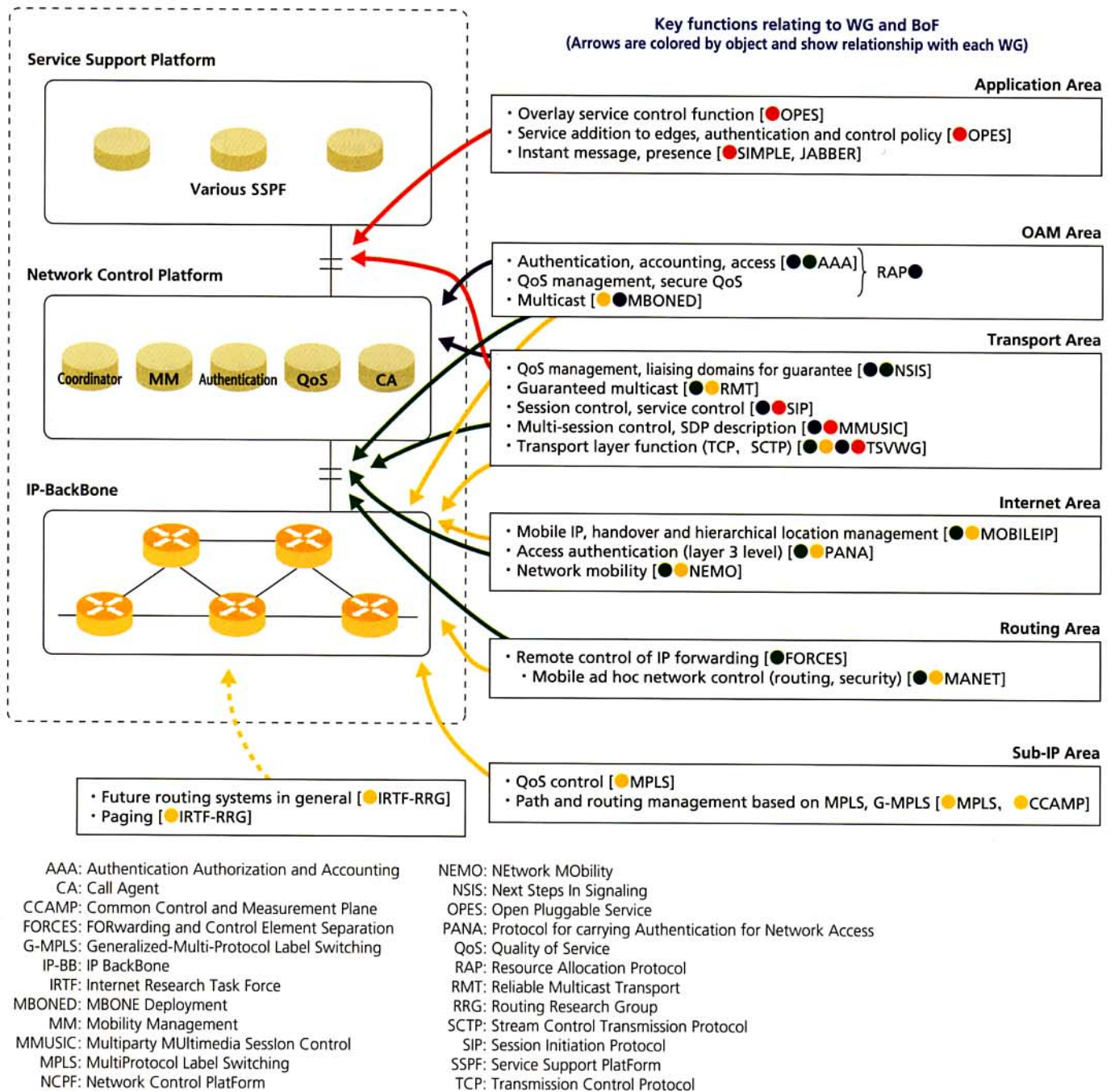
GSM: Global System for Mobile communications  
 IMT-2000: International Mobile Telecommunications-2000 (3G mobile communications)  
 UMTS: Universal Mobile Telecommunication System  
 UTRAN: UMTS Terrestrial Radio Access Network

Evolution Adhoc under the Technical Specification Group – Service and system Aspect (TSG SA), and plans to create a future roadmap in the period between September 2002 and June 2003 and determine 3GPP's scope based on a Technical Feasibility Study in the target technology field (chaired by Mr. Nakamura of DoCoMo Europe from establishment to chairperson election). Taking into account the directions of ITU, the Future Evolution Adhoc will consider the evolution of 3GPP. As discussions on shifting the entire network towards IP-based including transport—as is the case in IP<sup>2</sup>—may be regarded as part of the evolution of 3GPP systems, the discussions within 3GPP in succession to the Future Evolution Adhoc should be taken into consideration by studies for shifting mobile networks towards IP. The details will be explained in Chapter 4.

## 2.3 IETF

IETF, which is involved in a wide range of activities as a standardization body of IP systems, has already been engaged in much exchange with 3GPP/3GPP2 for various protocol specifications that are utilized towards IP-based systems. **Figure 3** shows the correspondence between IP<sup>2</sup>'s various technology areas reported in this Special Article and the WGs and BoFs of IETF. For reference, the Figure shows the extent of possibilities taken into account based on the knowledge gained so far in the IP<sup>2</sup> research stage. (As IETF handles up to the specification of protocols, it is difficult to map in simple terms.)

The work has been shared regarding to IMS and others: as mentioned in 2.2, specifications up to the functional level (up to around stage 2) have been handled by 3GPP while protocol level specifications have been implemented at IETF. However,



**Figure 3 IETF WG and BoF relating to IP<sup>2</sup> (as at 54th meeting)**

there seems to be room left for future improvements in regard to the actual correlation, including the harmonization with the culture of IETF that seeks a solution based specification via discussions of requirements and the identification of problems.

## 2.4 Other Organizations

As protocol platforms required for transferring information between nodes at the carrier level, telecom systems have been specified more comprehensively in terms of the applications

selection in nodes and terminals, address resolution, load balancing, in-sequence delivery, recovery in the event of failure, etc. while heeding and incorporating the distributed networks configuration as exemplified by the No.7 common channel signaling systems in ITU-T (based on Signaling Connection Control Part (SCCP) addressing, Service Indicator, Sub System Number, object identifier at TC level, etc.). Additionally, at IETF, the possibility of incorporating No.7 functions is being examined as demonstrated by the Stream Control Transmission

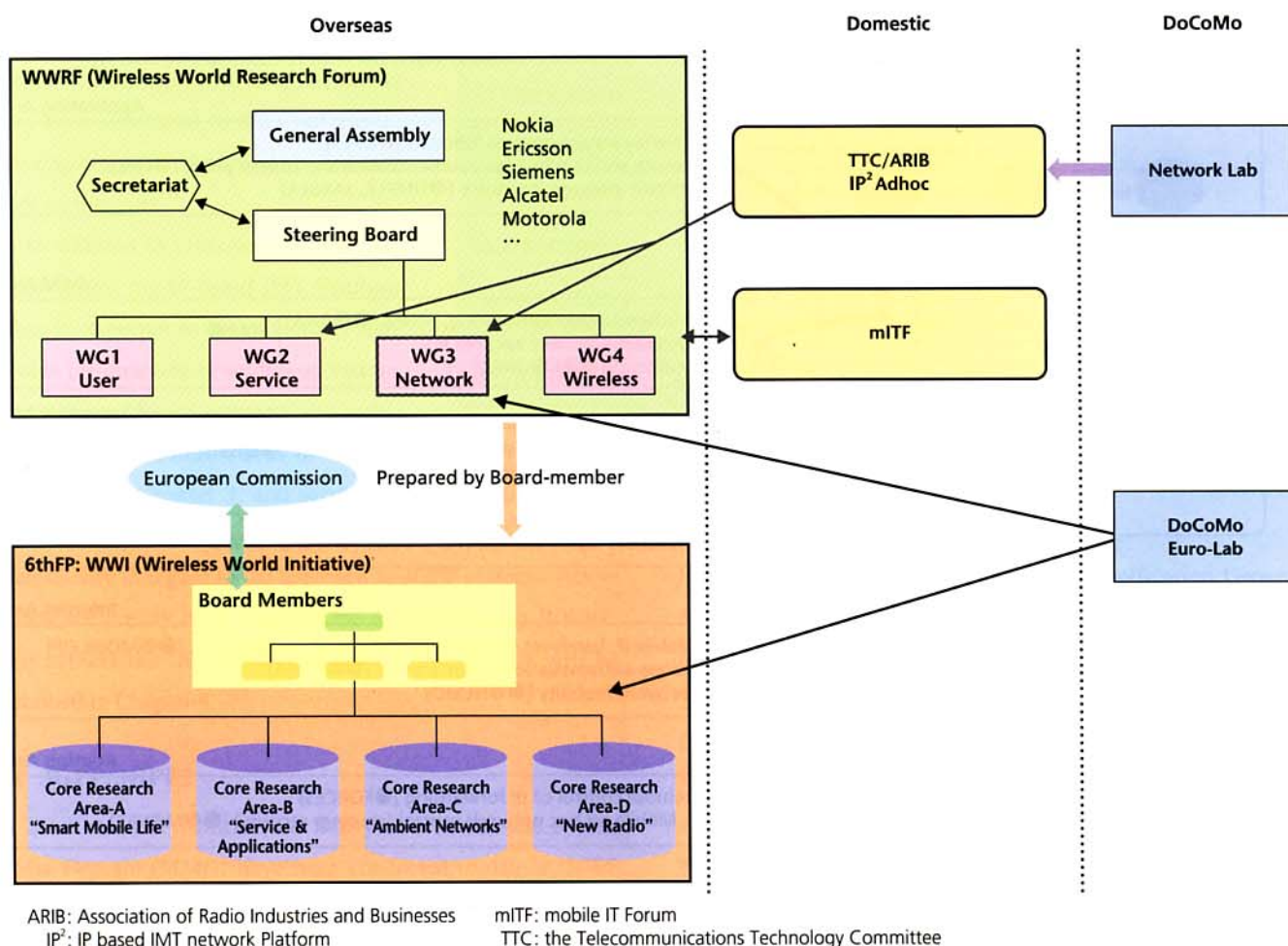


Figure 4 IETF WG and BoF relating to IP² (as at 54th meeting)

Protocol (SCTP), which is a candidate for next-generation TCP.

On the other hand, Jini, Common Object Request Broker Architecture (CORBA), etc. are already being examined as middleware specifications for providing comprehensive communication services with a distributed configuration in mind over an IP transport platform. In practice, Parlay, which is the parent of OSA, has been applied for service control, and the Object Request Broker (ORB) has been applied for de facto call control interface implementation. These may be regarded as the communication platform between the Service Support PlatForm (SSPF) and the Network Control PlatForm (NCPF) specified in IP². This means that there is some relationship with the Object Management Group (OMG) and the Java\* Consortium.

### 3. Trends in Technical Studies

This chapter discusses the international trends in technical

studies in regard to the research on future mobile networks with reference to WWRF and WWI. The left hand side of **Figure 4** shows the structure and the relationship of these bodies (In-house and domestic contributions will be described in Chapter 4).

#### 3.1 WWRF

WWRF, whose membership consists of leading European vendors, operators, various bodies, organizations and universities involved in mobile communications research, is an international forum aimed at discussing the directions, concepts and requirements concerning the research and development of future mobile systems. The first conference was held in 2001, and six conferences have been held by June 2002. WWRF –where the research themes handled by WWI (referred to in the next section) are consolidated and the directions are discussed in practice– is serving as a forum suitable for building a consensus among organizations examining the research directions on future mobile communication networks and the future technolo-

\* Java: An object-oriented programming language suited for use on networks, developed and advocated by Sun Microsystems in the U.S.

gies directions such as IP<sup>2</sup>.

### 3.2 WWI

WWI is regarded as an organization in charge of promoting the Integrate Project (IP) within the 6th framework of the European Committee. The said IP is expected to accommodate non-European participants as well. As the research and development of mobile communication systems in the future will be an amalgam of an extremely wide range of technical elements, WWI is making efforts centering on Europe, and is also actively engaged in international cooperation. Of note, the actual IP proposal is presumed to be drafted based on the accomplishments made in WWRF.

## 4. Future Activities and Contributions

This Chapter explains the contributions to organizations and bodies expected to be made based on the future progress studies. As stated in Chapter 3, WWRF serves as a place where the research direction, where it is introduced and discussed. Accordingly, substantial activities have already been carried out, and contributions have been made as described concretely.

### 4.1 WWRF and WWI

As for the technical requirements to WWRF, network laboratories has already inputted the requirements associated with the network architecture and elemental technologies to Working Group 3 (WG3). As for WG2, the content is currently being examined as there are arguments for and against making contributions externally in regard to service and architecture. Contributions to WG3 are made by a WWRF participant acting as a proxy based on the discussions at the IP<sup>2</sup> adhoc. As contributions by DoCoMo EuroLabs are also being considered, the two laboratories exchange information on how to proceed with WG3 and WG2.

Regarding to WWI, Network Laboratories takes no action. It is considering to harmonize the directions based on contributions to WWRF and making contributions via DoCoMo EuroLabs (due to be incorporated into WWI).

### 4.2 3GPP

In 3GPP, the Future Evolution Adhoc —which launched studies in September 2002 towards June 2003— is the primary candidate to which contributions are made. Requirements and functional models taking into account the evolutions from IMS

may be contributed which will be linked with the research directions of WWRF. It is presumed that the content will be decided in concrete after clearly defining what kind of contributions are to be made in consideration of the future networks requirements, and that a proposal will be made based on a consensus formed domestically at ARIB/TTC. Discussions are deemed to take place up to around stage 2.

### 4.3 IETF

In regard to network systems, IETF will implement protocol specifications for IP networks from its own standpoint, while taking into account the discussions at WWRF and 3GPP. Therefore, Network Laboratories is in the stage of considering the possibility of making contributions to realize “All Internet Mobile” in the future in a format compliant to IETF’s processes, while working on gaining a consensus at WWRF and 3GPP in regard to requirements. For the time being, contributions are consisting of proposals for fulfilling the necessary capabilities of mobile systems as reported in this special article.

## 5. Conclusion

The network architecture and the elemental technologies proposed by IP<sup>2</sup> may be adopted and operated ahead, as actual networks make progress towards IP-based on a worldwide scale in the years ahead. On the other hand, the future standardization activities reported in Chapter 2 are presumed to gain more momentum from the end of 2002 to 2003, to specify the deliverables on time. NTT DoCoMo must carry out flexible standardization activities consistently at the appropriate organizations and bodies with respect to various scenarios for future networks it depicts, including the research aspects. For the future, we intend to further enhance our cooperative efforts with both internal and external relevant divisions and departments.

### REFERENCES

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- [3] Yumiba, et al: Overview of IMT-2000 Network Systems, NTT DoCoMo Technical Journal, Vol. 6, No.4, pp.8-13, Jan. 1999. (in Japanese)

## GLOSSARY

3GPP: 3rd Generation Partnership Project	MMUSIC: Multiparty Multimedia Session Control
AAA: Authentication Authorization and Accounting	MPLS: MultiProtocol Label Switching
AMPS: Advanced Mobile Phone Service	NCPF: Network Control PlatForm
ANSI: American National Standards Institute, Inc.	NEMO: Network MObility
APIs: Application Programming Interfaces	NMT: Nordic Mobile Telephone
ARIB: Association of Radio Industries and Businesses	NSIS: Next Steps in Signaling
CA: Call Agent	OAM: Operation And Maintenance
CCAMP: Common Control and Measurement Plane	OMG: Object Management Group
CORBA: Common Object Request Broker Architecture	OPES: Open Pluggable Service
FOMA: Freedom of Mobile multimedia Access	ORB: Object Request Broker
FORCES: FORwarding and Control Element Separation	OSA: Open Service Architecture
FPLMTS: Future Public Land Mobile Telecommunication Systems	PANA: Protocol for carrying Authentication for Network Access
G-MPLS: Generalized-Multi-Protocol Label Switching	PDC: Personal Digital Cellular
GSM: Global System for Mobile communications	PDNRs: Preliminary Draft New Recommendations
IETF: Internet Engineering Task Force	QoS: Quality of Service
IMS: IP Multimedia Subsystem	RAP: Resource Allocation Protocol
IMT-2000: International Mobile Telecommunications-2000	RFC: Request For Comments
IMT-SSG: IMT Special Study Group	RMT: Reliable Multicast Transport
IP: Integrate Project	RRG: Routing Research Group
IP: Internet Protocol	SCCP: Signaling Connection Control Part
IP-BB: IP BackBone	SCTP: Stream Control Transmission Protocol
IP <sup>2</sup> : IP-based IMT network Platform	SIP: Session Initiation Protocol
IRTF: Internet Research Task Force	SSPF: Service Support PlatForm
ITU: International Telecommunication Union	TACS: Total Access Communication System
ITU-R: International Telecommunication Union-Radio Communication sector	TCP: Transmission Control Protocol
ITU-T: International Telecommunication Union-Telecommunication Standardization Sector	TL: Transport Layer
MBONED: MBONE Deployment	TSG-SA: Technical Specification Group-Service and system Aspect
MCS: Mobile Cellular System	TTC: the Telecommunications Technology Committee
mITF: mobile IT Forum	UMTS: Universal Mobile Telecommunication System
MM: Mobility Management	WG: Working Group
MMD: Multi-Media Domain	WWI: Wireless World Initiative
	WWRF: Wireless World Research Forum