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650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
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Foreword

This ETSI Guide (EG) has been produced by ETSI Technical Committee Services and Protocols for Advanced Networks (SPAN).

Introduction

ITU-T SG 13 has defined a new project, IP and Telecommunications Networks Inter-relationships. This project is managed within WP 1/13. It has been decided within ETSI WG SPAN 8 to initiate a supporting work item with the working title as above.

The problem the present document is addressing is how to achieve the most efficient integration of traffic types and existing protocols which have been designed and used in different technical cultures.

IP and related protocols designed by IETF have their roots in the need to transport files without guarantees of timely packet delivery which might result in packet loss. ATM and SDH or SONET have been designed by ITU-T and ATM Forum have their roots in the need to transport voice and telephony based services (fax) through circuit-switching based networks under very controlled circumstances. DTM is a new protocol system aiming at QoS management of real-time flows. In a situation where IP and its data format has been a common denominator for data communication access, and the volume of data traffic is overtaking voice communication, the interworking between circuit-switched and packet-switched networks has come under heavy debate.

The approach of the present document is to return to fundamental problems and principles which may serve as a basis for a non-biased discussion on the most effective protocol system that can integrate traffic types of completely different nature.

As can be inferred from the definitions of "IP network" as well as "telecommunication network" this classification is no longer very much technically relevant. There is no clear distinction any more. The only possible technical ground for an analysis of the relationships between networks of different historical origin, is to relate the specifications of those protocols to a canonical model of networking. The major source of this canonical model is ITU-T Recommendation G.803 [1] and ETS 300 299 [2].

The technically interesting borderline goes between real-time CBR bit-loss tolerant services and non-real time VBR non bit-loss tolerant services. These kinds of services are so different with respect to their requirements on the underlying network for routing/switching and transmission, that the commercial necessity to build and run one integrated services network becomes a very demanding technical challenge. This is what the network design problem is all about. Various techniques for traffic analysis, service classification, traffic policing, flows control, network management etc all aim at handling each kind of service in the most economical way in one integrated services network.

The historical background has led us to the current situation where many independent technical bodies are engaged in the production of specifications and standards for systems that have to interwork very tightly in the current commercial networking business. None of these bodies can now produce final technical specifications without checking the interrelationships with specifications from other bodies. The networking community is therefore now occupied with a web of many formal as well as informal technical liaisons.

It is in this context we shall see the present document. For ITU-T as well as ETSI, it has been found necessary and desirable to fully recognize the existence and justification of informal and voluntary technical standardization bodies such as IETF, IEEE, ATM Forum and Multiservice Switching Forum. The important aspect for the community of users of standards, manufacturers as well as operators, is to avoid a situation where political prestige or particular commercial interests are delaying or misguiding the standardization process.

The focus of the present document is therefore to identify those areas where the technical interfaces between standards and specifications from different bodies are causing problems for the community of standards users. These results can then be used in open and fair discussions between independent bodies to find which body is the best forum for solving these problems.

1 Scope

The following aspects of the relationship between IP networks and telecommunication networks are included:

1) access to IP networks using telecommunication facilities;

2) interworking between IP networks and telecommunication networks (e.g. gateway functions between IP and other protocols on layer 3);

3) transport mechanisms for IP networks (e.g. IP over other protocols).

The following aspects, which are within the scope of the ITU-T work, are not included:

1) application interworking;

2) the integrated use of signalling in IP as well as traditional networks;

3) analysis of future IP protocols;

4) access techniques for telecommunication networks.

NOTE: The ETSI project TIPHON is the lead body for Multimedia over IP.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] ITU-T Recommendation G.803 (2000): "Architecture of transport networks based on the synchronous digital hierarchy (SDH)".

[2] ETSI ETS 300 299 (1997): "Broadband Integrated Services Digital Network (B-ISDN); Cell based user network access for 155 520 kbit/s and 622 080 kbit/s; Physical layer interfaces for B-ISDN applications".

[3] ITU-T Recommendation I.363 (1993): "B-ISDN ATM adaptation layer (AAL) specification".

[4] ITU-T Recommendation I.363.5 (1996): "B-ISDN ATM Adaptation Layer specification: Type 5 AAL".

[5] IETF RFC 1483 (1993): "Multiprotocol Encapsulation over ATM Adaptation Layer 5".

[6] IETF RFC 2225(1998): "Classical IP and ARP over ATM".

[7] IETF RFC 1755 (1995): "ATM Signalling Support for IP over ATM".

[8] IETF RFC 2364 (1998): "PPP Over AAL5".

[9] IETF RFC 1973 (1996): "PPP in Frame Relay".

[10] IETF RFC 2615 (1999): "PPP over SONET/SDH".

[11] ETSI ETS 300 300 (1997): "Broadband Integrated Services Digital Network (B-ISDN); Synchronous Digital Hierarchy (SDH) based user network access; Physical layer User Network Interfaces (UNI) for 155 520 kbit/s and 622 080 kbit/s Asynchronous Transfer Mode (ATM) B-ISDN applications".

[12] ITU-T Recommendation I.432.1 (1999): "B-ISDN user-network interface - Physical layer specification: General characteristics".

[13] ITU-T Recommendation I.432.2 (1999): "B-ISDN user-network interface - Physical layer specification: 155 520 kbit/s and 622 080 kbit/s operation".

[14] ATM Forum af-lane-0084.000 (1997): "LANE v2.0 LUNI Interface".

[15] ATM Forum af-lane-0112.000 (1999): "LAN Emulation over ATM Version 2 - LNNI Specification".

[16] IETF RFC 1661 (1994): "The Point-to-Point Protocol (PPP)".

[17] IEEE 802.3z: "Media Access Control (MAC) Parameters, Physical Layer, Repeater and Management Parameters for 1 000Mb/s Operation".

[18] IETF RFC 2892 (2000): "The Cisco SRP MAC Layer Protocol".

[19] ITU-T Recommendation G.707/Y.1322 (2000): "Network node interface for the synchronous digital hierarchy (SDH)".

[20] ITU-T Recommendation G.983.1 (1998): "Broadband optical access systems based on Passive Optical Networks (PON)".

[21] ITU-T Recommendation I.113 (1997): "Vocabulary of terms for broadband aspects of ISDN".

[22] ITU-T Recommendation E.164 (1997): "The international public telecommunication numbering plan".

[23] IETF RFC 2105 (1997): "Cisco Systems' Tag Switching Architecture Overview".

[24] ATM Forum af-uni-0010.002 (1994): "ATM User-Network Interface Specification V3.1".

[25] ATM Forum af-phy-0128.000 (1999): "622 and 2 488 Mbit/s Cell-Based Physical Layer".

[26] ATM Forum af-phy-0133.000 (1999): "2,4 Gbps Physical Layer Specification".

[27] ATM Forum af-phy-0046.000 (1996): "622,08 Mbps Physical Layer".

[28] ITU-T Recommendation I.363.2 (2000): "B-ISDN ATM Adaptation Layer (AAL) type 2 specification".

[29] IEEE 802.1Q (1998): "IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks".

[30] ISO/IEC 15802-3 (1998): "Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Common specifications - Part 3: Media Access Control (MAC) Bridges".

[31] IETF RFC 1662 (1994): "PPP in HDLC-like Framing".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

access: function that enables connections from an end user equipment upstream as well as downstream

NOTE 1: The two directions of the communication can take different routes.

aggregate stream: aggregation of many individual streams

NOTE 2: Depending on the type of the component streams, we have real-time (aggregate) streams or non real-time (aggregate) streams.

best-effort relationship: particular kind of connection (relationship) between two nodes A and B for which no commitment exists, but where it is possible that a datagram accepted at node A will arrive at node B

NOTE 3: However, there is no guarantee that the datagram will arrive at node B.

NOTE 4: Connection (including circuit and best-effort relationship) is the only possible relationships for nodes that can be related.

cell: packet of fixed length (see ITU-T Recommendation I.113 [21])

characteristic information: those parts of a format definition of the basic traffic entity of a layer network which is transported unchanged across a connection or circuit

NOTE 5: Characteristic information is always defined in relation to a particular layer network.

For example, characteristic information on layer 2 may not be characteristic information on layer 3, since it can be changed when a traffic entity instance is moving across a network node.

For example, in IP a characteristic information is the information field of the IP packet but not its header which can be changed as the packet crosses the network.

circuit: relationship between two not necessarily adjacent nodes A and B such that there exists a connection from A to B with allocated bandwidth

NOTE 6: Thus a circuit is always a connection, by its definition at network layer.

EXAMPLE 1: Given connections A-B and B-C, there exists a circuit A-C that fulfils the minimal service requirements fulfilled by A-B and B-C.

connection: relationship between two endpoints A and B such that a flow can be transported from A to B under fulfilment of given service requirements. Only the endpoints are required to know of the connection while it does not exclude that the network or part of the network knows of said connection

NOTE 7: There is a very large number of possible distinct connections, based on the powerset of possible connection parameter value sets. (I.e. all parameter value combinations).

NOTE 8: A flow may be transported within a connection.

connection admission control: function that assesses whether there is sufficient resource to admit a connection across a subnetwork

NOTE 9: A connectionless network does not have a connection admission control function.

connection control: function that changes parameter values for a connection

NOTE 10: The scope a connection control function can be a single connection (link layer) or a single circuit (network layer). This function includes setting the rules for congestion handling.

connectionless network: network layer network with respect to nodes A and B such that when sending data from A, the data is not explicitly routed to B

NOTE 11: In order for a network data unit (e.g. IP packet) to find its destination B, a subnet has to set up ad-hoc link layer connections step-by-step and use them on a best-effort basis until the data unit has reached B. The network is in many respects non-deterministic:

- it is not guaranteed that B exists at run time;
- it is not guaranteed that there will exist a path from A to B;
- it is not guaranteed that intermediate nodes will take care of the data unit when it arrives;
- thus there is no guarantee at all the data unit will arrive to B.

connection oriented network: network layer network with respect to nodes A and B such that when sending data from A, some relationship exists and is invariant during transmission

NOTE 12: Such invariant may be very strong or very weak.

The strongest invariant is a reserved resource from A to B.

A weak invariant may be a commitment (such as in TCP) that only ensures that data eventually will reach B when transmitted from A.

Thus, a network with no invariants at all is a connectionless network.

content integrity: relationship for a connection A-B such that bits sent from node A are received unchanged at node B

NOTE 13: This relationship need only be maintained when data is in transit from A to B.

datagram: datagram is a packet with full address information enabling it to be routed to the endpoint without further information

Datagram control: functions that control the integrity of datagrams

NOTE 14: Checksums may be used to control content integrity. Timestamps may control timing integrity.

file: in the context of the present document *a* traffic type denoting finite flows for which content integrity is of importance

NOTE 15: File size is normally known before transmission starts. The knowledge of size may have implications for the connection.

file transport connection: connection that in some way is capable of transporting traffic type File

NOTE 16: The major requirement for this kind of connection is to support content integrity.

flow: unidirectional stream of packets that are sent from a particular source to a particular destination (unicast or multicast) address and any logical handling policy they may require

NOTE 17: A flow is a service instance, that is managed as a single entity.

flow control: capabilities for control of a flow

NOTE 18: Not to be mixed up with connection control, which is controlling the resource used by a flow.

flow transport: transport of a flow through a connection

NOTE 19: In this case, it is assumed that the flow is controlled individually. It may have a dedicated connection, but this is not necessary; it can also be using a shared resource.

frame: sequence of bits forming a delimitation of contained data

NOTE 20: In RFC 1661 [16] defined as: The unit of transmission at the data link layer. A frame may include a header and/or a trailer, along with some number of units of data.