SUNTECH

Z-Architecture

The telecommunications network architecture can be viewed from the functional, technological or organisational perspective, depending on whether the view is focused on network communications functions, on network transport resources or on the organisational hierarchy of the network, respectively. While the communications functions are usually described in accordance with the OSI reference model, there exist no such commonly accepted models as far as the other two aspects of the network architecture are concerned.

Z-Architecture is the network transport resources reference model proposed in 1990 at the Institute of Telecommunications of the Warsaw University of Technology in the context of research on the ATM and SDH network planning methodology. The key ideas of the model are consistent with the network modelling principles contained in the ITU-T G.803 Recommendation devoted to the architecture of transport networks based on the SDH. However, the Z-Architecture model is both more abstract, since its primary use is configuration planning not operations and management, and more general since it is not limited to transmission network resources only.

The basic function of a telecommunications network is to ensure information transport that the services offered by the network operator require. In modern telecommunications networks, providing such a transport effectively calls for a variety of connections to be set up. The connections and their elements are basic transport resources of a telecommunications network. Their description is by no means simple.

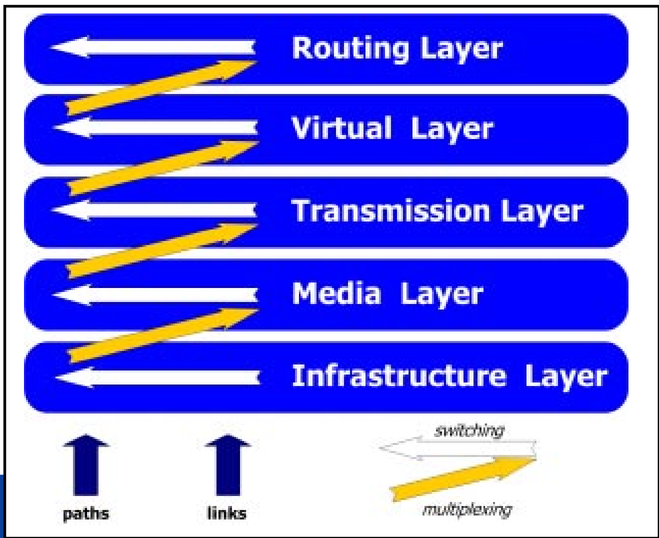
A wide range of connection classes existing in a telecommunications network results from the set of the available transmission and switching technologies and an even reacher set of services and their individual transport characteristics that have to be matched. The differences are reflected by different types of transmission media and transmission signals, different transfer modes and transfer speeds employed, different routing principles applied in the network etc. The differences of relative cost-effectiveness factors require that the connections be set up recursively.

The diversity of connection classes and their mutual dependance highly increase the complexity of the network resources description, which is increased even more every time a new connection class emerges. Z-Architecture provides the method of network decomposition by partitioning transport resources into hierarchically ordered layers. A network layer corresponds to all network resources forming connections of certain class. Although the objects of each layer and relations between them are different, the transport resources of all layers are modelled with the same set of generic object types - nodes, links and paths, and with the same set of generic operations that are applied to these objects - switching and multiplexing. Only the interpretation of objects and functions is layer-specific.

Links are direct elementary transport connections between pairs of nodes. Paths are sequences of cross-connected links corresponding to end-to-end connections. Nodes are places where paths are terminated and links are both terminated and cross-connected. The generic function of cross-connecting links at intermediate nodes in order to create paths is named switching.

Network connections of one type can be used to set up elementary connections of another type. One or more paths of certain layer can be used to create one or more links of some other layers. The generic function of creating links of paths of an adjacent layer is named multiplexing. The multiplexing function usually has the form of either grouping or splitting.

Z-Architecture introduces five generic layers: Infrastructure Layer, Media Layer, Transmission Layer, Virtual Layer and Routing Layer. Although the choice of these layers is to some extent arbitrary, nevertheless each of the introduced layers corresponds to essentially different principles of switching and multiplexing. The generic layers are usually further subdivided into specific sub-layers.



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Infrastructure Layer models telecommunications infrastructure required to install cable and radio transmission systems. The nodes correspond to telecommunications buildings, cable splays and radio masts. Links are either cable ducts and PVC tubes between pairs of splays or buildings, or pairs of radio masts that are "visible" to each other. Paths are routes for laying down optical-fibre cables.

Media Layer describes cable and optical-fibre connections. Cable connections are modelled within the cable sub-layer. A link of this sub-layer corresponds to a cable segment. Laying down one or more cable segments along an infrastructure route between a pair of splays or buildings is a specific form of the multiplexing function. Paths are sequences of connected cable segments of same type. Link switching is performed with cable-joins.

A link of the fibre sub-layer is a single fibre within an optical-cable connection. Nodes that terminate and switch links are fibre distribution frames at which fibres are cross-connected. Paths correspond to fibre connections.

Transmission Layer models optical and digital connections. Optical connections are paths of the optical sub-layer. A link of this sub-layer is an optical signal of certain wave-length within an optical-fibre connection. The installation of an optical transmitter at the termination of an optical-fibre connection leads to creating one or more (if WDM is used) optical links, and thus can be regarded as another form of multiplexing. Nodes of the optical sub-layer are optical cross-connects.

Digital connections of certain bit-rate are modelled as paths of an appropriate digital sub-layer. The digital sub-layers are derived from the definition of PDH and SDH hierarchies. A link corresponds to one digital channel of an optical signal or of a higher bit-rate digital connection. In the latter case multiplexing function is performed by traditional digital multiplexers. A node of a digital sub-layer is an electrical distribution frame or an automatic synchronous digital cross-connect of DXC or ADM type.

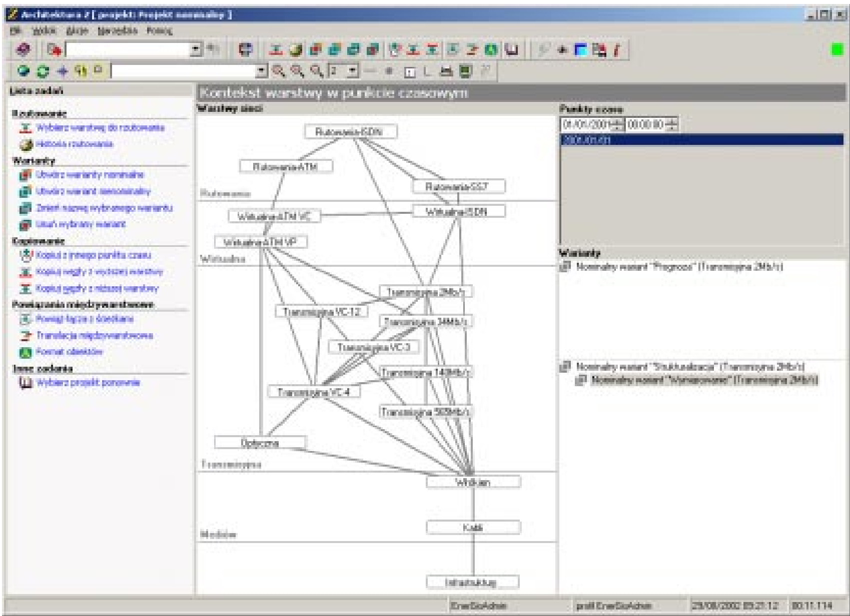
Virtual Layer describes leased semi-permanent connections of an ISDN network and VP connections of a B-ISDN ATM network. The connections are set up by the operations control of ISDN and ATM exchanges. A node of the ISDN virtual sub-layer is an ISDN exchange, in particular its switching matrix and operations control (call control functions are not utilised). A link corresponds to a synchronous (n x 64) kbps channel. A set of such links is obtained when a pair of ISDN exchanges are inter-connected with a 2 Mbps transmission connection; this is how the multiplexing function looks like. Links are switched in a switching matrix with operations control commands. A path is a semipermanent (n x 64) kbps connection.

A node of the B-ISDN ATM virtual layer is an ATM cross-connect. A link corresponds to a VP link. A set of 212 such links is formed by two ATM cross-connects on the VC-4 connection terminated at their ports. The multiplexing function has thus the form of asynchronous splitting of the synchronous transmission connection. A path is a VP connection. Switching function is performed by defining VP-level routing tables of the ATM cross-connects.

Routing Layer models traffic routes of the signalling and call-level user traffic in the ISDN and B-ISDN networks. A node of the SS7 routing sub-layer is an SS7 signalling point (SP) which can be part of an exchange or of a management centre. A link is a signalling link-set obtained by grouping of one or more semipermanent 64 kbps connections terminated at the signalling terminals of two SP. Such grouping is a task of the multiplexing function. A path is a signalling route, created by appropriate definition of SP routing tables.

A node of the ISDN routing sub-layer is an ISDN exchange. A link corresponds to a trunk group. The multiplexing function groups several 2 Mbps digital connections connected to the ports of two ISDN exchanges, and assigns at least one signalling route to such a group. Definition of the traffic routing tables in ISDN exchanges is a form of link switching. A path is a traffic route (in the form of trunk group sequence) for ISDN calls.

In case of the B-ISDN ATM routing sub-layer a node is an ATM exchange and a link is obtained by grouping VP connections instead of 2 Mbps connections.



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