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SERIES Y: GLOBAL INFORMATION
INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS
AND NEXT-GENERATION NETWORKS

Internet protocol aspects – Interworking

Principles of interworking

Recommendation ITU-T Y.1401

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Recommendation ITU-T Y.1401

Principles of interworking

Summary

Recommendation ITU-T Y.1401 provides an architectural framework and general principles for transport stratum interworking in a next generation network (NGN) environment. It describes client/server and peer-partition interworking.

Source

Recommendation ITU-T Y.1401 was approved on 29 February 2008 by ITU-T Study Group 13 (2005-2008) under Recommendation ITU-T A.8 procedure.

Keywords

CAL, client/server, interworking, peer-partition.

FOREWORD

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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.

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Recommendation ITU-T Y.1401

Principles of interworking

1 Scope

This Recommendation provides an architectural framework and general principles for transport stratum interworking in an NGN environment. It does not attempt to provide details for specific technology scenarios. Rather, it provides fundamental concepts and principles with illustrative examples. Specific scenarios are covered in other Recommendations.

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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- | | |
|----------------|--|
| [ITU-T G.805] | Recommendation ITU-T G.805 (2000), <i>Generic functional architecture of transport networks</i> . |
| [ITU-T G.809] | Recommendation ITU-T G.809 (2003), <i>Functional architecture of connectionless layer networks</i> . |
| [ITU-T G.8080] | Recommendation ITU-T G.8080/Y.1304 (2006), <i>Architecture for the automatically switched optical network (ASON)</i> . |
| [ITU-T Y.1314] | Recommendation ITU-T Y.1314 (2005), <i>Virtual private network functional decomposition</i> . |

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 client/server relationship [ITU-T G.805]: The association between layer networks that is performed by an "adaptation" function to allow the link connection in the client layer network to be supported by a trail in the server layer network.

3.1.2 logical external network-network interface (reference point) [ITU-T G.8080]: The E-NNI is the reference point between domains.

3.1.3 logical internal network-network interface (reference point) [ITU-T G.8080]: The I-NNI is the reference point within a domain between routing areas and, where required, between sets of control components within routing areas.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 interworking: The term "interworking" is used to express interactions between networks, between end systems, or between parts thereof, with the aim of providing a functional entity capable of supporting an end-to-end communication.

3.2.2 interworking function (IWF): These functions are referred to in the interworking definition, which include the conversion between protocols and the mapping of one protocol to another. The functionality required between networks can be separated from the functionality, if any, required in end systems.

3.2.3 message: A symbol selected from a finite set of symbols.

NOTE – The set of symbols from which a symbol can be chosen is a lexicon (or dictionary).

3.2.4 network interworking: Interworking between two similar (like) networks via an intermediary network with dissimilar characteristics.

3.2.5 open sequence (file): An open sequence is an open-ended sequence of messages, i.e., each symbol value is selected from a finite set of possible values for the symbol. The order of messages in the open sequence carries (implicit) information. An open sequence communication preserves the order of the messages.

3.2.6 peer-partition interworking: In peer-partition interworking, a client network's characteristic information (CI) is transferred transparently over a concatenation of peered server layer networks.

3.2.7 plane: A category that identifies a collection of related objects, e.g., objects that execute similar or complementary functions; or peer objects that interact to use or to provide services in a class that reflects authority, capability, or time period.

3.2.8 service interworking: Interworking between two dissimilar (unlike) networks directly without the benefit of an intermediary network.

3.2.9 service level agreement (SLA): A negotiated agreement between an end user and the service provider. Its significance varies depending on the service offerings. The SLA may include a number of attributes such as, but not limited to, traffic contract, availability, performance, encryption, authentication, pricing and billing mechanism, etc.

3.2.10 service plane: The service plane comprises:

- a) service presentation functionality being presented to the end user;
- b) service implementation aspects with which the end user interacts, e.g., service invocation, control service level agreement function.

NOTE – Items a) and b) use the totality of the transfer capabilities including control and management functionalities.

3.2.11 timed sequence (stream): A timed sequence is an open-ended sequence of messages where the timing of each message relative to another is significant. The sequence and the relative time of each symbol carries (implicit) information. A timed sequence communication preserves both the order of the messages and the timing between each message.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AP	Access Point
AS	Autonomous System
ASON	Automatically Switched Optical Network
ATM	Asynchronous Transfer Mode
BDI	Backward Defect Indication
CAL	Common Adaptation Layer
CC	Continuity Check

CI	Characteristic Information
cl-ps	connectionless packet-switched
co	connection-oriented
co-cs	connection-oriented circuit-switched
co-ps	connection-oriented packet-switched
CoS	Class of Service
CV	Connectivity Verification
E-NNI	External Network-Network Interface (as per [ITU-T G.8080])
FDI	Forward Defect Indication
I-NNI	Internal Network-Network Interface (as per [ITU-T G.8080])
IWF	Interworking Function
IWP	Interworking Path
MPLS	MultiProtocol Label Switching
NGN	Next Generation Network
OAM	Operations, Administration and Maintenance
PCI	Protocol Control Information
PNNI	Private Network Node Interface
QoS	Quality of Service
SAP	Service Access Point
SLA	Service Level Agreement
SLS	Service Level Specification
TCP	Termination Connection Point

5 Conventions

This Recommendation uses no specific conventions.

6 General aspects of interworking

The objective of interworking is to provide some end-to-end communications entity across a single server layer network or across a concatenation of (peered) server layer networks, which may consist of different networking technologies.

Throughout this Recommendation, an individual server layer network, within such a concatenation of server layer networks, is referred to as a server layer partition. The end-to-end communications entity may be a common higher layer network but may be a common application adaptation function.

Fundamentally, there are two interworking relationships, "client/server" and "peer-partition". They are sometimes known as "network" and "service" interworking. More complex interworking relationships can be derived from these two fundamental ones.

Client/server interworking describes and defines the way that end-to-end user traffic is transferred over a single server layer technology.

Peer-partition interworking describes and defines the way that end-to-end user traffic is transferred over a concatenation of discrete server layer technology partitions that may belong to different networking modes.

Interworking can take place between any two contiguous layer networks, regardless of their position in the total layer network stack. For example, there is interworking between transmission-media dependent technologies at the lowest level of the total stack and between the application signalling at the highest.

Combinations of layer networks in these two interworking relationships can produce complex networks.

Therefore, it is important to address interworking from the perspective of the end-to-end user traffic (the client layer) and not just from the perspective of the server layer(s). It is clear that in order to achieve this aim, a client/server relationship must be formed between each of the server layer(s) and their common client layer (i.e., the end-to-end user traffic).

The performance experienced by a client entity is dependant on the server layer partitions that it traverses and the performance experienced will ultimately depend on the networking technology and the networking mode that each server layer partition belongs to. More generally because a link connection in layer network N is supported by a trail in layer network N – 1, and this is a recursive relationship to the physical transmission media, the performance impairments experienced by layer network N are a sum (which is not necessarily linear) of the performance impairments inherited from all of the lower layer server networks (down to the physical transmission media) that support layer network N.

A given layer network can be defined in terms of the specific semantics and syntax of its user plane traffic units (including user plane OAM functions) and its control plane functions. Provided that the same functional semantics exists in two layer networks, both the user plane and the control plane can be interworked by passing on the semantics from one layer network to the other in the appropriate syntax.

The user plane semantics describes the purpose (or meaning) of a given user plane function in an abstract manner. The user plane syntax for a function describes how that function is encoded within the user plane traffic (i.e., how the bits used to encode that function are arranged). For example, both MPLS and Ethernet support connectivity verification (CV) functions. The semantics of a CV function could be described as "a function that monitors the availability of a path across a network". Although both MPLS and Ethernet support CV functions, the syntax that they use to encode the CV function differs: the format of an MPLS CV packet as described in [b-ITU-T Y.1711] differs from the format of an Ethernet ETH-CC frame as described in [b-ITU-T Y.1731]. In other words, MPLS and Ethernet share the same semantics for CV but they do not share the same syntax.

However, different layer networks may have differing functional semantics and syntax (the exact semantics and syntax will depend on the layer network's networking mode and technology), and therefore interworking is restricted to the functional semantics shared by all the peered server layer technologies used to support a given client layer entity. Similarly, all the functions and features of one server layer technology may not be available in another server layer technology, even if they belong to the same networking mode. Depending on the server layer partitions' network technology and mode, the set of common functions and features between different server layer partitions could be large or small.

It is also possible that a given application or client layer to server layer adaptation used by one server layer technology will not be the same as the one used by a different server layer technology. Therefore, it is possible that an attempt to map functions and features directly between server layer partitions will not be totally successful, and in some cases will have no meaning. When transferring a common client entity over a series of server layer networks, it is especially important for each server layer network to, wherever possible, transparently transfer all of the planes of its client entity.