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Networks Marketing

Routing Protocols

An important consideration when building multiprotocol networks.

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Abstract

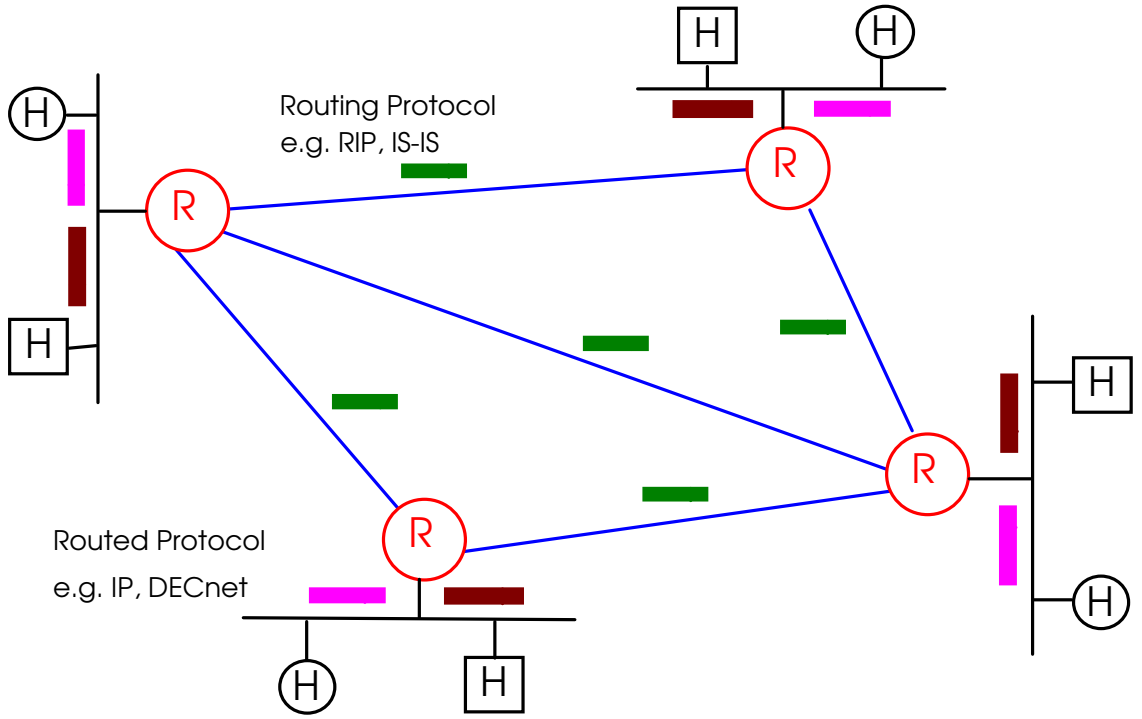
The routing protocol used between routers is an important consideration when building a multiprotocol network. The choice of routing protocol can affect bandwidth utilisation and network convergence. To operate within a network, routers need to know:

- The status of other routers in the network
- The status of links in the network
- The best path to any destination

Router to router information is provided by a routing protocol and is required regardless of the network protocols being routed. This document looks at the different factors that affect the performance of routing protocols and highlights some important factors to consider when choosing between different protocols.

Introduction

Routing protocols, such as Open Shortest Path First (OSPF), Routing Information Protocol (RIP), Intermediate System to Intermediate System (IS-IS) and Interior Gateway Routing Protocol (IGRP), are used to exchange information about the topology of the network between routers. These exchanges are in the form of routing protocol updates as shown in the following diagram.



There are two main areas to be considered when looking at routing protocol performance:

- Multiprotocol routing - should you use an independent, ships-in-the-night approach or an integrated approach? What are the advantages and disadvantages of each?

- Routing algorithm - distance vector or link state routing? How do they work and which one is appropriate?

The following sections look at these two` areas of routing protocol performance.

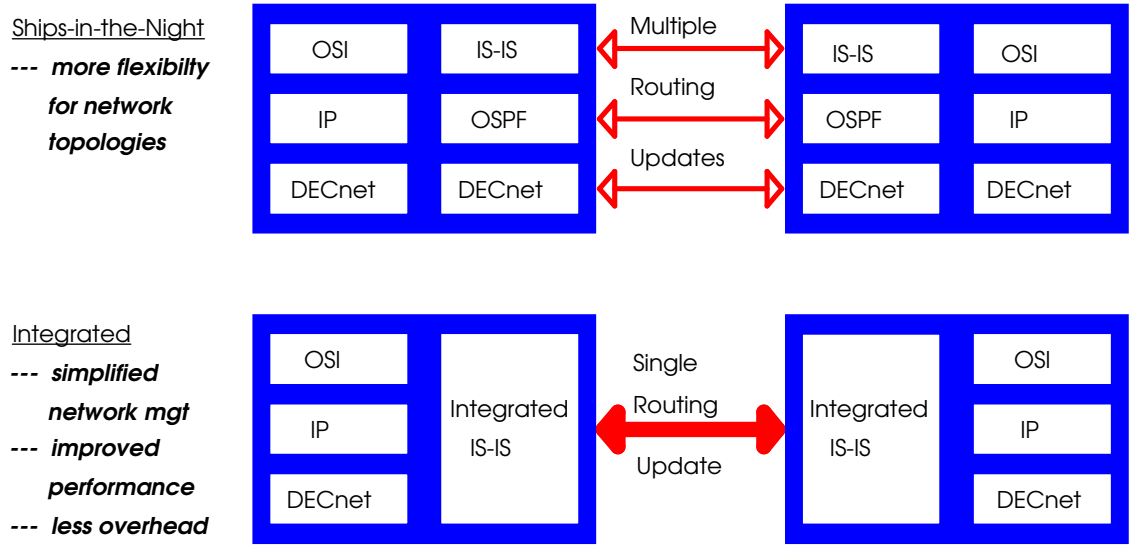
Multiprotocol Routing

There are two main approaches to running multiple routing protocols in a large network.

- *Independent routing, also known as ships-in-the-night.* With this approach, each routing protocol is run independently and routing exchange messages are sent for each network protocol being handled. This has the advantage for small networks that it is simple and keeps the routing update information separate. However, it has the disadvantage that bandwidth is consumed over wide area links by the exchange of several sets of routing update tables. Also, each routing protocol needs to be managed separately.

- *Integrated routing.* With this approach, the routing protocol handles routing exchange messages for multiple network protocols. The router propagates information about the reachability of end systems using different network protocols via a single routing exchange protocol such as Integrated IS-IS for IP, DECnet and OSI. This has the advantage of consuming less bandwidth over the wide area while offering easier management, especially in a large network.

The following diagram illustrates the essential differences between the ships-in-the-night and the integrated approach to routing.



There may also be situations where a combination of integrated and ships-in-the-night routing are appropriate. For example, integrated for IP and OSI protocols but ships-in-the-night for DECnet. This approach may be necessary during network migration or because of addressing constraints.

Routing Algorithms

There are two main routing algorithms in use today.

- *Distance vector routing* is a well established form of routing algorithm which relies on each router exchanging its view of the entire network to its neighbours. Each router constructs a description of the network topology based on the information it receives and communicates this updated picture to its neighbours on a regular basis (approximately every minute). The process is repeated and eventually stabilises when all routers have the same description of the network. Digital's DECnet Phase IV and Cisco's IGRP are examples of routing protocols which use the distance vector routing algorithm.

- *Link state routing* is a more recent form of routing algorithm which relies on each router exchanging information about what its local area of the network looks like with all other routers in the network. Each router constructs a description of its area of the network based on the knowledge it has of the availability and status of links and communicates this information to its neighbours only when a change occurs. Eventually, all routers receive a complete description of where all the other routers are and the links connecting them so that it can build a description of the network. OSPF and IS-IS are examples of routing protocols which use the link state routing algorithm.

Link state routing has several advantages over distance vector routing. Link state routing:

- Scales better, converges more quickly to changes in the network and exhibits more stable behaviour

- Uses less bandwidth and overhead when exchanging information over wide area links

- Offers management advantages in that network problems are easier to diagnose.

Although link state routing has advantages over distance vector routing, it is a newer routing algorithm and so has not been in use for as long. Also, distance vector routing may be more appropriate in some cases, for example in small networks, or where there is only a limited requirement to support a particular routing protocol.

The Importance of Standards

Which routing standards are appropriate? Should you use a routing protocol based on an open standard or one based on a proprietary standard?

- *Open standards* are developed by all interested participants who define and agree on guidelines in a particular area. These guidelines may be published and made freely available to other bodies. Examples of open standard routing protocols are OSPF developed by the Internet Engineering Task Force (IETF) and IS-IS developed by the International Standards Organisation (ISO).

- *Proprietary standards* are developed by a single body, usually a vendor, who has defined proprietary guidelines in a particular area. These guidelines may be published and made freely available to other bodies (in other words, an open proprietary standard), or are only made available to interested bodies under licensing agreements or alliances (in other words, a closed proprietary standard). Examples of open proprietary routing protocols are Apple's AppleTalk and Novell's IPX. An example of a closed proprietary routing protocol is Cisco's IGRP.

Standards provide the key to interoperability. This is an important consideration as it allows greater choice of vendor, investment protection and greater flexibility.

Integrated IS-IS Routing Protocol

Integrated IS-IS is the only integrated, open standard routing protocol. It is based on the ISO IS-IS protocol (ISO/IEC 10589) and has been extended by Digital to handle TCP/IP (RFC 1195) and DECnet Phase V. Digital is also working with other vendors to extend Integrated IS-IS further to include other routing protocols. Integrated IS-IS has several features and benefits:

- *Simplified network management* - as it is an integrated routing protocol, only one set of routing parameters needs to be managed.

- *Reduced bandwidth for routing updates* - as only one set of routing updates is exchanged for all supported network protocols, utilisation of expensive WAN bandwidth is not used unnecessarily.

- *Uses link the state routing algorithm* - offers faster convergence, exhibits more stable behaviour, is easier to diagnose and uses less bandwidth for routing updates than the distance vector routing algorithm

- *Converges at the same time for all supported network protocols* - there is no difference in service for different protocols and the network becomes available for all end systems at the same time.

- *Open standards* - is based on open standards and is freely available to other vendors. Several vendors have already demonstrated Integrated IS-IS interoperability at Interop and at NIST.

The DECNIS 500/600 multiprotocol routers support Integrated IS-IS as well as other routing protocols such as OSPF, RIP and DECnet Phase V. However, the features and benefits of Integrated IS-IS are able to provide the DECNIS with an additional performance advantage.

Further Information

More information about the Integrated IS-IS routing protocol is provided in the following *Digital Networks Marketing Documents:*

- *"The Integrated IS-IS Routing Protocol", Document Number NIPG-003*. This document provides a marketing perspective of the Integrated IS-IS routing protocol.

- *"A Comparison of OSPF and Integrated IS-IS", Document Number NIPG-004.* This document provides a detailed technical comparison of the Integrated IS-IS and OSPF routing protocols.

Conclusion

As shown above, the routing protocol used between routers can affect a number factors such as bandwidth utilisation and the time taken for the network to converge after reconfiguration. Digital believes that an integrated, routing protocol based on open standards that uses the more recent link state routing

algorithm provides the best choice when building large, complex multiprotocol networks. While a number of possible solutions exist, Digital believes that the Integrated IS-IS routing protocol provides the best solutions to meet these needs.

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