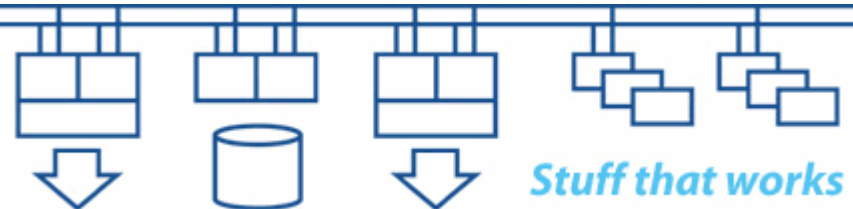


OpenVMS advanced technical bootcamp – June 2005

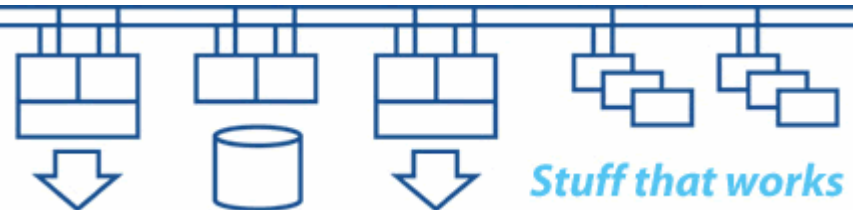
DECnet-Plus and DECnet over IP

Colin Butcher

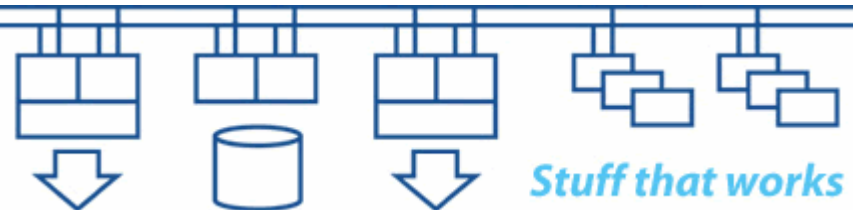
Technical Director, XDelta Limited



- **Network basics (bridging, switching etc.)**
- **Network protocols used with OpenVMS systems**
- **Introduction to DECnet - history and fundamentals**
- **Node naming, addressing schemes and routing mechanisms**
- **Implications for bridging and routing network traffic**
- **System hardware configurations and performance implications**
- **DECnet Phase IV components**
- **DECnet-Plus (Phase V) components**

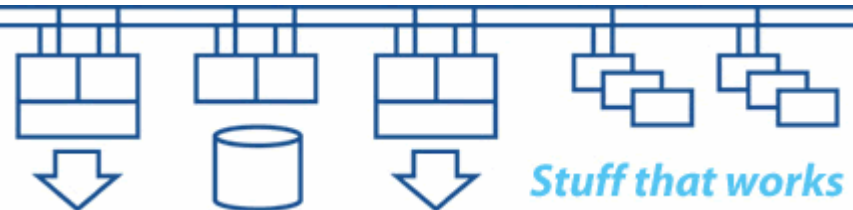


- **NCP (Phase IV) and NCL (Phase V) command syntax**
- **DECdns**
- **DTSS (time synchronization)**
- **DECnet over IP**
- **MOP device loading over network (e.g. terminal servers, cluster satellites)**
- **Installation and configuration**
- **Demonstrations**
- **Hints and tips**



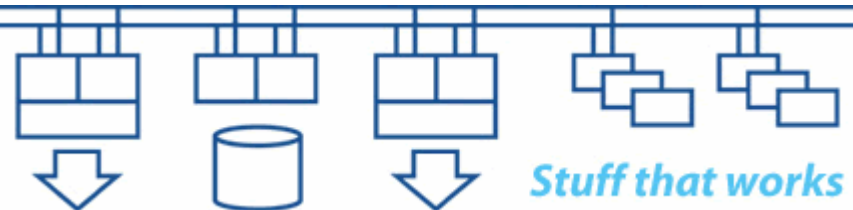
- **Hardware MAC address**
- **Physical MAC address**
- **Broadcast address**
- **Multicast addresses**
- **Point to point addresses**
- **Ethernet packet format v IEEE802.3 packet format**

- **TIP:** *SDA>SHOW LAN*



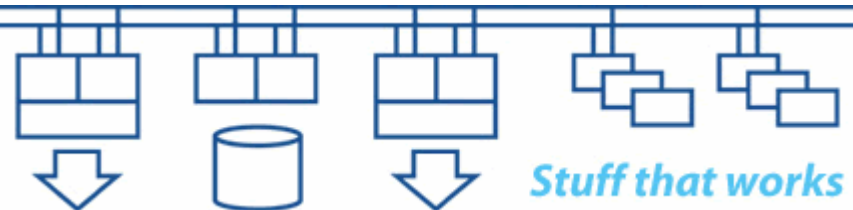
Why segment a network?

- **Repeaters**
- **Bridges**
- **Switches**
- **VLANs**
- **Routers**

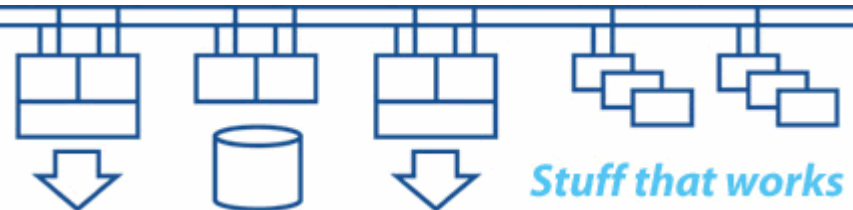


- **Layer 1 devices**
- **Provide electrical fault isolation**
- **Simply re-time and re-transmit signal**
- **No control of bandwidth**
- **Beware of cumulative end to end delay exceeding maximum permissible frame timing – which leads to ‘folklore’ such as the “three repeater rule”**

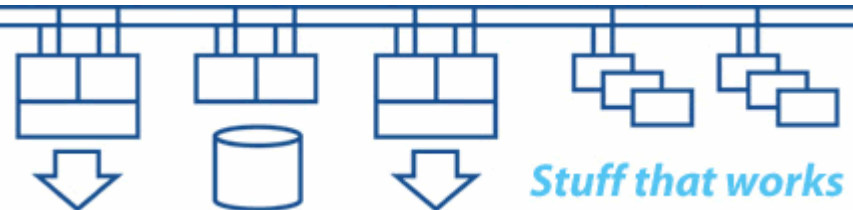
- ***TIP: Beware of the generic term “hub”***



- **Packet content based (Layer 2)**
- **Store and Forward**
- **Easy to use and configure**
- **Poor control of bandwidth (filtering)**
- **Spanning tree algorithm**
- **Provides an extended LAN**
- **Not all protocols can tolerate the inherent delays in working over an extended LAN**
- **Remote booting (MOP, BOOTP etc.) will absorb bandwidth**

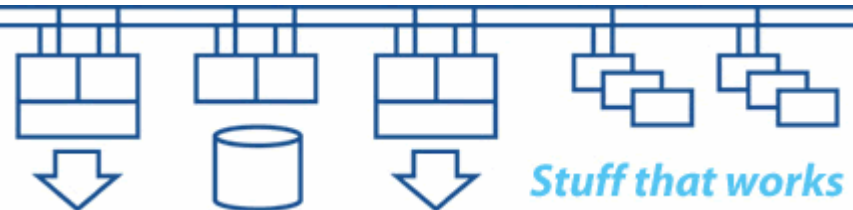


- **Introduces parallelism**
- **Speed of chipsets (latency & bandwidth)**
- **Full duplex operation on a single device per port basis**
- **Traffic monitoring (mirror ports)**
- **Link aggregation**
- **Bandwidth control**
- **“Store and forward” versus “Cut through” switching**
- **Layer 2, Layer 3 etc. switching**
 - **Layer 3 generally refers to TCP/IP routing layer**
 - **Layer 4 generally refers to TCP/IP port numbers, eg: HTTP port 80 traffic)**



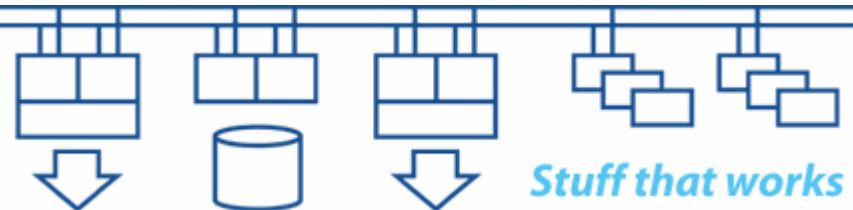
VLANs are another way to segment a network for performance and security

- **Implemented within core switches**
- **Layer 2, Layer 3 etc.**
- **Port based VLANs**
- **Protocol based VLANs**
- **Connectivity between VLANs**
- **VLAN tagging of packets (802.1Q)**

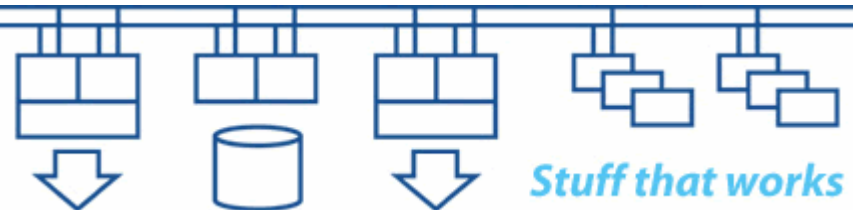


- **Latency** - determines response times
- **Bandwidth** - determines throughput
- **Parallelism** - make use of multiple paths and devices

- **Multiple adapters**
- **Multiple networks**
- **Split protocols across adapters**
- **Configure systems appropriately**

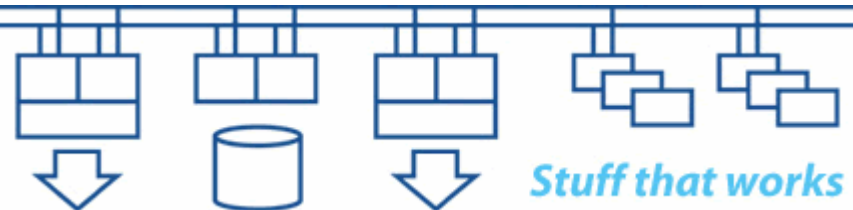


- **Availability is more important than performance**
- **Scale network so that desired overall system performance is based on minimum essential number of paths and maximum estimated traffic**
- **Take advantage of available bandwidth capacity to provide additional functionality when everything is working**
- **Duplicate devices such as network printers and terminal servers on different paths**
- **Segment the network to provide gradual degradation rather than wholesale failure**
- **Network management is all about problem identification and rectification**

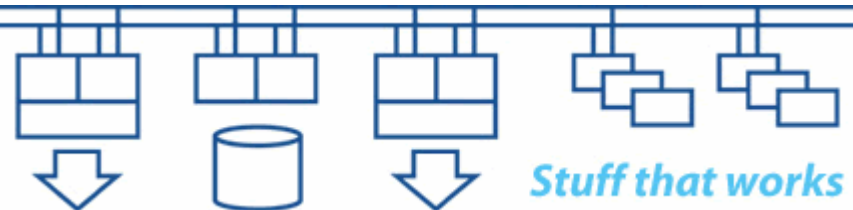


Typical network protocols in use with OpenVMS systems:

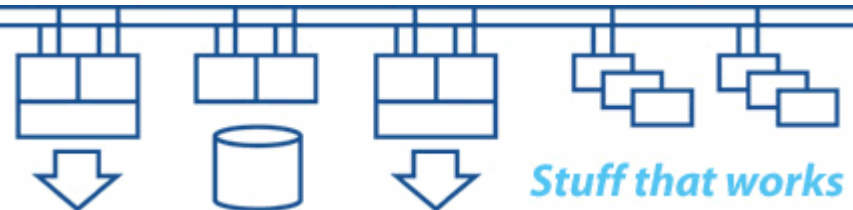
- **DECnet Phase IV**
- **DECnet-Plus**
- **DTSS**
- **DECdns**
- **LAT**
- **MOP + Remote Console**
- **LAD + LAST**
- **SCS**
- **TCP/IP**

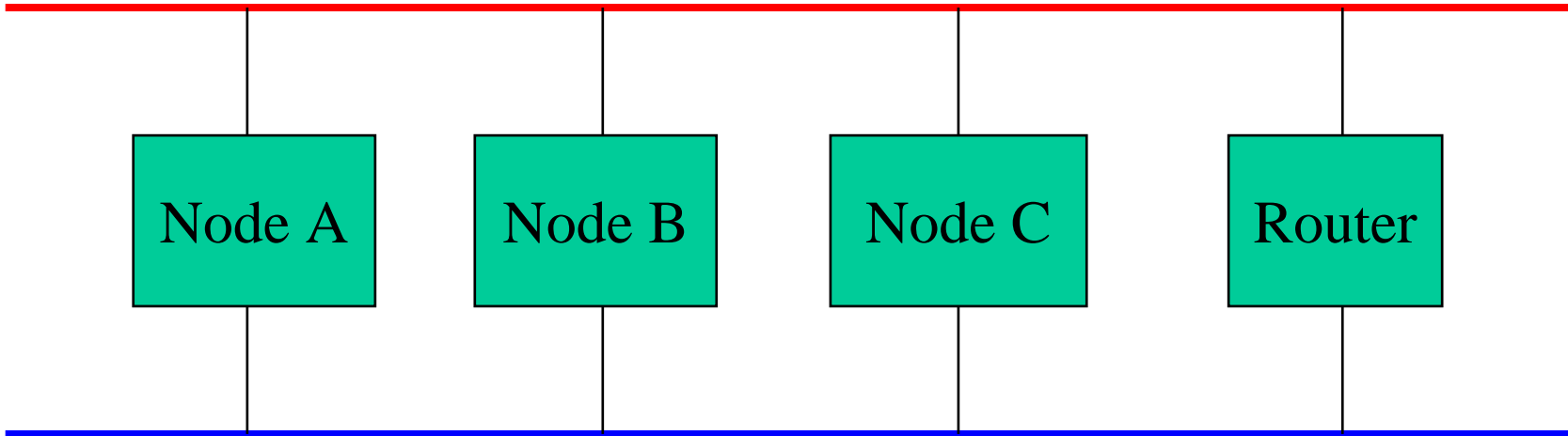


- **DECnet is a network protocol – a set of carefully constructed and written rules that define how computer systems can exchange data in a reliable and consistent manner.**
- **Underlying architecture has a name:
eg: Digital Network Architecture Phase V**
- **Product is an implementation of that architecture:
eg: DECnet/OSI V6.3 and DECnet-Plus V7.3-2 are both implementations of DNA Phase V**

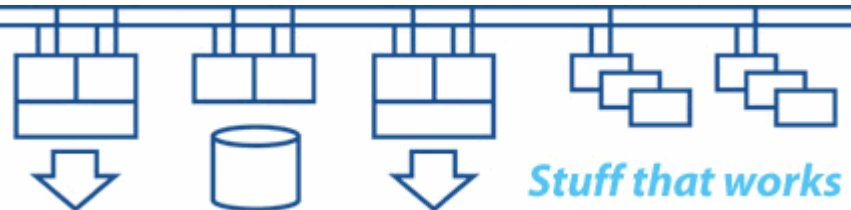


- **Phase IV (around VMS V4)**
- **Phase IV Plus (around VMS V5.2) – introduced:**
 - **End-Node Failover (Many circuits, only one active)**
 - **Path Splitting over multiple equal cost paths (Out of order packet cache)**
- **DECnet/VAX extensions for Phase IV**
 - **Provides NCL for router hardware setup on Phase IV**
- **DECnet/OSI (Phase V)**
 - **Multi-homed End System (Many circuits, all active)**
- **DECnet-Plus (Phase V)**
 - **Re-introduced Host-Based Routing**

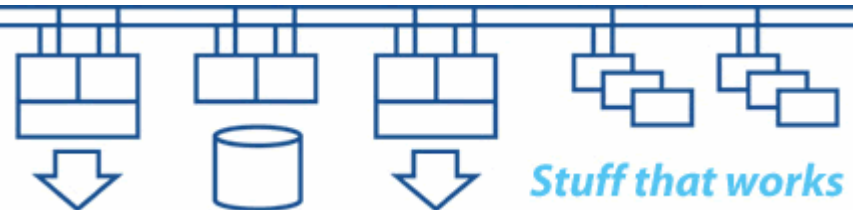




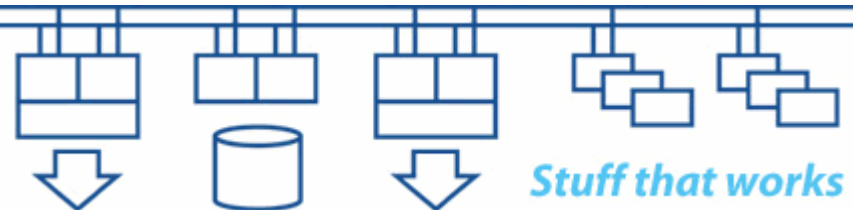
- **Phase IV – different costs, all L1 routers**
- **Phase IV Plus – same costs, all L1 routers**
- **Phase IV Plus – same costs, end node failover**
- **DECnet/OSI – both active, Multi-homed End Systems**
- **DECnet-Plus – both active, Multi-homed ES or IS**



- **Originally UCX (Ultrix Connection) up to V4.2**
- **Third party TCPIP protocol stacks available (TCPware, Multinet etc.)**
- **Became TCPIP Services from V5.0 onwards. Based on port of Tru64 UNIX TCPIP kernel to OpenVMS.**
- **Need PWIP driver for DECnet over IP functionality**
- **V5.4 introduces “Failsafe IP” for improved IP availability**
- **OpenVMS V7.3-2 introduces “LAN failover” for improved LAN availability (all protocols)**

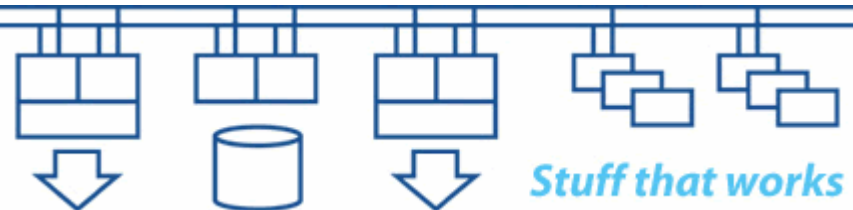


- **VAX VMS V4.x introduced SCS for LAVC**
- **Galaxy introduced SMCI pseudo-LAN interconnect**
- **Infoserver introduced LAD / LAST for serving remote disc containers. Also used by RSM. Coming back in OpenVMS V8.2-1 for Integrity to provide network upgrade.**
- **Pathworks (now Advanced Server) introduced DECnet for PC operating systems and LANmanager functionality for OpenVMS systems. Also uses LAD / LAST, TCP/IP and DECnet-Plus**
- **OpenVMS V7.1 introduced LANCP / LANACP for MOP loading without DECnet (needed to load cluster satellites)**
- **OpenVMS V7.3-2 introduced “LAN failover” for improved LAN availability (all protocols)**

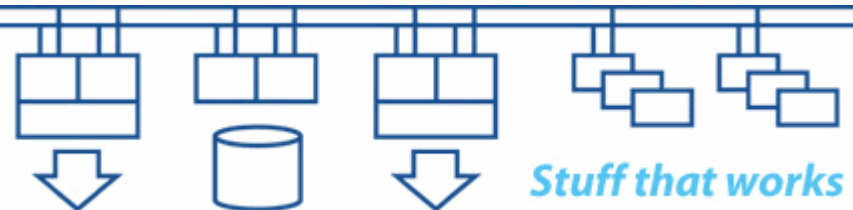


NCP entities:

- **Executor**
- **Circuit**
- **Line**
- **Node**
- **Object**
- **Link**



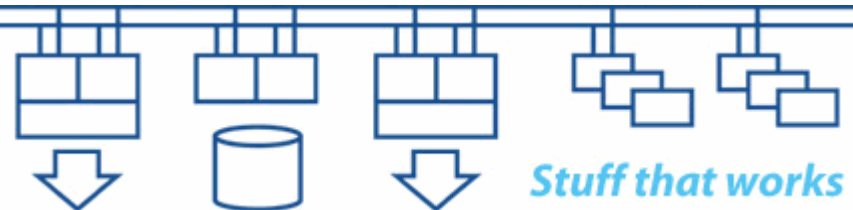
- **End Node**
- **Routing Nodes: Level 1 & Level 2 (Area) Routers**
- **MAC Address formed from Node address:**
 - **Area 1 - 63, Node: 1 - 1023**
 - **16 bit address = (Area x 1024) + Node number**
 - **AA-00-04-00-nn-mm**
 - **nn-mm = byte reversed hexadecimal 16 bit address**



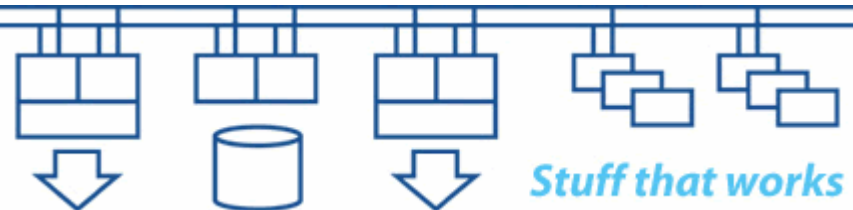
- **DECnet “hidden information”:**
 - **End Node to Routers (end node hello packets)**
 - **Routers to Routers (routing updates)**
 - **Routers to End Nodes (router hello packets)**

- **DECnet Phase IV bases the MAC address on the node number, so no need for routers on LAN except for determining adjacencies.**

TIP: Router on LAN will give fast “node unreachable” rather than slow “timeout” when attempting to connect to a node that is not on the LAN.

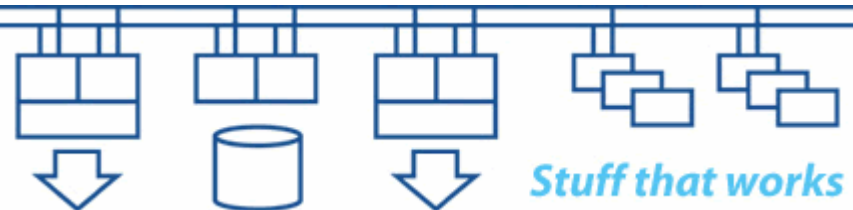


- **Areas are used to limit the size of routing tables and to reduce the “routing update” problem.**
- **DECnet addresses outside our area number need an area router if not on LAN.**
- **DECnet will use the highest numbered (by DECnet address) router node as the primary router by default.**
- **No need to change node address if node is moved within the LAN, or if all within the same DECnet area.**

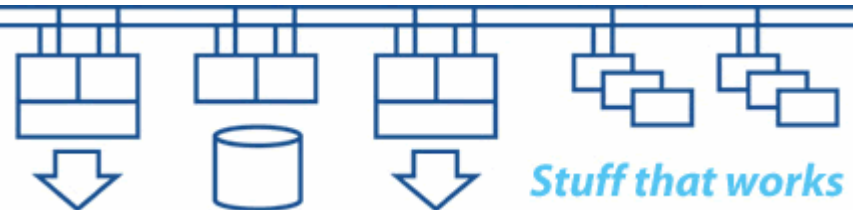


- **Number of nodes in a private network can exceed the address range (eg: Easynet)**
- **MOP loader needs fake node entries**
- **Sets MAC address on all LAN adapters based on DECnet node address, so cannot connect multiple LAN adapters to the same LAN (or extended LAN).**

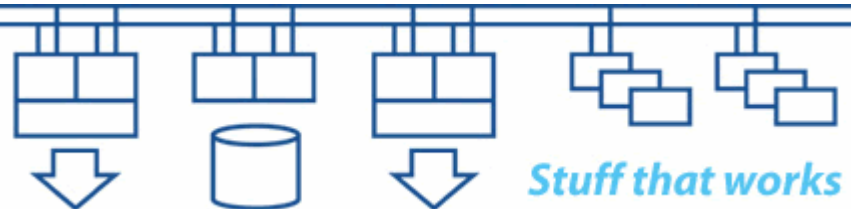
TIP: Can route between parallel LANs, but cannot bridge between them due to the risk of duplicate MAC addresses.



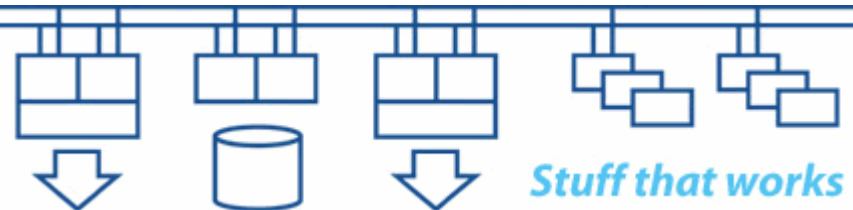
- **The obvious big difference - NCL in place of NCP**
- **Name Services**
- **DECnet over IP**
- **Permanent database is NCL script files (text)**
- **Time Synchronisation Service**
- **Routing algorithms (Phase V routers)**
- **Multiple path behaviour (multi-homed End System)**
- **Startup early in boot sequence**
- **Phase IV compatible addressing on first adapter only (by default)**



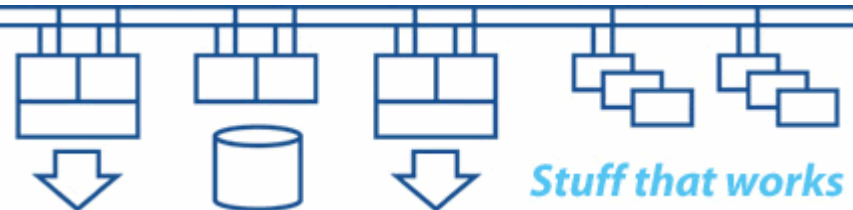
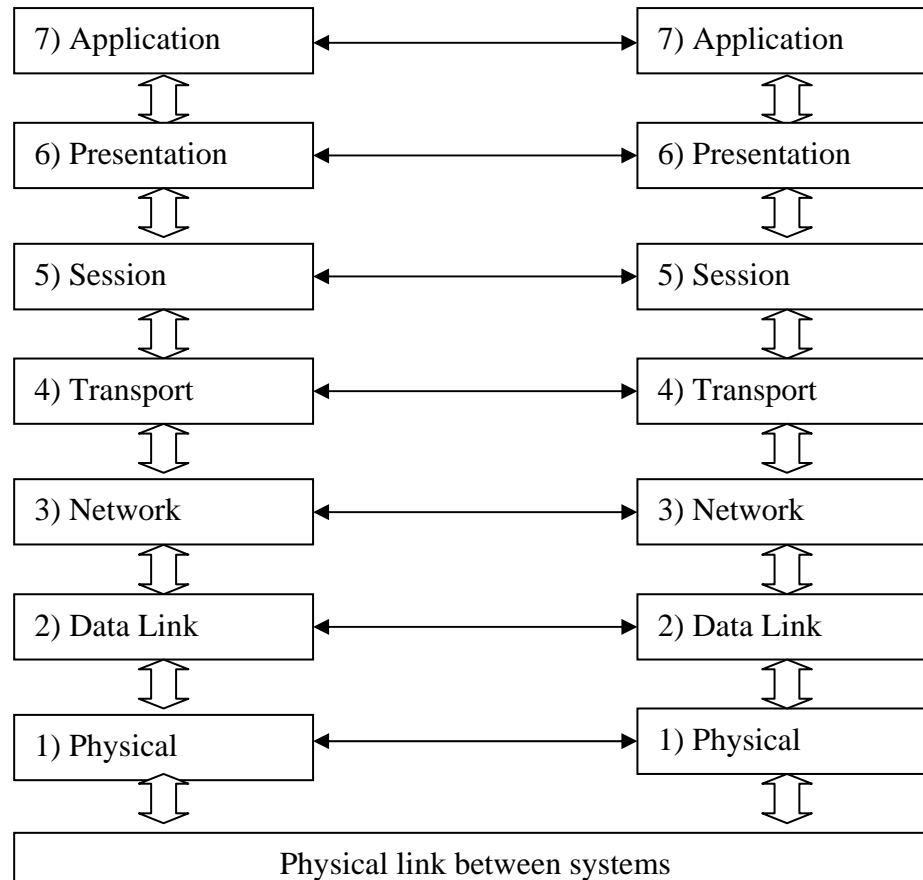
- **Clearly shows OSI layers in the “entity hierarchy”**
- **Very powerful, far more so than NCP**
- **NCL scripts form the equivalent of the Phase IV permanent databases.**
- **DECNET_REGISTER to maintain known nodes list**
- **DECwindows interface (NET\$MGMT) with ability to display the equivalent NCL commands**
- **NCL SHOW ... WITH ... syntax**



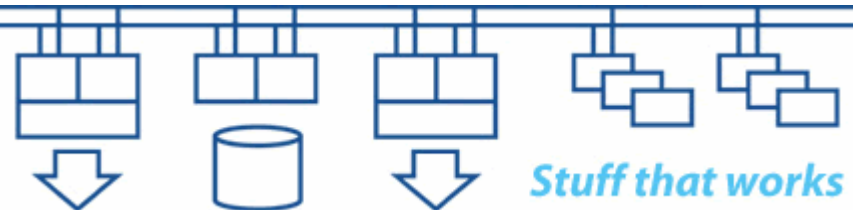
7	Application	Provides for distributed processing and access, contains application programs and supporting protocols (eg FTAM).
6	Presentation	Coordinates conversion of data and data formats to meet the needs of the individual applications.
5	Session	Organises and structures the interactions between pairs of communicating applications.
4	Transport	Provides reliable transparent transfer of data between end systems with error recover and flow control.
3	Network	Permits communication between network entities.
2	Data link	Specifies the technique for moving data along network links between defined points on the network, and how to detect and correct errors in the Physical layer (layer 1).
1	Physical	Connects systems to the physical communications media.



Stuff that works

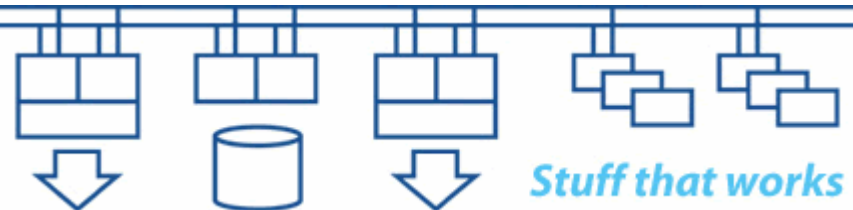


- **session control**
 - applications and ports
- **transports**
 - NSP and OSI (plus OSI templates)
- **routing**
- **routing circuits**
- **csma-cd station (ethernet and FDDI)**
- **<datatype> links (HDLC, DDCMP etc.)**
 - <datatype> link logical station
- **modem connect lines**

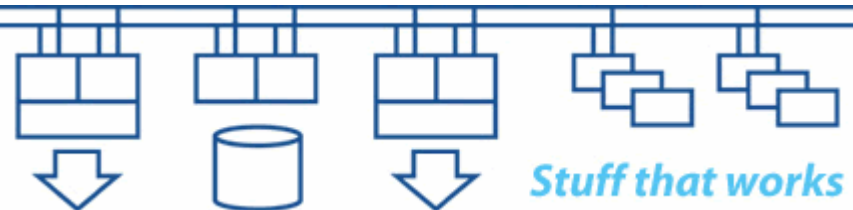


Which Name Service to use?

- **Local**
 - **DECdns**
 - **Domain (DNS/BIND)**
-
- **NameServer replication**
 - **Layered Product Requirements for DECdns use (DECdfs, RSM etc.)**

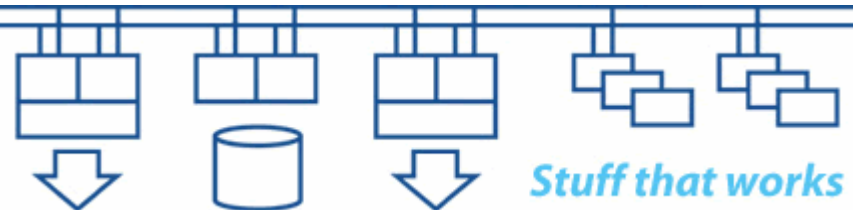


- **Phase IV compatible addressing**
 - **The AA-00-04-00-xx-xx address**
 - **Multiple CSMA-CD adapters**
- **Synonyms and FullNames**
- **Address Towers**
 - **Transport selection (NSP or TP4)**
 - **Session Control version selection (SC2 or SC3)**

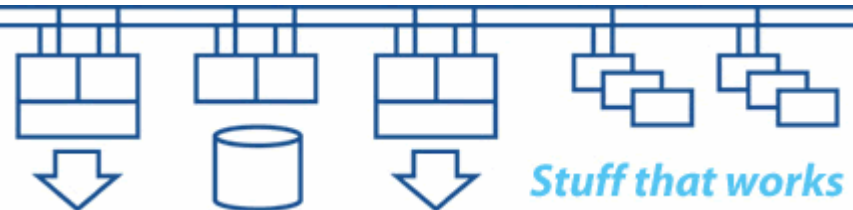


Relative time is more useful than absolute time

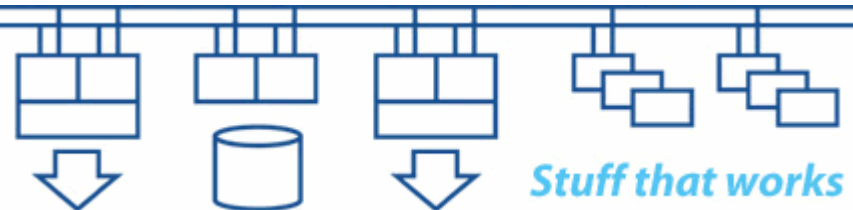
- **Need to be able to order events across the network based on timestamps**
- **Timestamp format**
 - **Time value**
 - **Inaccuracy component**
- **DTSS Servers and Clerks**
- **External reference Time Providers**



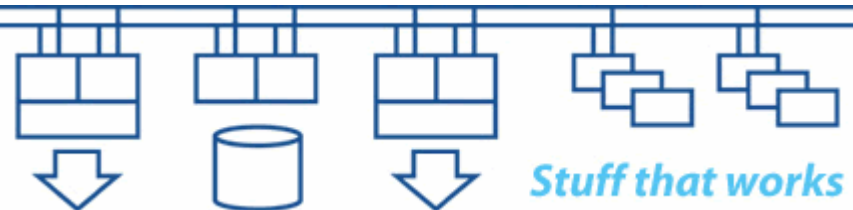
- **Why have Routers at all?**
- **Prior to DECnet-Plus V7.1 all Phase V routing is done by separate dedicated routers (Intermediate Systems). Good for big networks. Expensive for small networks.**
- **Multi-Homed End Systems can reduce routing requirements**



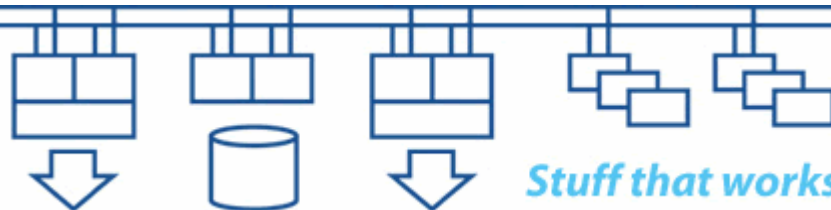
- **Can disable DTSS by defining the NET\$DISABLE_DTSS logical name in SYLOGICALS.COM.**
- **DTSS server can receive time from NTP (example provided)**
- **New procedures for changing DST zone rules (Alpha only), also see AUTO_DLIGHT_SAV system parameter**
- **Phase IV migration improvements (databases, FDDI)**
- **Improved NCL help**
- **Reduced NCL output on boot by default (NET\$STARTUP_QUIET_NCL logical)**



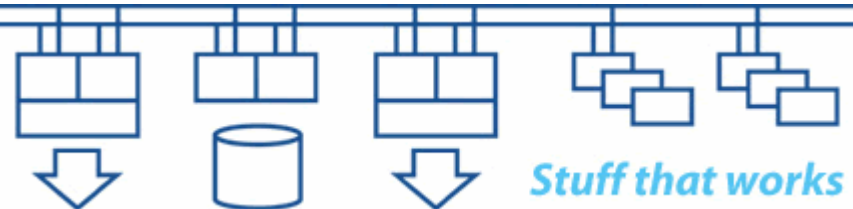
- **Preserves DECnet APIs for existing applications**
- **Performance and availability are determined by underlying IP network infrastructure**
- **DECnet uses TCPIP as a pseudo-transport layer**
- **Need to have RFC1006 and RFC1869 (aka RFC1006-Plus) OSI transport templates - ports 102 and 399**
- **Streams interface**
- **Need to have PWIP driver enabled**



- **Need to have DNS/BIND name service in list for access to local name resolver:**
 - **@NET\$CONFIGURE ADVANCED**
 - **Naming services: “LOCAL,DOMAIN”**
 - **use 127.0.0.1 as address of name resolver!**
- **Can enable DECnet over IP “on the fly”:**
 - **change the naming (remove from LOCAL or DECdns naming database with DECNET_REGISTER and add to HOSTS database or DNS/BIND server)**
 - **NCL> FLUSH SESSION CONTROL NAMING CACHE ENTRY “*”**

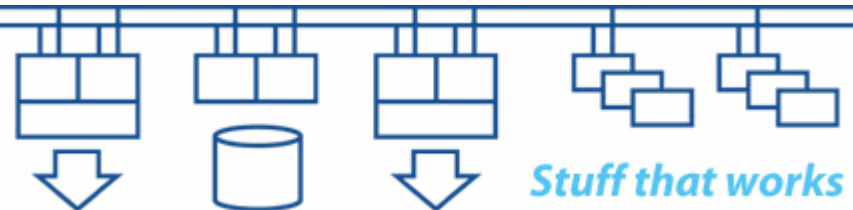


- **Don't be scared of Phase V - it works, generally at least as well as or better than Phase IV**
- **NCL is a much better tool than NCP**
- **Keep it simple - use Local naming, Phase IV compatible addressing and the NSP transport**
- **DECnet over IP lets you use applications with the DECnet APIs over a TCP/IP only infrastructure**
- **Multi-Homed End Systems get you load balancing for the price of an end-node licence**



Hardware setup:

- **3x Alpha XP1000 workstations with:**
 - **Dual LAN**
 - **OpenVMS V7.3-2**
 - **DECnet-Plus V7.3-2 ECO01 + MUP01**
 - **TCPIP Services V5.4 ECO04**
 - **current patches**



Thank you for your participation

Q & A

