

## **INTERNET PROTOCOL (IP)-BASED NETWORKS**

### **(Contribution to the Secretary-General's Report to the Council)**

#### **1. Background**

The explosive growth of the Internet, and other IP based networks, and with it the ever increasing demand for higher bandwidth/capacity, has network operators and manufacturers alike reconsidering their services, network structures, products etc. Information technology and the use of IP based networks and applications (e.g. E-Commerce) have become critical factors in the development of telecommunication networks.

Data traffic is growing at more than ten times the rate of voice traffic and it is estimated that in the near future data will account for 80% of all traffic carried by telecommunications networks. Therefore with this rapid change the past concept of telephone networks, which also carry data will be replaced by the concept of data networks that also carry voice. In this regard, seamless interworking between IP based networks and telecommunications networks and interoperability of their respective applications/services is essential to meet the burgeoning business requirements placed on modern communications networks.

Another important trend in telecommunications networks is the emergence of mobile networks and a significant increase of customers subscribing to them. The work on the 3<sup>rd</sup> generation mobile networks performed by ITU under the name of the IMT-2000 has, as its main features, an increased data speed of 384 kb/s up to 2 Mb/s, a global roaming capability and the virtual home environment (enabling users to move seamlessly between fixed and mobile networks). These features will provide an additional infrastructure for the IP-based network services with fast, ubiquitous access through the global roaming capability.

In short, business directions are changing across the telecommunications industry. Consequently standards organizations, forums and consortia are facing new challenges in terms of work direction and focus. We are also seeing the emergence of new bodies to address related areas e.g. the ETSI TIPHON (Telecommunications and Internet Protocol Harmonization over Networks; IMTC (International Multimedia Teleconferencing Consortium) Voice over IP Forum (VOIP).

Not only are we facing major changes to the telecommunications network, but also these changes are developing in ever shorter time intervals, along with reduced development intervals and corresponding shorter life-cycles for services and products. Standards bodies must be able to change their focus and work direction to produce necessary standards in much shorter intervals.

Interoperability of networks and of applications is becoming an increasingly important aspect. The interaction of IP based networks and telecommunications networks for the purpose of gaining access to Internet, or other IP network applications, and the need for the interoperability of IP-based services and telecommunication services means providing real time Internet or other IP based multimedia services with the speed, capacity, ease of use, reliability and integrity of the public telephone networks in use around the world. These are aspects of telecommunication network standardization in which the ITU-T has an excellent track record.

Although the ITU-T and the Internet Engineering Task Force (IETF) are collaborating in a number of areas, given the new industry emphasis on Internet and IP structured signals, it is our view that this collaboration must be strengthened within the context of changes in work emphasis and direction within the ITU-T on IP based networks. Both the ITU-T and the IETF will play key roles. However, in our view neither the IETF nor the ITU-T will be able to adequately address this area independently. For example, the IETF strength lies in the protocol and application areas, whereas the ITU-T has a great deal to offer in the areas of architectural, network interworking and network evolution.

These aspects have been considered by PP98 in adopting Resolution COM 5/14 (Internet Protocol (IP)-based networks). The PP98 Resolution considers:

- that studies have already started in ITU-T on IP-based network issues, including service interoperability with other telecommunication networks, numbering, signalling requirements and protocol aspects, security and infrastructure component costs; and
- that general cooperation arrangements between ITU-T and the Internet Society (ISOC) and its Internet Engineering Task Force (IETF) have recently been established which encourage the ITU-T continue its collaborative activities on IP-based networks with ISOC/IETF."

In this respect the next WTSA will be in the year 2000 at which time the ITU-T will review its work priorities, direction and structure. However, it is TSAG's view that by the year 2000 the telecommunications environment will have already moved significantly towards making IP based technology a key part of the network infrastructure. Therefore, the ITU-T cannot wait until 2000 to change its work directions in order to maintain its leadership role in the development of global standards, as part of the inevitable network evolution.

## **2. TSAG guidance**

Considering the above background TSAG, at its September 1998 meeting reached the following agreements:

- 1) Study Group 13 is assigned Lead Study Group responsibility on IP related aspects.
- 2) Guidelines for Study Group collaboration with the ISOC/IETF, including the process of informing the IETF of ITU-T Study Group activities, and acquiring information on the activities of the IETF.
- 3) All ITU-T Study Groups to review their Questions to determine how best to address the development of Recommendations for IP based networks in their specific area of responsibility.

Furthermore TSAG has agreed on a Liaison Statement to all Study Groups to encourage and aid in the understanding of collaboration on standards development between the ITU-T and the internet Society (ISOC)/Internet Engineering Task Force (IETF). It should be remembered that ISOC is a member of ITU-T, in accordance with the decision taken by the Council.

### **3. The current situation:**

Study Group 13, since 1998, has acted as lead Study Group for 'IP related aspects' with the mandate "to provide a focal point in ITU-T for IP related studies, including the inter-relationship between IP and telecommunication networks and their convergence". Subsequent to this the Plenipotentiary Conference in October 1998 actioned the Secretary General to conduct a study of IP network related activities underway in the ITU and indicate areas where additional collaborative activities may be required.

In recognition of the relevance of IP (Internet Protocol) based networks and their impact on the short term business perspectives of the ITU members, Study Group 13 has developed an 'ITU-T IP Project' separate from but closely related to GII studies. The project, which is intended to encompass all the ITU-T IP related work, will be regularly updated as the work progresses and as the various ITU-T Study Groups expand their activities in support of the IP related work.

In order that IP-related work may progress a Study Group 13 'IP Experts meeting' is planned for September 1999 to which IP experts of other Study Groups are invited in order that they may assist Study Group 13 in its studies. In preparation for this meeting Study Group 13 has sent a Liaison Statement to all ITU-T Study Groups requesting their comments on the ITU-T IP Project, particularly to help expand the descriptions of the areas of work and the deliverables planned.

The project description for GII and IP is given in the report of the February 1999 meeting of Study Group 13 and has been posted in ITU-T Web site <http://www.itu.int/ITU-T/com13/index.html> (see Internet Protocol).

The ultimate value of IP and telecommunications networks interactions is the building of an integrated network through which people will have increased opportunities to interconnect and to exchange ideas. It is a major challenge for the ITU-T to respond and it is necessary, if the vision is to become reality, for the ITU-T to leverage its knowledge, experience and competence in developing global standards for communications networks.

The primary objective of the IP project is to identify the issues relative to IP and telecommunications interoperability, utilizing the features of both to mutual advantage in the support of business needs.

The Internet Protocol suite, developed by the IETF is taken as a basis.

Further, the objective is to identify the areas of work germane to the ITU. Areas where the ITU can provide substantial added value, working in close cooperation with other key industry and standards organizations, such as the IETF, as appropriate.

The following twelve work areas have been identified as being of current major concern to the ITU-T.

Area 1 - Integrated architecture

Area 2 - Impact to telecommunications access infrastructures of access to IP applications

Area 3 - Interworking between IP based network and switched-circuit networks, including wireless based networks

Area 4 - Multimedia applications over IP

Area 5 - Numbering and addressing

Area 6 - Transport for IP-structured signals

Area 7 - Signalling support, IN and routing for services on IP-based networks

Area 8 - Performance

Area 9 - Integrated management of telecom and IP-based networks

Area 10 - Security aspects

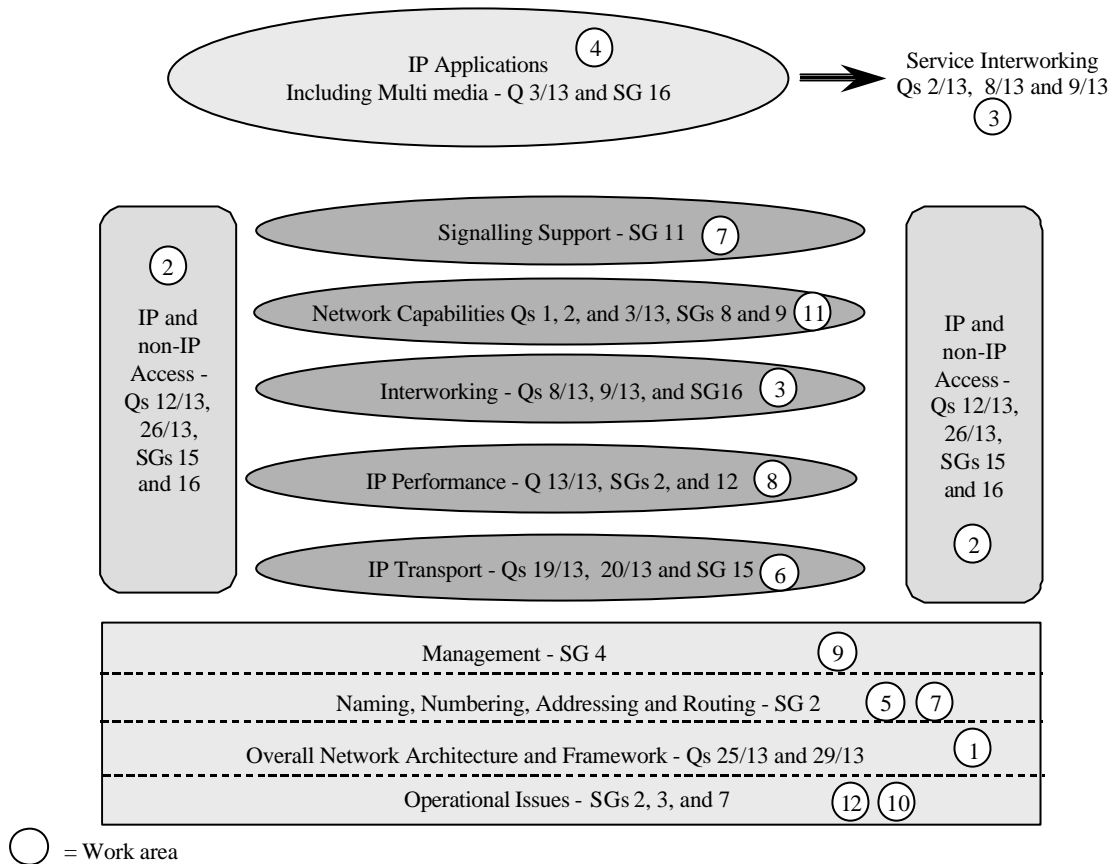
Area 11 - Network capabilities including requirements for resource management

Area 12 - Operations and Maintenance (OAM)for IP

For each of these areas the project describes the scope and focus of the work area, the issues, the current work in the ITU-T Study Groups and related work in the IETF. In some cases the information is not yet complete and further work is necessary to expand the information. Particularly in relation to the IETF work an analysis of the IETF Working Group Charters is currently being undertaken to identify areas of potential overlap and areas where the ITU-T could collaborate with the IETF. The ITU-T Web site contains a detailed description of the project. An outline of the scope of the project areas so far defined is attached as Annex 1.

Study Groups will continue to study IP-related aspects in accordance with their respective responsibility and mandates, as established in Resolution No. 2 of WTSC-96. In accordance with the request made by TSAG the Study Groups have updated their Questions by including IP-related aspects. TSAG, at the meeting in April 1999 has reviewed the report of the leading Study Group, as well as the liaisons received by the various ITU-T Study Groups and will prepare further actions to WTSA-2000 in order to positively respond to this priority item in the Sector Strategic Plan. A summary of information so far provided by Study Groups, both to Study Group 13 as inputs to the IP Project and in response to the TSAG request, is attached in Annex 2.

The following is a schematic representation of the scope of the Project.



### Scope of the ITU-T IP Project

The IP project will be continuously updated thereby reporting on major deliverables from the various Study Groups in terms of Recommendations approved or planned.

Concerning the publication of IP related Recommendations it is proposed that the Y. Series is renamed as “Global Information Infrastructure and Internet Protocol Aspects”. The Y.100 to Y.999 series will continue to be used for GII Recommendations and the Y.1000 to Y.9999 will be used for IP related Recommendations. The other Study Groups will continue to use their series as appropriate for IP-related matters.

## ANNEX 1

### OUTLINE OF THE SCOPE OF THE IP PROJECT AREAS

#### **Area 1 - Integrated architecture**

The advent of IP networks and their integration into telecommunications networks, including both fixed and mobile networks, provides substantial new thinking for the evolution of both networks. For example, the separation of service provision from transport, a key element in IN development and in Internet applications, changes much of the basic telecommunications architecture.

Also, control systems, which in telecommunications networks have evolved to outband SS7 and ISDN signalling systems as opposed to inband approaches in an IP based network, provide opportunities for new developments. One example under consideration is to use an IP overlay as a control structure for both telecommunications and Internet type networks.

The future of the IP protocol also requires analysis. With new approaches for integrating connectionless services with traditional telecommunications services and with new applications and business coming into use, it is likely that a new IP protocol, meeting all the new needs, including additional control requirements will be developed. The architectural implications of this have yet to be determined.

The initial focus is to identify the new network concepts and to propose architectural approaches which meet the challenging future needs of data, video and voice as well as multi-media applications.

#### **Area 2 - Impact on telecommunications access infrastructures of access to IP applications**

The key objective is to identify the key access network interface requirements and access configurations to provide an effective gateway from telecommunications access networks and telecommunications access components to IP networks (including both wired and wireless accesses).

The project will address the issues (including interfaces, protocols, network management, etc.) related to access to IP applications via an IP based network Points of Presence (POPs), using the various access networks and technologies.

Some access networks, such as cable TV networks and broadcast satellites, were only designed to broadcast signals to the home, not to carry data back towards the core network. One-way access systems have to be enhanced to two-way capability or used in combination with other techniques (e.g. upstream modem/phone line configurations) to support bi-directional communication, for example, in client-server applications.

In addition, problems related to traffic management in the case of switched access to Internet over PSTN/ISDN may require the development of dedicated functions and interfaces on voice switches to re-route data traffic on dedicated Points-of-Presence as close as possible to the source.

The initial focus will be on terminal interfaces from PSTN and ISDN (e.g. ADSL) and on access network interfaces (e.g. V interfaces) to determine changes necessary to accommodate additional requirements for access to IP based applications.

### **Area 3 - Interworking between IP based network and switched-circuit networks, including wireless based networks**

The primary objective is to identify and analyse potential network configurations and network interface requirements (for both fixed and mobile networks) to ensure mutually effective IP and telecommunications network support to the burgeoning business requirements encompassing both technologies.

Concerning network interworking the area will address interworking (including network management capabilities) between IP-based networks (Intranets, the Internet, etc.) and a number of typical core networks. The project will also consider related issues, such as traffic management. For example networks supporting Internet traffic have different traffic characteristic from telephony and solutions must be developed to ensure efficient management of processing power, network capacity and memory resources. The initial focus is the identification and analysis of alternative inter-related architectures to determine the key interface requirements between IP network and telecommunications network components.

The project will also include study of the various voice over IP scenarios and the support of the integration of PSTN services (e.g., a telephone call) with those offered by an IP based network through the World Wide Web. Examples of such services are Click-to-Dial, Click-to-Fax, and Voice access to content. The initial focus is on identification and preliminary definition of interactive services for which functional and architectural requirements will be determined for input to the Access and Interworking considerations

### **Area 4 - Multimedia applications over IP**

There is a growing market for real-time multimedia communication over IP-based networks and for extending this over the PSTN/ISDN. The objective of this project is to support this market through the coordination of ITU-T activities, and ensure inter-operation for a variety of scenarios.

The initial benchmark service to be supported in this area of the project is interworking between voice over IP-based networks and PSTN/ISDN.

This area of the project will address a number of issues, including:

- requirements for interoperability between IP networks and PSTN/ISDN
- service definitions
- requirements for service interoperability
- reference configurations and functional models
- multimedia coding
- call control procedures, information flows and protocols
- numbering and addressing
- charging/billing
- security
- end-to-end quality of service aspects, including transcoding and echo-cancellation.

### **Area 5 - Naming, Numbering, Addressing and Routing**

The increasing demand to extend the capabilities afforded by provision of an IP based telecommunications infrastructure which provides the flexibility and capacity required to satisfy the growing international multimedia needs has resulted in urgent commercial necessity to enable interworking with conventional telecommunication networks e.g. PSTN/ISDN and PSPDN.

Initially the key issues to be addressed under this area are:

- Numbering, and Addressing to provide international access to users who are IP based initially for the purpose of VoIP,
- The operational requirements to route international correspondence traffic to IP based networks and user interfaces, and
- The service interworking for the provision of international public correspondence including evolving multimedia applications.



## **Area 6 - Transport for IP-structured signals**

Currently IP traffic is transported largely over telecommunications facilities, using telecommunications channels to support IP protocols and applications. Depending on the tariffs and other cost considerations, IP network traffic is moving to dedicated transport, independent of the telecommunications networks. If this trend continues, the Internet could eventually overlay the telephone network, removing much of the data traffic from telecommunications networks, causing severe decline in telecommunications business. On the other hand it is axiomatic that joint use of networks for voice and data provides more efficient use of precious resources.

The focus of this part of the project deals with evolutionary aspects of the transport used for IP-based networks. This includes the optimisation for the direct transport of IP traffic over Synchronous Digital Hierarchy (SDH) and optical infrastructures. One example is their possible evolution towards integration with ATM Networks.

ATM has become the chosen technology for the B-ISDN within traditional telecommunication networks. As such it is ideally suited to fulfil the needs of large multi-function networks requiring high-speed connections in the backbone and access segments. In addition, ATM provides defined quality of service parameters, in contrast to the current "best effort" of the Internet. Thus ATM can support the foreseen evolution towards a highly reliable and highly available Internet, with defined qualities of service. ATM may also make use of SDH and optical network infrastructures.

The objective of this section of the project is to determine approaches to share network resources to the mutual benefit of both IP and telecommunications networks, and their users.

## **Area 7 - Signalling support, IN and routing for services on IP-based networks**

This area of the project will address at least the following topics:

- Efficiently identifying and routing traffic destined for Internet Service Providers (ISPs) to minimize negative impact upon the Public Switched Telephone Network (PSTN), which has been engineered for relatively short holding time calls;
- Defining signaling support for new, value added services which may enable public network operators, as well as ISPs, to capitalize on the growing demand for Internet based and Intelligent Network (IN) based capabilities;
- Serving the need of ISPs, Internet Access Providers, and "Internet users" to flexibly manage dynamic bandwidth and quality of service demands from a public network;
- Defining mobile wireless access to services over an IP based network, e.g., virtual private networks, provided by either ISPs or public network operators; and

- Signaling support for Service Interworking of both dial-up Internet access data applications and Voice over IP applications with traditional telecommunication services, including support of signaling applications and user parts over IP based networks.

### **Area 8 - Performance**

Performance Recommendations for IP-based networks and services, interpreted broadly to include IP based networks and affiliated technologies (e.g., World Wide Web) are being developed by a number of Study Groups. The planned work will:

- Build upon and specialise ongoing GII performance studies
- Apply and revise the existing ITU-T Recommendations that establish performance and quality requirements for end-user services in light of the unique performance issues of IP-based networks and services
- Develop new performance-related ITU-T Recommendations (i.e., define performance parameters and objectives) for IP-based networks and services
- As necessary, revise or develop ITU-T Recommendations addressing the performance of the lower layer networking ("layer 2 networking") to support the transport of IP networking ("layer 3 networking"), e.g., timing and synchronisation issues as they relate to IP-based networks and services
- Address a broad range of performance issues, including IP-network interworking with and integration with other telecommunications services and networks (e.g., public switched telephone network, Integrated Services Digital Networks, radio/mobile telecommunications networks, broadcast/cable networks, SDH, ATM, frame relay).

The initial focus is on the definition of quantitative quality-of-service (QoS) commitments applicable to well-defined IP-based services and meeting performance needs of end-users for real-time IP-based services (e.g., telephony, multimedia) while continuing to support conventional best-effort IP communication services.

### **Areas 9, 11 and 12 - Management of mixed telecom and IP-based environments**

The objectives of these areas are two-fold:

- To address the evolution of TMN Recommendations to support the integrated remote management of mixed environments as well as management of their constituent parts and
- To address the management of mixed environments not covered by the evolution of TMN Recommendations.

Integrated remote management is expected to be essential to gain the full benefits of integrating IP with traditional telecom technologies. Currently management of IP-based networks is focused on the use of IETF management standards while the management of traditional telecom networks are supported by ITU-T TMN Recommendations. However there is a need to understand the management needs of both

domains in order to develop an integrated perspective. It is expected that as the distinction between these two network domains blurs, the convergence of their management approaches will naturally follow. During this convergence period and in part to ensure its success, integrated remote management will be needed and will focus on the creation of an integrated set of management architecture, requirements, information, and protocols.

It is expected that a similar philosophy will drive the creation of ITU-T management specifications outside of the realm of TMN.

### **Area 10 - Security aspects**

There are many interworking scenarios with existing telecommunication networks and IP-based networks. Due to the fact that the structure of the IP-based networks and the associated security aspects are completely different to those of telecommunication networks, the security aspects have to be analysed in relation with interworking between telecommunication and IP-based networks. Requirements have to be developed for these scenarios, especially for:

- A voice call from an IP terminal connected to an IP-based network to a GSTN phone
- A voice call from a GSTN phone to an IP terminal connected to an IP-based network
- A voice call from a GSTN phone to another GSTN phone via an IP network
- A voice call from an IP terminal connected to an IP-based network to another IP terminal connected to an IP-based network via the GSTN.

When the word “security” is used without qualification there are usually many interpretations of the term. Hence it is useful to provide a taxonomy of security-related issues so that a common understanding can be more quickly reached. Within a telecommunications context there are four roles, each with a different set of security related concerns. These are user, network operator, third party and government. These roles are not mutually exclusive and any given individual or organisation may assume two or more of the roles. For example, a third party is inevitably also a user, and a network operator may assume a government role.

There are ranges of security concerns. Some are of interest to a single role, and some to several. These include end-to-end privacy of data, user identification, anonymous access, access control intrusion detection, non repudiation and lawful intercept.

## ANNEX 2

### SUMMARY OF RESPONSES FROM STUDY GROUPS

#### **Study Group 2:**

A number of IP related issues are relevant to the work of Study Group 2 in the following three broad areas:

- Impact of incorporating IP technology into the existing telecommunications infrastructure,
- Emulation of (existing) services on IP based networks including the Internet and dedicated IP networks and
- Interworking between existing networks and IP based networks.

The areas include topics such as numbering/addressing, routing, mobility, service definition/customer expectations, human factors, performance and traffic engineering.

In general terms no substantial change is needed to the role of the Study Group to accommodate IP based network technology. Increased co-operation may be needed with external organisations notably the IETF and also, for example the ETSI project 'TIPHON'. A co-ordination team has been appointed to ensue internal co-ordination of the issues across the Study Group.

Some initial results have already been achieved e.g. in routing of multimedia connections when interworking with PSTN, ATM and IP networks and in service interworking for systems using user-network interfaces based on IP with international public correspondence networks, see Recommendations E.MM and E.ip, respectively. In dealing with IP numbering issues sensitive economic/regulatory/political problems were faced. The solution of these will require close cooperation not only with SG3 but also with the IP Task Force of ITU-D.

The following Questions are concerned with IP related issues:

- Q.1/2 on numbering and addressing plans
- Q.2/2 on routing and interworking plans
- Qs.6, 7 and 8/2 on traffic engineering
- Qs.3 and 5/2 on service quality of networks
- Qs.10, 11, 12 and 13/2 on service aspects.

#### **Study Group 3:**

Study Group 3 has work under way specific to the study of IP related activities. Specifically, under the study of Question 6/3 work has begun on international network cost components for the Internet. Working Party 3/3 has established a Rapporteur's group to focus efforts and progress has been made

on increasing awareness and understanding of the various parts and aspects of an IP network and the Internet. In addition to this work area, Working Party 3/3 currently has the responsibility to act as the focus from the Study Group 3 perspective on tariff and accounting principles as well as related telecommunications economic and policy issues specific to IP Network offerings.

Study Group 3 will continue to review its activities in the area of IP related studies to ensure alignment of work.

#### **Study Group 4:**

Study Group 4 has implemented a number of changes to its work programme to reflect the requirements of integrated management of telecomms and IP based networks. A new project (covered by Question 25/4) will address the evolution of TMN to manage IP networks including issues such as:

- TMN architecture for managing mixed and IP networks,
- Management services and functions for mixed and IP networks,
- Information Models for managing IP networks,
- Interworking among existing and new technologies introduced to support IP,
- Integrated management of IP over ATM, SDH and optical networks and
- Service management of IP services, including Voice over IP.

Study Group 4 have agreed a number of new and revised Questions to cover the IP related work. These include:

- Qs.10 and 11/4 on transmission system test and measurement techniques and instrumentation
- Q.15/4 on service management and generic network element information models for TMN interfaces
- Q.18 and 23/4 on generic and technology-specific network level management of transport networks
- Q.19/4 on protocol aspects
- Q.20/4 on management models for common and switching applications
- Q.21/4 on management information models for ANT and ATM
- Q.24/4 on TMN management support for IMT-2000 and IN
- Q.25/4 on a framework for unified management of integrated circuit-switched and packet-based networks.

#### **Study Group 7:**

Study Group 7 is responsible for Data Networks and Open System Communications. Thus there is great affinity between the Study Group 7 work and efforts on IP based networks.

The activities completed, underway, or being considered regarding Internet and IP related topics are outlined below:

IP related work completed or in progress:

- Addressing/Numbering (Questions 3/7 and 10/7)
  - NSAP address - assignment of AFI values for Internet addresses (X.213/Amd. 1)

- IP/X.121 numbering plan interworking/mapping (X.ipim)
- Internet-PDN interworking (Question 6/7)
  - Interworking between the Internet and public data networks (PSPDN, ISDN-PS and FRPDN)
- Operation of IP over subnetworks (Question 10/7)
  - IP over SDH/SONET (X.ipos)
- Multicast (Question 13/7)
  - Enhanced communications transport service (X.605) and protocol (X.ectp)
  - IETF BOF session on protocols for negotiated QoS multicast communications and interoperability demonstration during December 1998 IETF meeting
- Message Handling Systems (Question 14/7)
  - X.400-series on MHS and use of RFC 1006 and TCP/IP (X.419/Amd. 2)
- Directories (Question 15/7)
  - X.500-series on Directory
  - Authentication framework (X.509)
  - Mapping of Directory protocols directly onto TCP/IP (Amendments to X.500-series)
  - Multi-master replication and access control (Amendments to X.500-series)

Work in progress likely to be applicable to IP based networks:

- Data compression (Question 11/7)
- Multicast network (Question 12/7)
- Security (Question 20/7)
- Open Distributed Processing (ODP) (Question 24/7)

IP related work under consideration:

- IP over various types of sub networks including frame relay, X.25 and ISDN (Question 10/7).

### **Study Group 8:**

Study Group 8 has produced two recommendations in collaboration with the IETF:

- Rec T.37 - Procedures for the transfer of facsimile data via store and forward on the internet,
- Rec T.38 - Procedures for real time Group 3 facsimile communication over IP networks.

Further development is in progress on these Recommendations to standardize additional features in continuing collaboration with the IETF Fax WG. Study Group 8 are also seeking collaboration with the MMUSIC WG on the use of Rec T.38 using SIP for call control.

### **Study Group 9:**

Study Group 9 has revised its mandate to include IP aspects and has the following Questions covering IP issues:

- Q.17/9 covering multimedia data transmission on non-homogeneous cable transmission systems
- Q.24/9 on requirements and possibilities for interactivity in the secondary distribution of television
- Q.31/9 on requirements and methods for sound-programme and television 'webcasting'.

### **Study Group 10:**

Study Group 10 is working on a new Recommendation Z.600 which includes IP considerations. In particular:

- Question 3/10 is working on Middleware standardisation with the objective to recommend a Distributed Processing Environment Architecture,
- The draft text for Z.600 defines a DPE interoperability framework extending the CORBA interoperability architecture as defined by the OMG,
- The DPE architecture defines a generic mechanism to transport object service requests/replies over different transport networks,
- Currently the transport of object service requests/replies over TCP/IP is specified by the OMG. The specification of the Generic Inter-ORB Protocol (GIOP) over TCP/IP, known as Internet Inter-ORB Protocol (IIOP), is used for inter-DPE communication.

Recommendation Z.600 is planned for determination in November 1999 and final approval in 2000.

### **Study Group 11:**

Study Group 11 has many questions covering IP related signalling issues and has ensured coordination across the various Working Parties by the appointment of an 'issues manager'. As a consequence Study Group 11 has concluded that there is, at this time, no need to specifically revise its Questions to take account of IP related issues which are covered by the following:

- Qs.8, 23 and 24/11 on protocols and interfaces for IMT2000
- Qs.5 and 22/11 on Intelligent Network aspects
- Qs.11, 13 and 20/11 on signalling for FPLMTS
- Q6/11 on capabilities and requirements for multimedia
- Q21/11 on signalling for ISDN
- Q15/11 on ATM signalling
- Q9/11 on signalling for transmission systems.

### **Study Group 12:**

Study Group 12 is addressing the impact of IP-based systems and networks on end-to-end transmission performance. Several Questions have been actively considering the impact on speech transmission quality of emerging technologies, especially IP-based systems and the title and text of Q.18/12 was recently modified to explicitly include interworking between the PSTN and the Internet. In addition Study Group 12 has recently approved a new, urgent question that considers the transmission performance impact of introducing IP-based technology into the PSTN itself. The main points of study are the identification of relevant IP-related transmission parameters, quantification of the transmission

quality impact of variations in these parameters, and the development of necessary planning rules for networks using IP technology in the transport of voiceband and multimedia services.

The activities described above have already been productive and the Study Group has recently determined the following new recommendations especially to take account of the impact of IP related systems on performance:

- Rec G.108 Application of the e-model – a planning guide
- Rec G.109 Definition of categories of speech transmission quality
- Rec G.177 Transmission Planning for voiceband services over hybrid Internet/PSTN connections.

The concerned Study Group 12 Questions are:

- Q.9/12 on speech characteristics and measurement methods
- Q.16/12 on transmission planning of mixed analogue/digital networks
- Q.18/12 covering transmission quality aspects of the interconnection of the public ISDN/PSTN with other networks (e.g. private networks, Internet)
- Q.20/12 on analysis and extension of the E-model
- Q.21/12 on echo, transmission time and stability in multicarrier networks
- Q.22/12 on speech quality assessment
- Q.23/12 on transmission performance considerations for voiceband services carried on networks that use the Internet Protocol.

### **Study Group 13:**

As well as being responsible for developing the IP Project and leading the work Study Group 13 has several Questions which cover IP studies. These include:

- Qs.8&9/13 which take into account the interworking situations
- Q.12/13 on access network architectures and interfaces
- Q.13/13 on performance aspects
- Q.19/13 on transport network architectures and interworking
- Q.20/13 which covers IP over ATM
- Q.25/13 on the frameworks for the GII (including IP considerations)
- Q.29/13 on telecommunications architectures for an evolving environment.

In these areas of work:

- Substantial progress has been made on a new Recommendation on IP over ATM
- A new Recommendation has been initiated on Interworking of IP and Telecommunications Networks
- Text has been prepared for the support of IP services in a Recommendation on B-ISDN network requirements,
- A new Recommendation is being developed on Internet based services over B-ISDN which will include aspects such as interworking models for IP on B-ISDN, relationships between IP domain name servers and ATM naming servers, and echo control considerations,
- A revised Recommendation on Connectionless Data Services has been approved



- The work on Telecommunications Architectures for an Evolving environment is including consideration of the impact of the Internet and other IP based networks
- A Recommendation on IP frameworks is being developed
- Work is underway on IP network performance and a new Recommendation on 'Internet Protocol Data Communication Service - User Information Transfer and Availability Performance parameters' has been approved.

### **Study Group 15:**

Study Group 15 has reviewed all, revised eight and prepared one new Question in order to develop relevant standards optimized for the transport of IP type data traffic.

In the case of Question 14/15, the revision also reflects the transfer of 'ATM object modelling' related work to ITU-T SG 4.

The revised questions address various aspects related to transport networks, systems and equipment optimised for IP type data traffic in the areas of access, protection/restoration, SDH/SONET, ATM, management and optical networking. The new question addresses equipment/system aspects for interconnection between GSTN and IP networks.

The Questions concerned are:

- Q.2/15 on characteristics of optical systems in local access networks for transport and distribution
- Q.4/15 on transceivers for subscriber access systems
- Q.9/15 on transport equipment and network protection/restoration
- Q.10/15 on ATM and IP network element functions
- Q.11/15 on signal structures, interfaces and interworking for transport networks
- Qs.13 and 14/15 on management functions and services of transport systems and equipment
- Q.20/15 on characteristics of optical networking
- Q.21/15 on transport network equipment for interconnecting GSTN and IP networks

### **Study Group 16:**

Study Group 16 is concerned with multimedia applications over IP and has a number of Questions covering studies relating to IP including:

- Q.4/16 on modems for PSTN and leased lines
- Q.13/16 on packet switched multimedia systems and terminals, including gateway control p protocols
- Q.14/16 on protocols for interworking with H.300 series Recs
- Q.15/16 on video coding
- Qs. 19 to 21/16 on speech and audio coding
- Q.23/16 on PCM modems

The work under Question 13/16 is one of the most advanced areas in regard to IP related studies and the aim is, as far as practical, to use direct reference to IETF RFCs to avoid duplication of existing protocols. The IETF strength lies in the transport protocol and non-real time application areas, whereas the ITU-T has a great deal to offer in the areas of architectural, network integrating, network evolution, and the real-time application area, including audio and video coders. In Questions 11 and 15/16, the division of labour that has been found useful is to rely on the IETF for transport protocol work, and store/forward applications such as email, while ITU-T work focuses on real-time applications such as MM communications and real-time data conferencing. The ITU-T standards H.323 and T.120 are widely used on the Internet for these purposes. Also the ITU-T G-series and H-series audio/video coders/decoders are nearly universally used, and constitute a great strength of the ITU-T. Further, the ITU-T G3/G4 standards for real-time fax are universally used, and it is anticipated that the new T.38 recommendation for real-time fax over IP will have broad usage, especially in the context of H.323 Voice over IP sessions.