



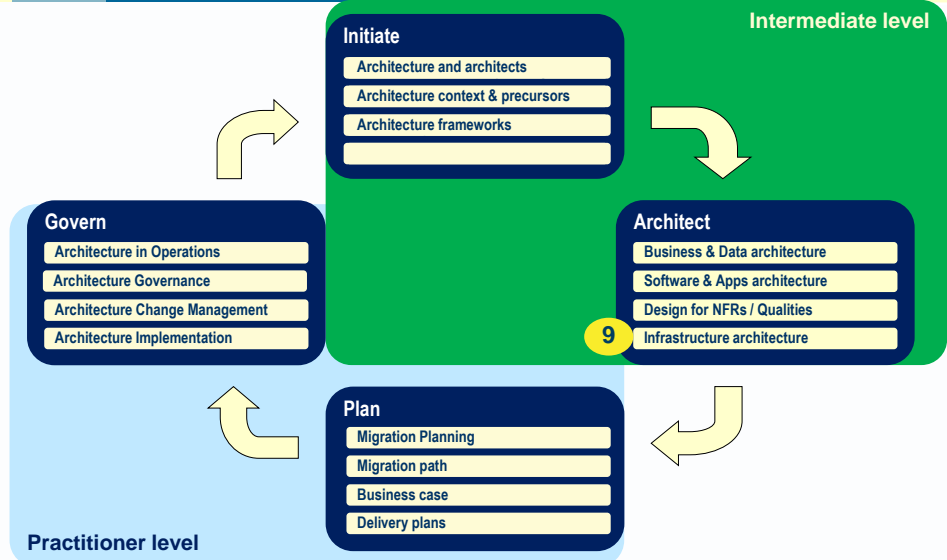
Avancier Reference Model

Infrastructure Architecture (ESA 9)

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Mapping this session to an architecting process



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1.9 Infrastructure (platform technology) architecture

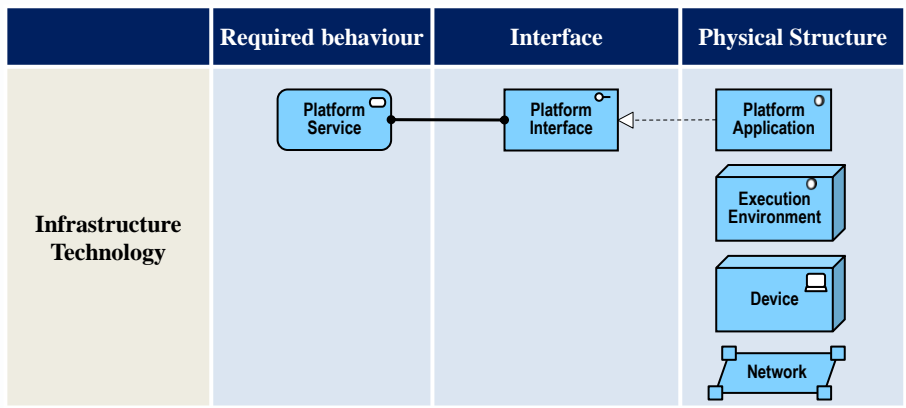
Infrastructure architecture in the AM core framework for EA



	<i>Passive Structure</i>	<i>Required Behaviour</i>	<i>Logical Structure</i>	<i>Physical Structure</i>
Business		<div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Business Service</div> <div style="border: 1px solid black; padding: 2px;">Business Process</div>	<div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Function</div> <div style="border: 1px solid black; padding: 2px;">Role</div>	<div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Org Unit</div> <div style="border: 1px solid black; padding: 2px;">Actor</div>
Data / Information	<div style="border: 1px solid black; padding: 2px;">Data Entity</div>	<div style="border: 1px solid black; padding: 2px;">Data Flow</div>	<div style="border: 1px solid black; padding: 2px;">Log Data Model</div>	<div style="border: 1px solid black; padding: 2px;">Data Store</div>
Applications		<div style="border: 1px solid black; padding: 2px;">IS Service</div>	<div style="border: 1px solid black; padding: 2px;">Application Interface</div>	<div style="border: 1px solid black; padding: 2px;">Application</div>
Infrastructure Technology		<div style="border: 1px solid black; padding: 2px; text-align: center;">Platform Service</div>	<div style="border: 1px solid black; padding: 2px; text-align: center;">Platform Interface</div>	<div style="border: 1px solid black; padding: 2px; text-align: center;">Platform Applicat'n</div>

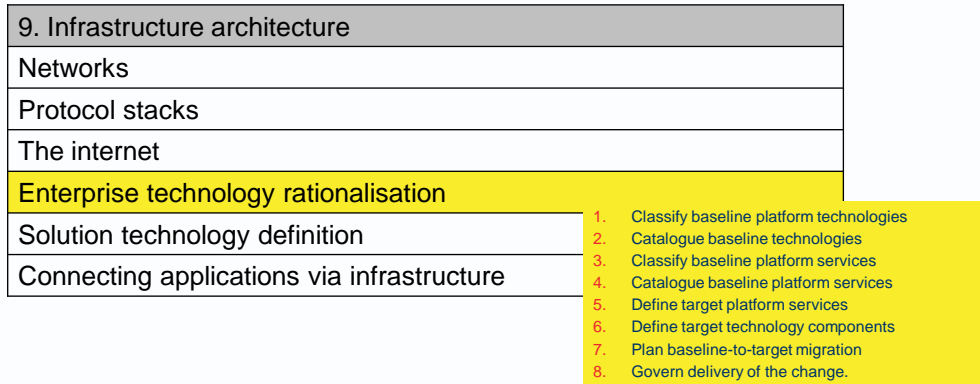
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9: Infrastructure domain / viewpoint



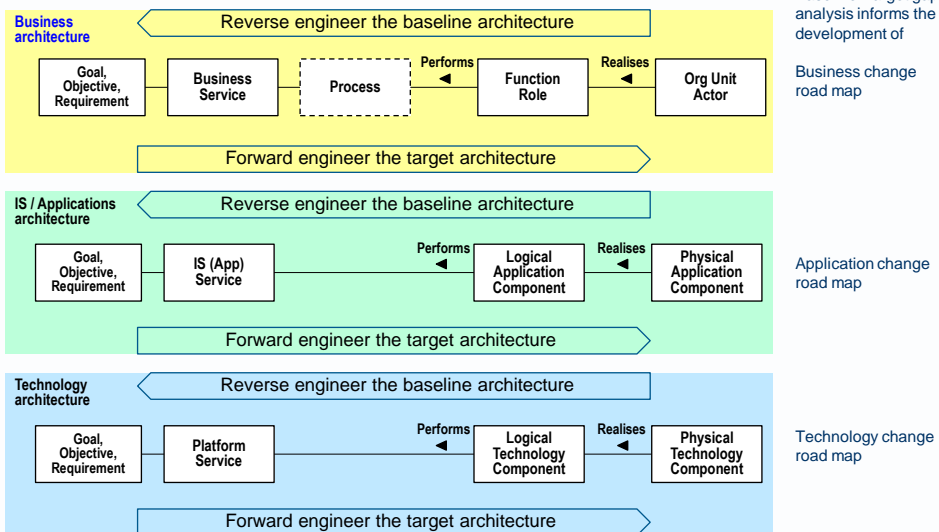
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9. Infrastructure architecture



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Enterprise architecture transformation



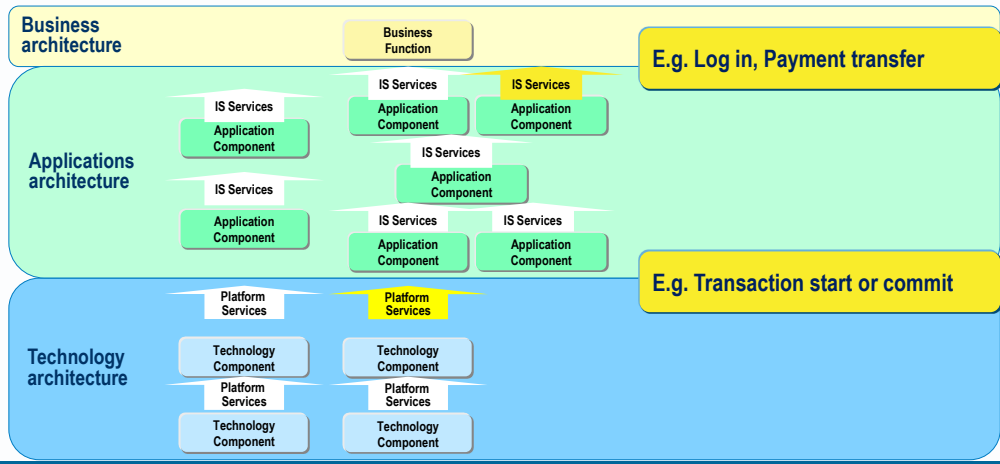
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1.9 Infrastructure (platform technology) architecture

Defining (encapsulating) components by the services they offer

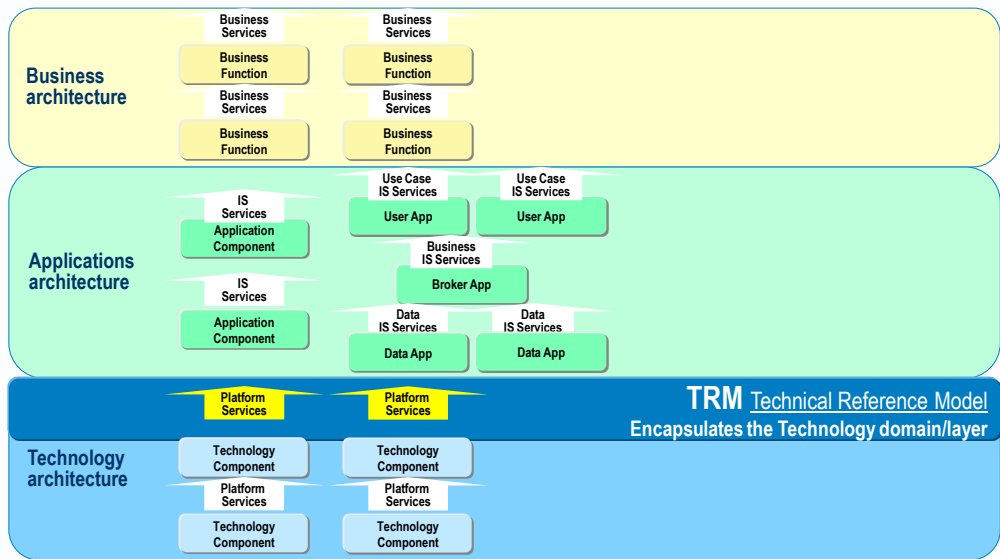


► In TOGAF, an Architecture Building Block that is a **Logical Component** provides a **portfolio of Services**



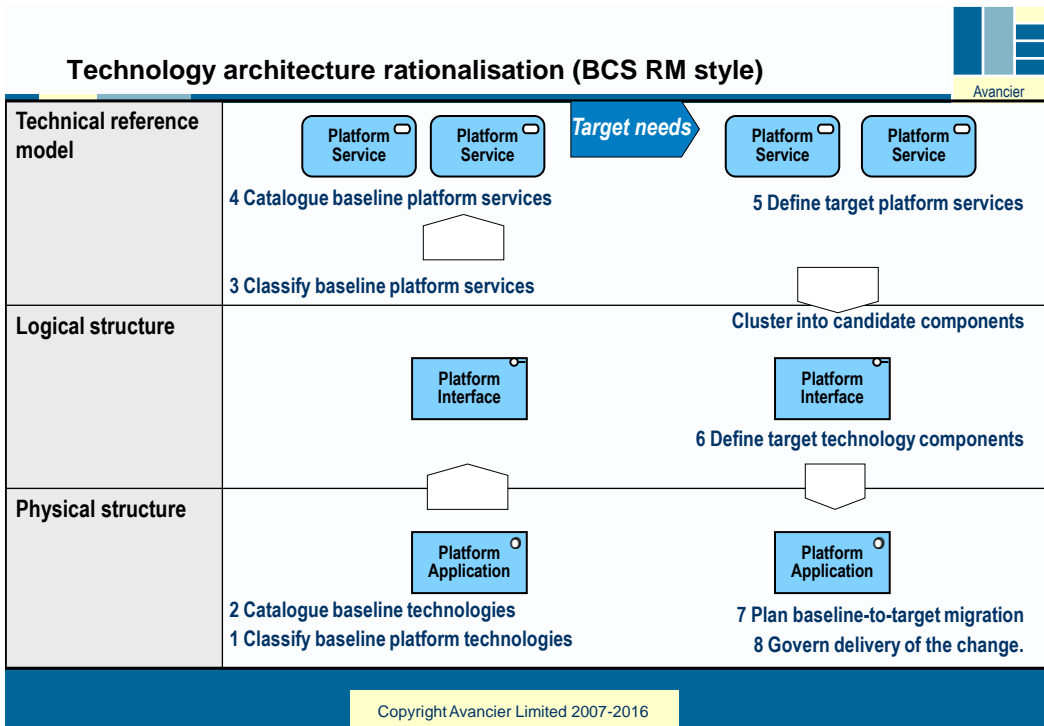
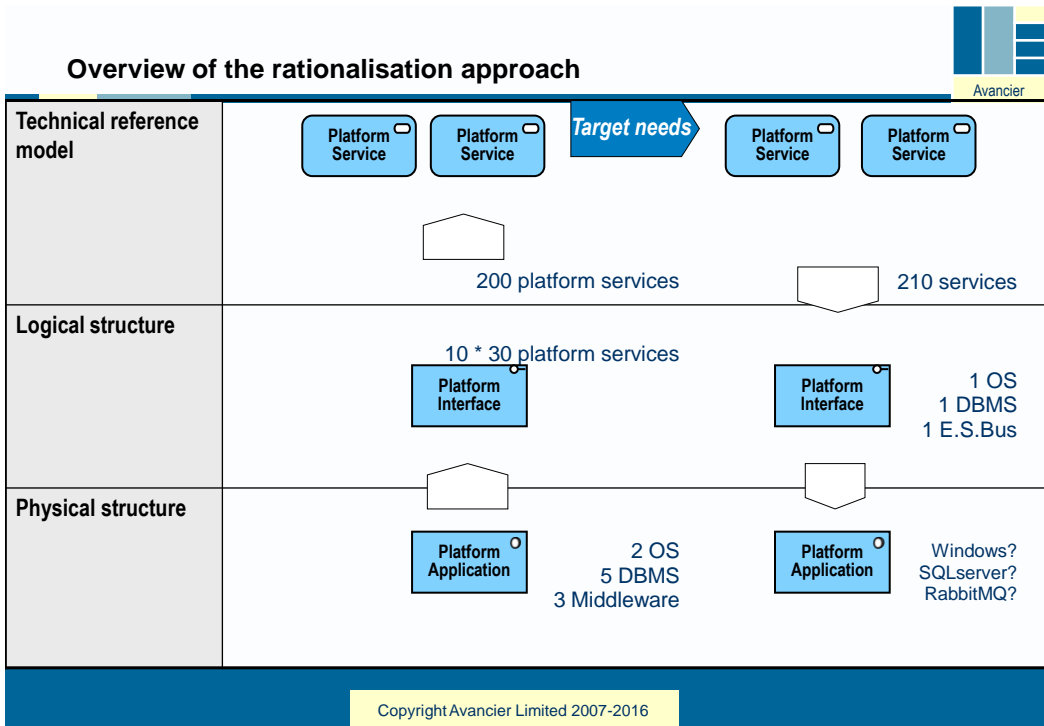
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Using a Technical Reference Model to encapsulate infrastructure



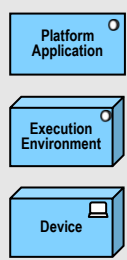
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1.9 Infrastructure (platform technology) architecture



1. Classify baseline platform technologies

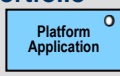


<p>Enterprise technology classification</p> 	<p>A structure for a catalogue of technology components, with headings such as those below.</p> <ul style="list-style-type: none"> ▶ Client (user access) devices ▶ Generic user applications ▶ Application platform ▶ Software development ▶ Integration tools ▶ Data management ▶ Servers ▶ Data storage ▶ Networks ▶ ITSM/operations ▶ Environment ▶ Security 	<ol style="list-style-type: none"> 1. Classify baseline platform technologies 2. Catalogue baseline technologies 3. Classify baseline platform services 4. Catalogue baseline platform services 5. Define target platform services 6. Define target technology components 7. Plan baseline-to-target migration 8. Govern delivery of the change.
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2. Catalogue baseline technologies



<p>Technology catalogue or portfolio</p> 	<p>A list of technology components types in a baseline or target architecture, usually arranged in the hierarchical structure of an enterprise technology classification. [See ETC.]</p>	<ol style="list-style-type: none"> 1. Classify baseline platform technologies 2. Catalogue baseline technologies 3. Classify baseline platform services 4. Catalogue baseline platform services 5. Define target platform services 6. Define target technology components 7. Plan baseline-to-target migration 8. Govern delivery of the change.
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3. Classify baseline platform services



<p>Infrastructure service</p>	<p>A term that can be interpreted at several levels and in different ways. For example:</p> <ul style="list-style-type: none"> ▶ A basic service such as computing power or memory, provided by real or virtual computers. ▶ A platform service. [See below.] ▶ An operational service such provided by an IT services management tool or organisation. [See "IT Service".]
<p>Platform service</p> <div style="border: 1px solid black; border-radius: 5px; padding: 2px; width: fit-content; margin-top: 10px;"> <p>Platform Service</p> </div>	<p>A service such as transaction management or user access control, provided by one or more platform technology components to applications. [See Technical Reference Model.]</p>

1. Classify baseline platform technologies
2. Catalogue baseline technologies
3. [Classify baseline platform services](#)
4. Catalogue baseline platform services
5. Define target platform services
6. Define target technology components
7. Plan baseline-to-target migration
8. Govern delivery of the change.

3. Classify baseline platform services



<p>Technical Reference model (TRM)</p> <div style="border: 1px solid black; border-radius: 5px; padding: 2px; width: fit-content; margin-top: 10px;"> <p>Platform Service</p> </div>	<p>A logical and hierarchical classification of the platform services provided by infrastructure technologies to applications. Can provide a requirement specification for technology rationalisation.</p> <p>For example, the service categories in the TOGAF Technical Reference Model include:</p> <ul style="list-style-type: none"> • Data Interchange Services • Data Management Services • Graphics and Imaging Services • International Operation Services • Location and Directory Services • Network Services • Operating System Services • Security Services Software • Engineering Services • System and Network Management • Transaction Processing Services • User Interface Services • Quality of Service
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1. Classify baseline platform technologies
2. Catalogue baseline technologies
3. [Classify baseline platform services](#)
4. [Catalogue baseline platform services](#)
5. Define target platform services
6. Define target technology components
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8. Govern delivery of the change.

1.9 Infrastructure (platform technology) architecture

TOGAF's Technical Reference Model (TRM) – The graphic

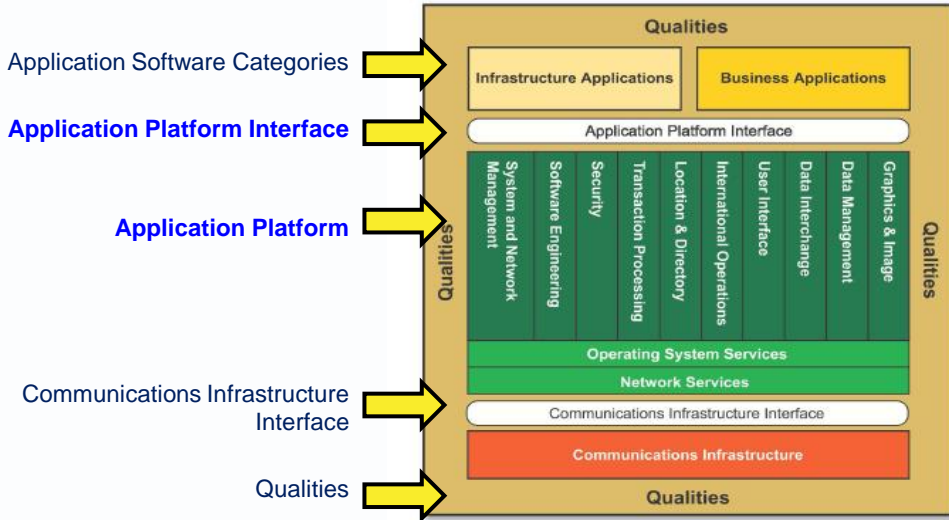


Figure 43-2 Detailed Technical Reference Model (Showing Service Categories)


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TOGAF's Technical Reference Model (TRM) – The taxonomy

User Interface Services	Transaction Processing Services	Operating System Services	Software Engineering Services
Graphical Client/Server services	Starting a transaction	Kernel Operations	Programming Language services
Display Objects services	Co-ordination of recoverable resources in a transaction	Command Interpreter and Utility services	Object Code Linking services
Window Management services	Committing or rolling back transactions	Batch Processing services	CASE Environment and Tools services
Dialogue Support services	Controlling timeouts on transactions	File and Directory Synchronization	Graphical User Interface (GUI) Building services
Printing services	Chaining transactions together		Scripting Language services
Computer-Based Training and Online Help services	Monitoring transaction status		Language Binding services
Character-Based services			Run-Time Environment services
			Application Binary Interface services
Graphics and Imaging Services	Data Management Services	Network Services	OO Provision of Services
Graphics services	Data Dictionary/Repository services	Electronic Mail services (send, receive...)	Object Request Broker (ORB) services
Graphical Object Management services	Database Management System (DBMS) services	Distributed Data services	Implementation Repository services
Drawing services	OO Database Management System (OODBMS) services	Distributed File services	Installation and Activation services
Imaging functions	File Management services	Distributed Name services	Interface Repository services
	Query Processing functions	Distributed Time services	Replication services
International Operation Services	Screen Generation functions	Remote Process (Access) services	Common Object services
Character Sets and Data Representation services	Report Generation functions	Remote Print Spooling and Output Distribution services	Change Management services
Cultural Convention services	Networking/Concurrent Access functions	Enhanced Telephony functions	Collections services
Local Language Support services	Warehousing functions	Shared Screen functions	Concurrency Control services
		Video-Conferencing functions	Data Interchange services
		Broadcast functions	Event Management services
		Mailing List functions	Externalization services
			Licensing services
Data interchange services	Location and Directory Services	System and Network Management Services	
Document Generic Data Typing and Conversion services	Directory services	User Management services	Lifecycle services
Graphics Data Interchange services	Special-Purpose Naming services	Configuration Management (CM) services	Naming services
Specialized Data Interchange services	Service Location services	Performance Management services	Persistent Object services
Electronic Data Interchange services	Registration services	Availability and Fault Management services	Properties services
Fax services	Filtering services	Accounting Management services	Query services
Raw Graphics Interface functions	Accounting services	Security Management services	Relationship services
Text Processing functions		Print Management services	Security services
Document Processing functions		Network Management services	Start-Up services
Publishing functions		Backup and Restore services	Time services
Video Processing functions		Online Disk Management services	Trading services
Audio Processing functions		License Management services	
Media Synchronization functions		Capacity Management services	
Multimedia Processing functions		Software Installation services	
Information Presentation and Distribution functions		Trouble Ticketing services	
Hypertext functions			

Cross-organisational technology rationalisation

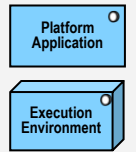


<p>Technology rationalisation</p>  <p>Baseline Platform Application</p> <p>Platform Service</p> <p>Target Platform Application</p>	<p>A process for studying the services provided by a baseline technology infrastructure and defining a de-duplicated target architecture:</p> <ol style="list-style-type: none"> 1. Classify baseline platform technologies 2. Catalogue baseline technologies 3. Classify baseline platform services 4. Catalogue baseline platform services 5. Define target platform services 6. Define target technology components 7. Plan baseline-to-target migration 8. Govern delivery of the change.
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Environment: progression in data centre efficiency



<p>Virtual machine</p>  <p>Platform Application</p> <p>Execution Environment</p>	<p>Software that enables application programs to run above – that is, decoupled from - the underlying operating system and/or hardware processor.</p> <p>Optimises resource usage, enables applications to be moved between different operating systems and/or processors.</p>
<p>Server consolidation</p>	<p>In this context, server means a computer hosting one or more applications.</p> <p>So server consolidation means deploying more applications to fewer servers.</p>

In parallel, automate the management and optimisation of the infrastructure services based on well-defined policies.

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9. Infrastructure architecture – end of pass 1



▶ SHOW RELEVANT MOCK EXAM QUESTIONS

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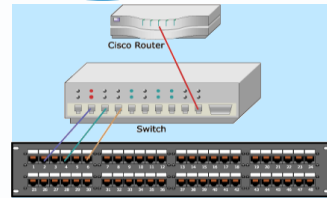
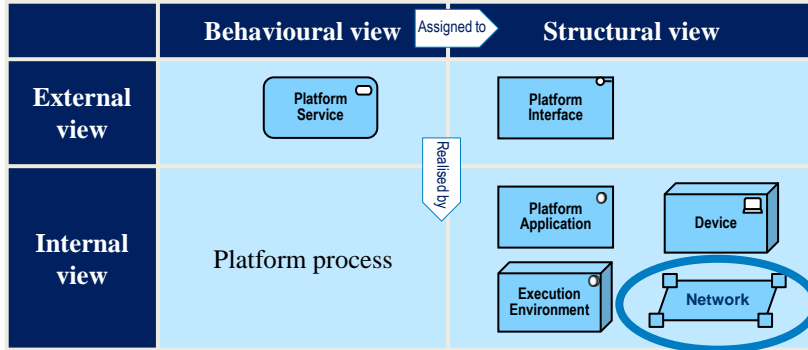
Foundation terms: computers



Node	<p>A node on a computing network.</p> <p>A physical node is a computer, switch, router, bridge, repeater or any other device attached to a network.</p> <p>A logical node is a web server, app server, database server or other platform for application software.</p>
Computer	<p>The primary building block of IT systems.</p> <p>A system that can execute stored programs.</p> <p>A hardware device that contains a processor.</p> <p>May take the role of a client or server.</p>
Processor (CPU)	<p>The part at the heart of a computer that reads and executes elementary software instructions.</p> <p>The power or speed of a processor may be increased by various kinds of parallel processing.</p>
Operating System (OS)	<p>The bottom level platform application, which enables other applications to execute instructions on the hardware.</p>

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9: Infrastructure domain / viewpoint



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Network scopes



<p>Network</p> 	<p>1: Generally: a structure of links in which arcs connect nodes, lines connect boxes, relationships connect entities, or channels connect inter-communicating components.</p> <p>Or 2: More specifically: a set of communications links that enables one computer or electro-mechanical device to receive data sent by another. There are computer networks and phone networks.</p>
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Network scopes



Personal Area Network (PAN)	The smallest scope of network, typically carried or worn by a person.
Local Area Network (LAN)	The scope of a network under the control of a local network administrator, usually within a building or closely connected buildings.
Metropolitan Area Network (MAN)	A network that connects several LANs within the area of a large campus or metropolis, using some kind of private WAN.
Wide Area Network (WAN)	The largest scope of network, managed by a network service provider, usually employs the Internet.

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Network scopes: VPN



Virtual Private Network (VPN)	<p>A network in which communication between nodes is carried by connections within some larger network (usually the Internet) instead of by physical wires.</p> <p>Feels like a LAN; usually uses a WAN.</p> <p><i>The link-layer protocols?</i> of the virtual network are said to be tunnelled through the wider network.</p> <p>Can reduce costs.</p> <p>Can raise security concerns. [no longer true?]</p>
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Network scopes: A SLA is needed!!!



Cloud Computing

The provision of computer power, data storage *and/or* application services over the internet.

Remote hosting of enterprise applications in a “virtual data centre” managed by a service provider.

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Topologies



Topology

The shape of a network, or communication routes over it.

A shape that connects nodes or constrains communications routes over a network.



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9. Infrastructure architecture



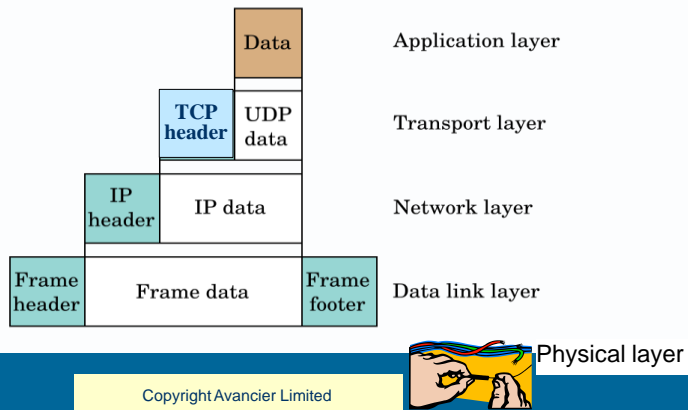
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Networks layers



Network Layer	A level in a hierarchy of communication layers, corresponding to layers of platform technologies.
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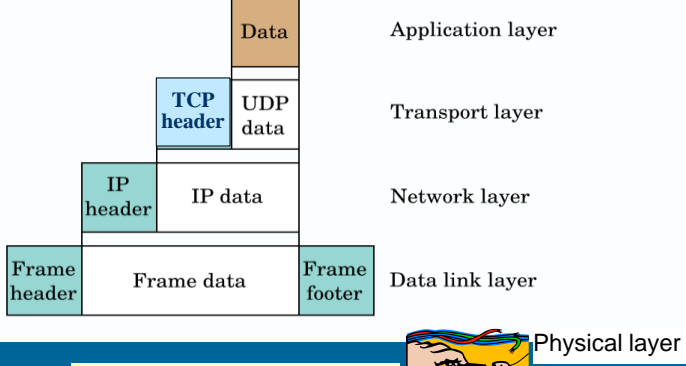


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Protocol



Protocol The rules used by message senders and receivers when they exchange messages via transport mechanisms, or by end points in a telecommunication exchange. Rules define a standard format for the header that precedes the message, the footer that follows the message, and the sequence in which messages are exchanged.

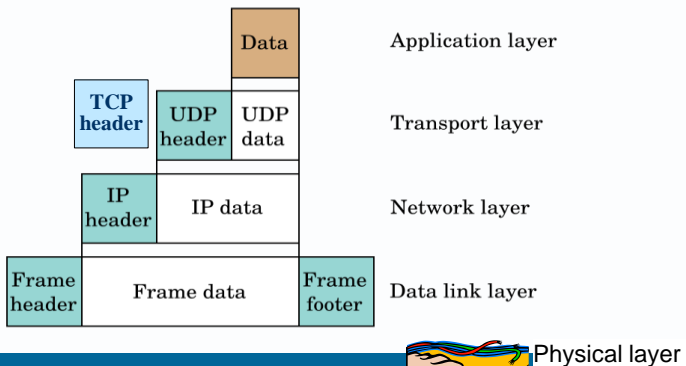


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Protocol stack



Protocol Stack Protocols are arranged in layers, corresponding to layers of platform technologies. The best known protocol stacks are probably OSI and TCP/IP.



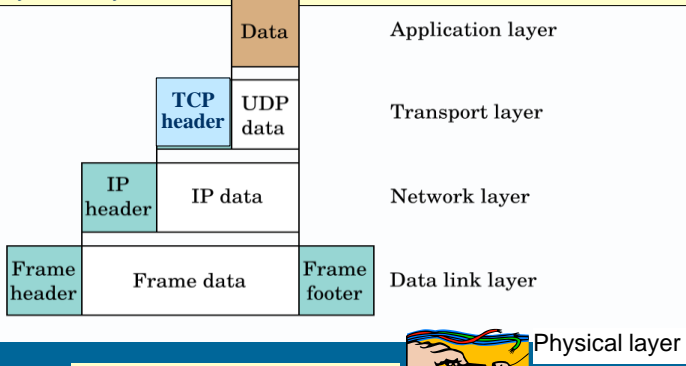
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TCP/IP 5 layer stack



TCP/IP 5 layer stack

A widely-discussed alternative to the OSI model:
 5: application layer
 4: transport layer
 3: network/internet layer
 2: data link layer
 1: physical layer



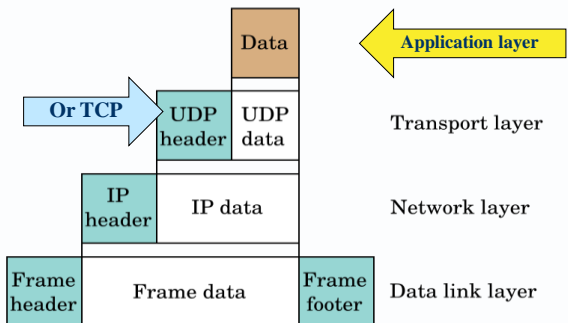
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Application level



Application or component connection level

The top level - where application components communicate.
 E.g. RPC, SOAP, HTTP, HTTPS, POP3, SMTP, DNS and FTP.



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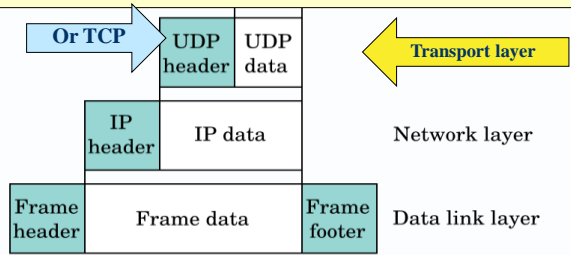
Transport level



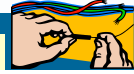
Transport level Manages the end-to-end control of message delivery.

E.g. The major transport layer protocols, TCP and UDP, have a checksum that covers all the data they carry. TCP checks for errors and either ensures complete data transfer or times out.

By contrast, UDP is a lightweight protocol that does not.



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Transport level e.g. TCP v UDP



	Transmission Control Protocol	User Datagram Protocol
Protocol	connection-oriented	connectionless
Connection	requires handshaking to set up end-to-end connection.	no effort to set up a dedicated end-to-end connection.
Reliability	Reliable - either no missing data, or, in case of multiple timeouts, the connection is dropped.	Unreliable - no concept of acknowledgment, retransmission and timeout.
Ordering	Ordered - when data packets arrive in the wrong order, the TCP layer holds data until the earlier data can be rearranged and delivered	Not ordered - the order in which packets arrive cannot be predicted.
Weight	Heavy - requires three packets just to set up a socket, before any actual data can be sent.	Light – simpler and faster
Unit	Streaming - Packets may be split or merged into bigger or smaller data streams arbitrarily.	Datagrams - Packets have definite bounds and no split or merge into data streams may exist.

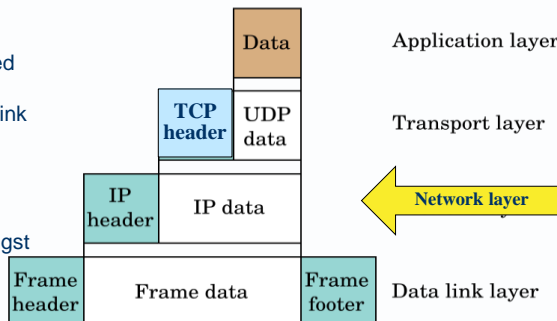
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Network level e.g. Internet Protocol



Network level	<p>Handles routing and forwarding of data at the packet level. Sends outgoing transmissions in the right direction to the right destination.</p> <p>Receives incoming transmissions.</p> <p>E.g. IP is a network level protocol.</p>
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Internet Protocol (IP)
 used for to send data across a packet-switched internetwork. encapsulated in a data link layer protocol (e.g., Ethernet). provides the service of communicable unique global addressing amongst computers.



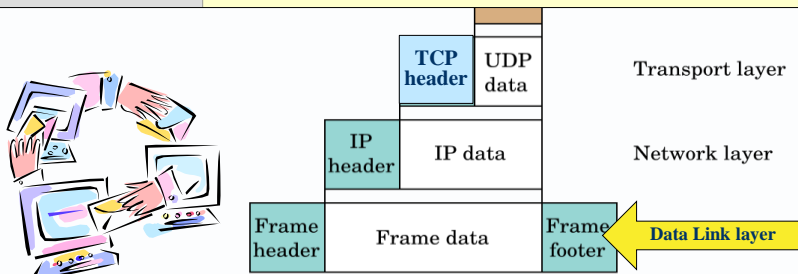
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Data transport level e.g. Ethernet



Data transport level	<p>The protocol that physical nodes use to communicate. The level at which data is transported around the physical network by network communications software.</p>
Aside	<p>E.g. Wi-Fi. Ethernet (based on a bus topology) and Token passing (based on a ring topology).</p> <p>May provide synchronisation for the physical level, do bit-stuffing for strings of 1's in excess of 5 etc.</p>

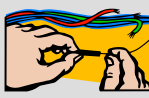


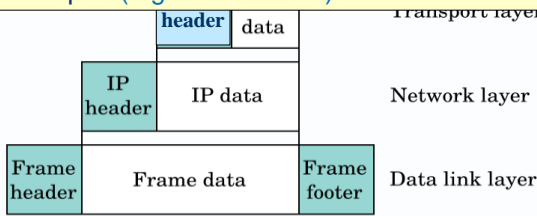
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Physical level



Physical level	 <p>The bottom level, where nodes are connected by a physical network medium. Conveys the bit stream through the network at the electrical and mechanical level - provides the hardware means of sending and receiving data on a carrier.</p>
Aside	E.g. Modems, Optical fiber, Coaxial cable, Twisted pair (e.g. 100Base-T?)



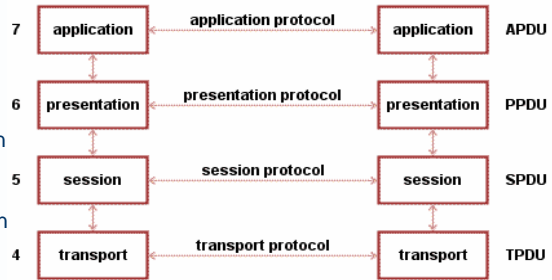
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OSI 7 layer stack

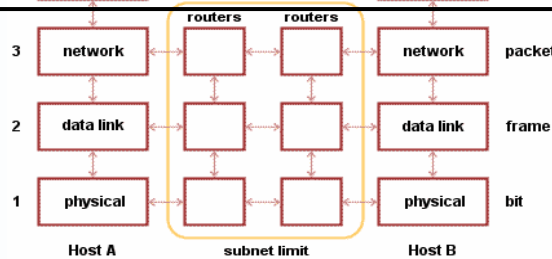
“All People Seem To Need Data Processing”
“All Pork Sausages Take Nine Dead Pigs”
Please Do Not Take Sales People’s Advice”



- ▶ **The Data Exchange level**
 - Host computers that are message sender and receiver end points use these layers
 - Applications control sessions between end points
 - Applications send/receive information after the network connection has been established




- ▶ **The Network Switching level**
 - Intermediate routing computers
 - Establish connectivity through the network
 - Forward messages



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“All People Seem To Need Data Processing”
“All Pork Sausages Take Nine Dead Pigs”
Please Do Not Take Sales People’s Advice”


OSI 7-layer Stack


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OSI 7-layer Stack	<p>A classification that divides telecommunication into seven layers, which technology vendors can use to explain their products.</p> <p>7: application layer: identifies communication partners and quality of service, authenticates users, considers privacy, identifies constraints on data syntax.</p> <p>6: presentation layer: usually part of an OS that converts incoming and outgoing data from one presentation format to another (for example, from a text stream into a popup window with the newly arrived text).</p> <p>5: session layer: sets up, coordinates, and terminates conversations, exchanges, and dialogs between the applications at each end. It deals with session and connection coordination.</p> <p>4: transport layer: 3: network layer: 2: data-link layer: 1: physical layer:</p>
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9. Infrastructure architecture


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Two ways around the limited IP address range



- ▶ Network Address Translation
- ▶ The router is given
 - A public IP address
 - A configurable list of local IP addresses
- ▶ Common addresses
 - 192.168.0.0
 - (255.255.255.0)
 - 172.68.0.0
 - (255.255.0.0)
 - 10.0.0.0
 - (255.0.0.0)

- ▶ Subnet
 - Use the second (host) part of the IP address to identify both
-
- The network address

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The internet



Internet Protocol (IP)	A protocol to send data across a packet-switched internetwork.
IP address	An IP4 address is made from four numbers. (E.g. Binary: 10010110.11010111.00010001.00001001, or Decimal: 150.215.017.009.) The 4 numbers are used for two addresses: the network address (first 1, 2 or 3 numbers) and the host computer address (last 1, 2 or 3 numbers). IP6 numbers are not discussed here
Subnet	The network administrator can divide the host part of the IP address so as to identify both a subnet and a host.

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Networks: **Convergence**



Convergence (of telecommunications media)

The enabling of one operating platform to supply many media. The merger of telecom, data processing and imaging technologies.

So fixed, mobile, and IP service providers can offer content and media services. Equipment providers can offer services directly to the end user.

A new epoch of multimedia, in which voice, data and images are combined to render services to the user.

Voice Over IP (VoIP).

A subset of IP Telephony (IPT). Promoted as offering lower network installation and management costs, lower voice phone tariffs and mobility of phone numbers.

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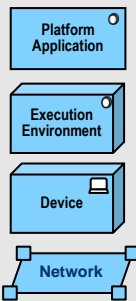


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Infrastructure architecture process



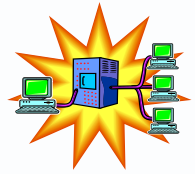
<p>Solution technology definition</p>  <p>The diagram illustrates the layers of solution technology definition. It consists of four stacked rectangular boxes: 'Platform Application' at the top, followed by 'Execution Environment', 'Device', and 'Network' at the bottom. The 'Network' box is connected to the 'Device' box by a horizontal line with small squares at its ends, suggesting a network connection.</p>	<p>A process that progresses through stages from a logical application-information view through progressively more physical views up to a hardware configuration diagram.</p> <p>A process for defining the technologies that will support and run an application that includes the activities such as:</p> <ol style="list-style-type: none">1. Clarify the precursors, requirements & context2. Establish baseline opportunities and target constraints3. Define client-end devices4. Define data servers5. Define intermediate servers6. Map software layers to platform and hardware tiers7. Define the network8. Iteratively refine to handle non-functional requirements9. Define the environment strategy.
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Solution technology architecture



<p>Hardware configuration view</p>	<p>1: A physical system; a structure of Nodes connected via one or more Networks.</p> <p>Or 2: A logical model of 1.</p>
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9. Infrastructure architecture



9. Infrastructure architecture
Networks
Protocol stacks
The internet
Enterprise technology rationalisation
Solution technology definition
Connecting applications via infrastructure

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How do applications relate to networks?



- Computer** ▶ A computer hosts
- Process** ▶ A Process - an application such as a browser instance, email software – which uses a
- Socket** ▶ A Socket – which is attached to a
- Port** ▶ A Port - to send and receive I/O messages using
- Service Type** ▶ A service type (a protocol for file transfer, email, etc.), over
- Network** ▶ A Network

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1.9 Infrastructure (platform technology) architecture

Solution technology architecture: Connecting apps to networks



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Network address	The address of a computer on a network; can be any of a variety of address types, mostly notably MAC address and IP address.
MAC address	A quasi-unique identifier (physical address) assigned to most network adapters or network interface cards (NICs) by the manufacturer for identification. If assigned by the manufacturer, a MAC address usually encodes the manufacturer's registered identification number.
IP address	A numerical identification (logical address) assigned to a node in a computer network that uses the Internet Protocol for communication between its nodes.
Service Type	A protocol for computer I/O (e.g. file transfer, web access, or email)
Port	A computer's network address has thousands of logical ports for sending and receiving data. Each port sends or receives data using one protocol or service type. An international standard defines default port numbers. E.g. •An http: (unsecured) URL typically uses port 80. •An https: (secured) URL typically uses port 443. •An SMTP server typically uses port 25. •A POP3 server typically uses port 110. However, the choice of port number is an architectural design decision. E.g. A security architect might ban the use of port 80 for http.
Socket	A socket (a software thing) is the use of a port to input/output a service type via a network. A socket is identified by a logical network address and a port number (which is used for a service type). E.g. Socket = port 80 for http: at IP address nnnn.nnnn.nnnn.nnnn.
Active process	A computer can run several applications (e.g. browser instance, email software) at once; each has a process number. A process can use several sockets, for different kinds of input and output. Several processes can use the same socket.

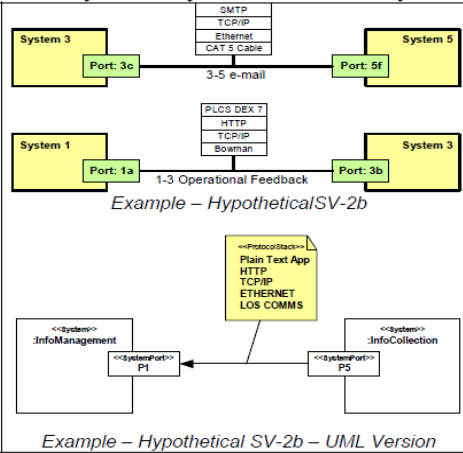
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AM: Communication engineering diagram: MODAF style



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SV-2b System To System Port Connectivity



Data objects:
Systems
Ports
Port Connections

Usage:
Interoperability analysis
Articulation of system composition, as the nature of a connection between two systems.
Specification of system interoperability requirement in SRD

Description:
Defines the protocol stack used by a connection between two ports. The ports may be on different systems.

Alternative Views:
UML and possible SysML alternatives

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