



DECnet to TCP/IP Migration for OpenVMS Users

An ArrAy, Inc. White Paper

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1. Introduction

OpenVMS recently celebrated its 25th anniversary, and, since first booting on VAX hardware, OpenVMS, with its DECnet networking protocol, has created a loyal user base. Customers are pleased by its reliability, robustness, security, and performance, and OpenVMS continues to perform demanding tasks at installations throughout the world.

Even though some users may elect to migrate away from OpenVMS to some other environment, such as Linux, Windows, or UNIX, many users plan to continue running OpenVMS for years to come. Migrating from DECnet to TCP/IP for networked applications is a viable option that will permit users to continue to operate on OpenVMS and to do so without wide area DECnet support. In response to this opportunity, ArrAy, Inc. provides a set of comprehensive services to help OpenVMS users to plan and execute their DECnet to TCP/IP migrations.

This white paper discusses:

- DECnet and OpenVMS today
- The business and technical factors that are driving migrations to TCP/IP
- Migration strategies and alternatives
- Technical and other challenges
- Business considerations
- ArrAy's DECnet experience and its DECnet service offering

2. DECnet and Open VMS Today

OpenVMS has over 400K licensees and is in active use around the world. OpenVMS runs on both Alpha and VAX hardware, and Alpha has long provided full 64-bit capability. Important factors for future planning include:

- OpenVMS releases, with continuously improving DECnet support, TCP/IP support, performance, security, reliability, UNIX portability, and functionality, are planned.
- The OpenVMS V8.2 (Topaz) release in 2005 will support the Itanium® Processor Family (IPF), as well as VAX and Alpha, providing operation on platforms with industry leading price-performance. Alpha-based applications will port to IPF easily, and OpenVMS releases will continue to be qualified on Alpha indefinitely.
- OpenVMS will benefit from HP's Itanium experience, enterprise focus, and integration into the HP OpenView management framework.
- TCP/IP Services for OpenVMS assure that sockets-based OpenVMS applications can interoperate with Linux, UNIX, Windows, and other systems in intranets and the Internet.
- DECnet over TCP/IP assures that DECnet-based OpenVMS applications can communicate with other DECnet-based applications over intranets and the Internet.

- DECnet Phase IV and DECnet-Plus, along with X.25 V1.6 and V2.0 will be supported well into the future and will operate on IPF as well as Alpha and VAX.

OpenVMS will be used actively and productively for many years to come, and migration to TCP/IP will both enhance OpenVMS's usefulness in enterprise environments and allow for reduced networking and administrative costs.

2.1 Technical and Business Strengths

OpenVMS user loyalty and commitment, as well as continued sales to existing and new customers, stem from the system's many strengths:

- Maturity provides benefits such as high reliability
- OpenVMS clustering continues to provide leadership availability and scalability for mission critical applications, and it supports fiber, SCSI, Ethernet, and WAN for the cluster interconnect. For example, one user reports an OpenVMS supporting 96 nodes in a "shared everything" environment for more than a decade, making OpenVMS clustering far more scalable than clustering on most other operating systems.
- Security is strong, and, in head-to-head testing against other systems, OpenVMS has consistently proved to be one of the most difficult systems to "hack." This was reinforced at the 2001 DEFCON9 Hacker Convention where the judges declared that OpenVMS was "Cool and Unhackable" after an OpenVMS system was attacked continuously while still providing ongoing service.
- There is a large installed base of third party, open source, and custom applications
- ISV support, including recent announcements from companies such as Veritas and Legato
- Over the years, OpenVMS has been selected for sound business reasons, and it continues to meet and exceed requirements for many users
- OpenVMS provides complete OSI and TCP/IP services, allowing interoperability with other systems

Customers report excellent experiences that testify to the excellent software engineering that has gone into OpenVMS. For example, one customer related that his OpenVMS had been running continuously, without ever having to re-boot the system, for over a dozen years.

2.2 Potential Problems for OpenVMS DECnet Users

There are, however, significant issues for OpenVMS users who rely on DECnet.

- Major router vendors are indicating that they will stop supporting DECnet in the near future. This will hinder Internet and wide-area intranet communication between DECnet applications.
- DECnet applications can only communicate with other DECnet applications. They cannot communicate and interoperate with TCP/IP applications on the same or other systems. Even

if applications use DECnet over TCP/IP, they cannot interoperate with applications that use sockets.

- Enterprises can save money and simplify their networks by mandating that only IP will be supported, so many enterprise-wide networks will not route DECnet packets (they will route DECnet over TCP/IP packets, however), restricting pure DECnet applications to local area or building wide networks.
- Personnel with DECnet management, administrative, and development skills can be difficult to find and to justify in budgets.

Many OpenVMS users, therefore, need to plan to move away from “pure” DECnet (that is, DECnet that uses the OSI or NSP transport layers) to TCP/IP or DECnet over TCP/IP. These plans must encompass all DECnet services as well as DECnet API usage for application-to-application communication.

2.3 DECnet to TCP/IP Migration Benefits

A well-planned and executed migration can provide both short- and long-term benefits.

Applications will be able to interoperate over the Internet and over global, wide-area intranets, leveraging the strengths of IP, including IPv6. IPv6 support, in particular, will be important for future operation in large-scale, worldwide networks.

- Using IP throughout the enterprise will enable data communication efficiencies and reduce network expenses while also supporting corporate strategies and standardization.
- TCP/IP migration will extend the life and enhance the value of existing proprietary and third party applications.
- DECnet and TCP/IP can coexist, so applications slated for replacement do not need to be migrated, simplifying the overall task.
- TCP/IP, with all its services, programming interfaces, etc., provides the industry standard for networking, and many users are choosing to replace proprietary protocols.
- While most routers can handle both DECnet and IP, it will be possible in some environments to eliminate duplicate circuits, wiring, and networking equipment, and administrative costs can be reduced, as DECnet routing requirements are eliminated.

3. Migration to TCP/IP

Migration requirements differ greatly among users, but there are numerous common problems and issues. Users, will, however, want to set their own goals and objectives for resolving these problems, selecting from the alternative migration scenarios.

For simplicity, “LAN” will denote Local Area Network, indicating operation limited to a department, or, perhaps a building. “WAN” will denote an IP-based “Wide Area Network” for both the enterprise intranet as well as the Internet.

3.1 Setting the Goals and Objectives

Goals and objectives can be set by considering the desired “end point,” whether or not the migration can be phased, and whether or not DECnet over TCP/IP usage will satisfy the requirements. Questions to consider include:

- Is it necessary to eliminate DECnet completely, or is it acceptable to have a limited number of applications continue to use DECnet within LANs?
- Is it necessary to eliminate DECnet proprietary networking hardware (routers, switches, bridges, etc.) that cannot handle IP packets, and how quickly should this be done and what are the cost benefits of doing so?
- How quickly can users and administrators be retrained to use TCP/IP services? In many cases, the required skills will already be in place.
- How many DECnet-based applications, using the OpenVMS QIO System Services for interprocess communication, must be reprogrammed using sockets to gain the benefits of application interoperability and code portability. Alternatively, can some or all of the applications continue to use DECnet in a limited environment or via DECnet-over-TCP/IP?
- Will DECnet-based applications be replaced in the future?
- In what ways, if any, are DECnet capabilities, such as security, DECnet alias, DECnet proxy, and DECnet multipath failover, used in unique ways? Can they be emulated with TCP/IP, or will there be compromises or changes to the overall model?
- How will the DECnet services be mapped to TCP/IP services, and do the services need to be extended beyond existing network users? For example, RMS file sharing operates with DECnet over TCP/IP, but the file access is still restricted to OpenVMS users. Therefore, it may be appropriate to export shared files using a file access protocol such as NFS or SMB/CIFS.
- Are applications such as DECnet IBM interconnect, FTAM, X.25, and DDCMP used?
- What are the implications, positive and negative, of the migration? Which implications are just a matter of changed processes and methods, and which, if any, actually impact security, reliability, performance, and other important features?

Answering these questions will require:

- Achieving a full understanding of business objectives and end user requirements
- Taking an inventory of existing DECnet applications and equipment and determining, on a case-by-case basis, their future migration or replacement
- Determining the migration time frame and the migration phases through initial testing to a complete production environment
- Communicating the impact to users in order to assure that users are prepared and that their applications are appropriately modified

- Analyzing the inventory and planning the disposition and replacement of existing DECnet infrastructure

With this information, the migration goals, objectives, phases, and time line can be established. The following sections give additional information that can factor into the goal-setting process.

3.2 Alternative Migration Scenarios

TCP/IP migration can be phased depending upon schedules, the desired endpoint, interoperability requirements, and so on. There are several alternatives to a full migration.

3.2.1 Hybrid Environments: Coexistence with DECnet over TCP/IP

Switch to DECnet over TCP/IP, allowing wide area operation in the WAN's IP environment. Running DECnet over IP means that DECnet uses the TCP/IP transport stack.

This switch away from native DECnet does not require application changes and will allow DECnet applications to continue to operate in the enterprise, but it will not allow them to interoperate with other TCP/IP applications.

In either case, this is a *coexistence* strategy that does not provide interoperability outside the DECnet environment. This is not a new issue, however, as DECnet users already have this same limitation; the point is made so as to avoid setting unreasonable expectations for a TCP/IP migration.

Section 4 discusses some of the technical issues involved when migrating with DECnet over TCP/IP.

3.2.2 DECnet Islands

A more passive strategy is to allow OpenVMS and DECnet applications to continue in operation without significant upgrades and use TCP/IP and UNIX, Windows, or Linux for new systems and applications. This approach will, over time, result in smaller and smaller "DECnet island" LANs, and, perhaps, wide-area X.25 point-to-point communication, performing specialized functions. This strategy will not be discussed further as it is not really a migration strategy, it and does not leverage the benefits of continuing to use OpenVMS.

3.2.3 Full TCP/IP Migration

Full TCP/IP migration is a proactive strategy to eliminate all DECnet usage, even within LANs, and is the most complex of the alternatives. The most significant tasks, in addition to those mentioned for the other alternatives, are:

- Upgrade or replace all custom and third party applications in the application portfolio that use DECnet QIO System Services, replacing QIO System Services usage with sockets. This can require reprogramming as well as development costs. The reprogramming task is complex, using a stream-oriented programming model rather than DECnet packets.
- Develop and execute a coordinated plan for the application replacement, assuring that all application interoperation is supported throughout the process.

- Replace legacy networking equipment .

3.3 Hardware, Software, and Administrative Considerations

Migration from one technology to another can create costs, some obvious and some hidden. The DECnet to TCP/IP migration is no exception, although the costs are not large. Here are some factors to consider.

3.4.1 Network Infrastructure

Older DECnet-only routers, concentrators, bridges, etc. will eventually become obsolete and will need replacement by up-to-date network infrastructure components. In many cases, proprietary cabling will need to be removed. Ethernet wiring investments, however, will be protected.

3.4.2 Software Version Requirements

DECNet Plus is required in order to run DECnet over TCP/IP.

TCP/IP Services upgrades will not normally be required, but users should still plan to upgrade to the upcoming V5.3 and V5.4 releases in order to get the latest functionality, security and performance enhancements.

Likewise, OpenVMS should be kept up-to-date, especially if users wish to run on the latest hardware platforms.

3.4.3 Management and Administrative Impact

TCP/IP-based management will become the norm for all OpenVMS systems. An immediate benefit will be that OpenVMS can be managed in the same way as other systems. Nonetheless, some specific management tasks will change significantly.

Fortunately, TCP/IP management tools and methods are well known, and most administrators will already be familiar with their use. Furthermore, it will no longer be necessary to use DECnet tools beyond the DECnet LANs. However, there will be learning curve costs associated with relearning specific tasks.

3.3.4 Clustering and Failover

Clustering is one of OpenVMS's strengths as it enables failsafe operation and scalable performance. Clusters operate within a LAN using their own LAN protocol stack for cluster communications. TCP/IP services for OpenVMS provide WAN access to clusters.

TCP/IP Services for OpenVMS also provides a degree of load balancing along with transparent failover between cluster members. There are differences, however, compared to using DECnet, and these differences must be planned for as part of the migration project.

Several DECnet failover services, such as transparent failover between OpenVMS node network interfaces, in case a primary interface fails, are not provided by TCP/IP services for OpenVMS at this time. However, transparent failover is being implemented for TCP/IP Services for OpenVMS V5.4, scheduled for H2 2004.

4. DECnet Over IP: Requirements and Implications

Converting native DECnet usage to DECnet over TCP/IP, described in Section 3.2.1, is a strategy that many users will select, at least as a first step, as it is straightforward, preserves most of the value of legacy applications, and does not require extensive equipment investment.

The requirements and implications are described here, and they provide an example of what to expect from any DECnet migration, regardless of the actual strategy selected.

4.1 Administrative Impact on DECnet Systems

Administrative tasks to convert to DECnet over TCP/IP include:

- Systems running DECnet Plus software must be properly configured to run DECnet over TCP/IP. Configuration involves modifying name search paths, enabling specific ports, and updating host files. ArrAy has developed custom tools to perform these operations.
- DECnet objects will not be manageable using OpenView, but they will be manageable within the LAN using DECnet management tools.
- DECDns (Distributed Name Service) will not be available beyond the local DECnet network. Tools are available to help maintain node names and addresses and to expedite the use of IP BIND servers.
- DECdts (Distributed Time Services) must use local time services since DECDns is not available to locate servers beyond the LAN. Conversion to the equivalent TCP/IP NTP protocol is an alternative to DECdts, and there are tools to help perform this conversion. Furthermore, since DECdts uses NTP, there is no change in functionality.
- IP addresses, network masks, etc. must be configured.
- DFS (Distributed File Services) will need to serve access points locally; DECDns cannot be used. Hence access and mount commands will require modification.
- Furthermore, DECDns is used by some applications as a distributed database. These applications will require modification or upgrading to a version running natively over IP.

4.2 Version Requirements

OpenVMS 6.2 is the minimum version requirement, but OpenVMS 7.1 is recommended.

4.3 Print and Terminal Services

Most terminal and print services will continue to operate within LANs, although they may not be available over the WAN. This assumes, however, that the IT organization permits DECnet within LANs, which may not be the case. Even if LAN DECnet usage is permitted, there will be some administrative requirements.

- DECnet, LAT, and MOP will still be allowed on the LAN, providing terminal and print services. However, these services will not be available in the WAN. Furthermore, some older LAT printers will require replacement.

- LAT has been shown to be more effective in terminal traffic than TCP/IP; this difference will not, in general, be large enough to degrade network performance, and most users are familiar with `telnet` operation.
- LAT terminals need to be connected to IP terminal servers, and the `telnet` command should be used instead of `connect`.
- Distributed Queuing System (DQS) will operate when DECnet over TCP/IP is configured. It is important, however, to assure that print servers have up-to-date OpenVMS versions installed.
- LPS printers that are loaded from systems beyond the limits of the LAN will no longer work. They will need to be loaded locally.

4.4 Programming Impact

Depending upon the objectives, there may not be any programming impact.

- Application-level DECnet objects will work in the enterprise network if they are programmed using good engineering practices.
- Where practical, conversion to sockets should still be considered, although such conversions are actually only required for a full migration (Section 3.2.3).

Socket conversion is not simple, however, as socket programming (the programming interface to TCP/IP) is stream oriented, whereas DECnet is packet oriented. This programming model difference means that reprogramming is not a simple matter of replacing system calls. The DECnet packets need to be emulated using sockets.

4.5 Project Scheduling Considerations

Deliverables that should be planned and scheduled include:

- Setting the goals and objectives which are consistent with corporate business objectives
- Prepare an inventory of applications and equipment
- Communicating the project goals and impacts to all stakeholders
- Scheduling site transitions if multiple sites or organizations are involved
- Documenting all decisions and their impact
- Training for users and network and system managers
- Circuit transitions, with replacement of routers and other networking equipment
- Cluster transitions which assure that required business operations are maintained

5. DECnet Migration Services from ArrAy

ArrAy, Inc. is actively working with HP and its customers to provide a full set of DECnet to TCP/IP services to address customer needs. The services include:

- **Workshops** to provide information to OpenVMS users about DECnet to TCP/IP migration
- **Assessment** to work with the customer to determine goals, requirements, and objectives and to understand current and future operations
- **Project Planning** to create a phased migration schedule, plan resource usage and costs, specify any hardware and software purchases, training requirements, and acceptance criteria
- **Technical Specifications** defining service mapping, application migration techniques, etc.
- **Tools** to assist migration and for ongoing use once the migration is complete
- **Project Execution and Management** to perform the migration as specified during planning
- **Testing and Acceptance** to assure that all customer requirements are satisfied
- **Future Planning** to address potential future issues such as application migration and OpenVMS phase out

5.1 *ArrAy's DECnet Experience and Expertise*

ArrAy's technical staff is experienced in all aspects of OpenVMS and DECnet development, maintenance, and usage. Several staff members have been working with OpenVMS for over a decade.

The ArrAy team has provided engineering support to HP, Compaq, and DEC for TCP/IP on VMS for over six years and has supported both the Compaq Secure Web Server and the COE Project. ArrAy's activities with HP include:

- TCP/IP code maintenance
- Testing failover, performance, and functionality
- Testing new features in OpenVMS releases
- Functional review of new OpenVMS TCP/IP features
- Porting major software products from Windows and UNIX source code to OpenVMS

ArrAy's knowledge of IP as well as an in-depth understanding of the TCP/IP for VMS and DECnet products uniquely qualifies the company to provide a well-engineered DECnet to TCP/IP Solution Path.

5.2 *About ArrAy*

ArrAy Incorporated (<http://www.arrayinc.com>), headquartered in Westborough, Massachusetts, is a global software engineering services firm that provides unique support to software developers. Clients include application software companies, tool providers, system software developers, and embedded software vendors.

With both onshore and offshore capabilities, ArrAy's highly expert staff, ArrAy Way™ methodology, and collaborative work style deliver the industry's most productive yet economical outsourcing solution. ArrAy's comprehensive set of services help developers preserve and extend the viability of software products cost-effectively and with high quality.

6. Conclusion

OpenVMS and DECnet have provided excellent service for 25 years, and OpenVMS will provide a viable platform running on state-of-the-art systems for years to come. Users can perform an orderly and cost-effective DECnet phase out, replacing it with TCP/IP, the industry networking standard. By retaining the benefits of OpenVMS and the integration of TCP/IP as their primary interconnect, customers will be able to take advantage of the advanced and evolving technologies being offered on OpenVMS.

ArrAy, Inc., backed by HP OpenVMS Engineering, provides a full set of services, using proven best practices and its experienced staff, to plan and execute DECnet to TCP/IP migrations.