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SNE
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Introduction to ITU-T Recommendation G.805

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Abstract
This technical report serves as a short introduction to the terminology and functional elements defined in ITU-T Recommendations G.805. It defines connection point, link connection, tandem connection, network connection, adaptation, termination, multiplexing, subnetwork, subnetwork connection, client layer, and server layer.

Rather than the formal definitions as used in the standard, it uses an informal approach.

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1 Context

The process of creating an abstract description of a network involves two steps, as shown in figure 1.

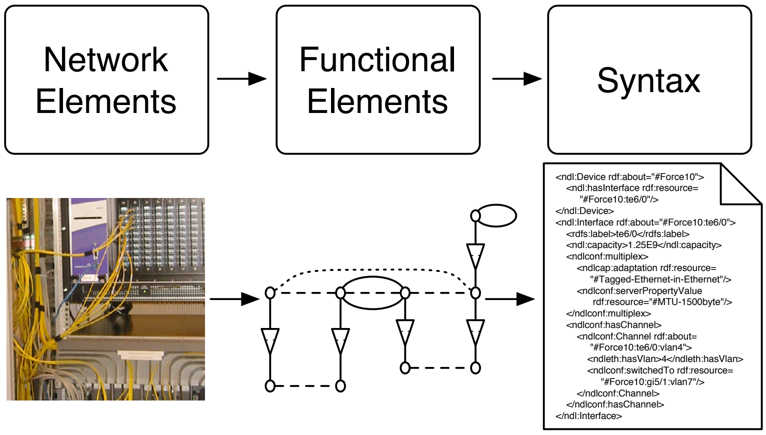


Figure 1: The two steps required to create an abstract description of a network.

The first step contains the creation of an abstract representation of the physical network elements. Individual components in the abstract representation are so-called functional elements, like *device* and *interface*. The mapping of network elements to functional elements is called information modelling [1]. A second step is the mapping of the functional elements to a certain syntax.

2 G.805 Functional Elements

ITU-T Recommendation G.805 [2] provides a set of generic functional elements, without actually specifying the mapping from network elements to functional elements. Neither does it provide a syntax to describe the functional elements.

The functional elements defined by ITU-T G.805 allow a description of circuit switched network connections through a multi-layer network.

2.1 Connection Point and Layer

ITU-T G.805 defines a **connection point** as a source and sink for data transport. A good way to think about it is as a hop or (virtual) interface on a network connection. One physical interface can consist of multiple logical interfaces. For instance one for each distinguishable data flow.

A **layer** is defined as the set of all possible connection points of the same type. Two connection points are of the same type if a data-transport function can be created between them. So each connection point resides at one specific layer.

2.2 Connections

Informally, a **connection point** can be thought of as a vertex in a graph, and a **link connection** as an edge in the graph. A **tandem connection** is a series of contiguous link connections, and a **network connection** is a tandem connection between two connection points where the connection is terminated for that layer: an end-to-end connection on a certain layer.

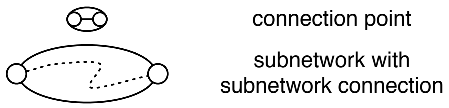
More formally G.805 defines a link connection as *a "transport entity" that transfers information between parts across a link.* A network connection is defined as *a series of contiguous link connections and/or subnetwork connections between "termination connection points".*

The termination connection point in the previous definition means that the network connection is an end-to-end connection on that layer.

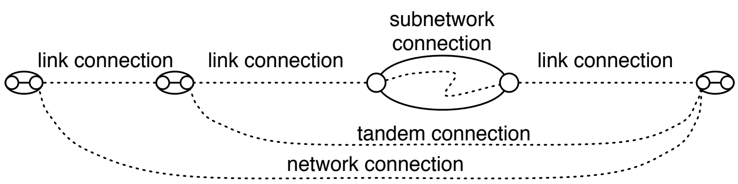
Subnetworks can represent parts of the network *at a single layer.* In general, subnetworks may be partitioned into smaller subnetworks interconnected by link connections. The minimal subnetwork in G.805 is called a **matrix**. A connection through a subnetwork is called a **subnetwork connection**. An undividable subnetwork connection is called a **matrix connection**. As subnetworks and matrices are defined at a single layer, subnetwork connections and matrix connections can only be described at a single layer as well.

A subnetwork is typically used to describe a network without giving further information about the exact details. For example, a subnetwork can be used to model a domain or a device.

The diagrammatic conventions are depicted in figures 2a and 2b.



(a) connection point and subnetwork connection



(b) link connection, tandem connection and network connection

Figure 2: Graphical representations of functional elements.

2.3 Adaptation and termination

If we want to send data belonging to layer X over a different layer Y, the data needs to be transformed. This transformation is defined by an **adaptation function**.

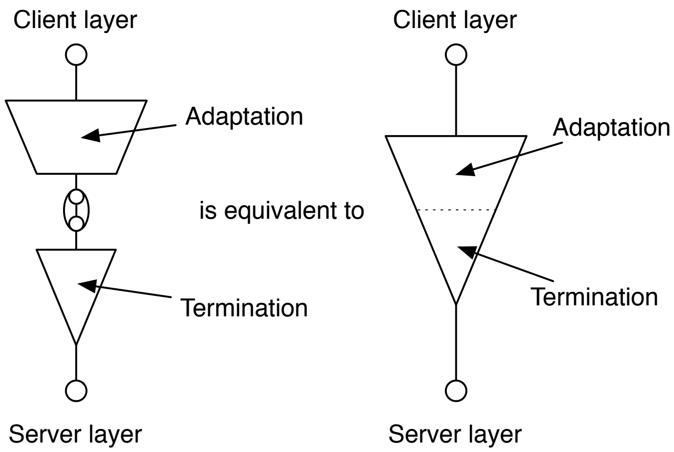


Figure 3: Graphical representation of the adaptation and termination functions. The representation on the right is a simplification of the representation on the left.

ITU-T G.805 defines the **adaptation function** and the **termination function**. The adaptation function defines how data belonging to a **client layer** network is embedded into data of a **server layer** network. The termination function adds monitoring information to the server layer network connection, taking care of a reliable data transmission.

The trail termination function is defined by G.805 as *a transport processing function that consists of the trail termination source where monitoring information is added and the trail termination sink which removes the monitoring information.* So in short, a termination function just adds *monitoring information.* For example, a termination function adds a checksum field to each data packet.

A graphical representation of these functional elements is depicted in figure 3. The adaptation function is visualised by the upper part of the triangle and the termination function is visualised by the lower part of the triangle.

Adaptation and termination have analogies in the real world. For example, we want to send ten Tulip bouquets from Amsterdam to New York. Rather than sending them as-is, we wrap them in a box for shipping. This is the adaptation. However, a box may only contain six bouquets, so we use two boxes and mark them as “box 1/2” and “box 2/2”. This allows the recipient to verify that the shipment arrived complete and unmodified. This is the termination.

Figure 4 shows how adaptations can be used to build network connections on a higher layer, the client layer, using network connections on an underlying layer, the server layer. Formally, such a link connection *represents a pair of adaptation functions and a trail in the server layer network*, where the **trail** is a terminated network connection. So if there is a network connection on a (lower) server layer network, and both ends have the same termination and adaptation functions, then there is a link connection at the client layer above.

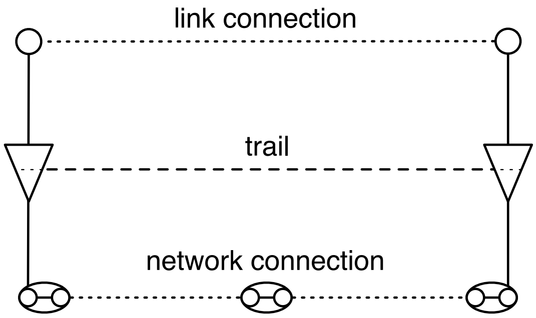


Figure 4: A network connections on the server layer with two adaptations functions yields a link connection on the client layer.

2.4 Multiplexing

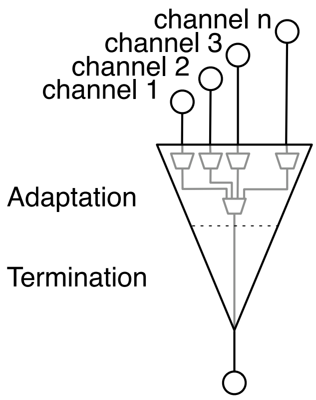


Figure 5: Implementing multiple connections over a network link is equivalent with multiplexing at the adaptation function.

Channeling, implementing multiple connections over a network link, is equivalent with multiplexing at the adaptation function in G.805. As figure 5 shows, the adaptation function may consist of specific processes for each channel at the client layer and one common process that converts these adapted client layer channels to the server layer. Each logical channel interface is represented as a connection point on the client layer, while there is only one (termination) connection point at the server layer.

3 Further Reading

This short introduction is rather informal in style. For a more concise definition, please refer to the standard itself [2]. It is also not complete. It does not define the concepts of access point and inverse multiplexing.

The functional elements defined by ITU-T G.805 allow a description of circuit switched network connections through a multi-layer network. In addition, ITU-T G.809 [3] describes the same kind of functional elements for packet switched network connections. In our view, G.809 tries to map the terminology of circuit switched networks to packet switched networks, ignoring important characteristics of packet switched networks such as packet sizes or buffer sizes.

References

[1] A. Pras, J. Schoenwaelder, On the Difference between Information Models and Data Models, RFC 3444 (Informational) (Jan. 2003).
URL `http://www.ietf.org/rfc/rfc3444.txt`

[2] ITU-T Recommendation G.805: Generic functional architecture of transport networks, Tech. rep., International Telecommunication Union (March 2000).
URL `http://www.itu.int/rec/T-REC-G.805`

[3] ITU-T Recommendation G.809: Functional architecture of connectionless layer networks, Tech. rep., International Telecommunication Union (March 2003).
URL `http://www.itu.int/rec/T-REC-G.809`