hp-ux networking

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technical white paper

HP-UX Route Administration Manager (ramD)

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Introduction

A router is a hardware device or a software application that directs the flow of packets as they travel from one network to another network or networks. It determines the next network point, which receives a packet and forwards it to the appropriate destination. A router is connected to at least two networks. It decides the path for sending each packet, based on its current cognition of the state of the networks to which it is connected. A router creates or maintains a table of the available routes and their conditions. It uses the route information along with the distance and cost algorithms to determine the best route for a given destination. A packet usually traverses through various network points, which are connected to routers, before reaching the final destination.

Routers are designed to find a path between nodes in a network. In a large network, there might be more than one path to other parts of the network. In this case, the router design will generally be such that the shortest path is chosen. Each network protocol to be routed will have a cost or a metric value that applies to each path. In most cases, the lower the cost, or metric for a given path, the most likely it is that the router will choose to use it.

Any router will use both hardware and software to implement general routing principles, but a hardware router will transmit information to its destination more quickly.

Since chips on the board determine all the logic on a hardware router, it might take a few nanoseconds to transmit information, but embedding routing logic into a hardware device is a tedious task, and, if the logic is intricate, the implementation can be nearly impossible. When designing a hardware routing system, it is often difficult to ensure that the design meets the specification, and then afterwards, it is costly to upgrade it.

Conversely, a software router relies on a processor to make logical decisions in its efforts to determine an optimal route for an intended data transfer. It is generally much easier and cost-effective to upgrade and maintain a software router. A software router maintains and synchronizes the kernel routing table in user space with the routing table in the kernel space. Furthermore, a software router offers greater flexibility in terms of what functions are available to network administrators.

IPv6 Routing on HP-UX

With the advent of IPv6, there is a critical need to support an efficient routing protocol that handles millions of routes.

Routing protocols such as Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), Routing Information Protocol (RIP), and Exterior Gateway Protocol (EGP) were originally developed for use in IPv4 networks. They remain unable to handle IPv6 routes.

Administrators are impelled to carry out these tasks manually, using the route command. At its current rate of proliferation, IPv6 urgently necessitates a new software routing protocol implementation.

The upgrade process, though proven cumbersome, is gradually being built up around IPv6 routing protocols and relentless efforts to work around the necessity of decimating human intervention are on.

Executive Summary

This white paper presents a macro view of HP-UX Route Administration Manager (ramD) supported on HP-UX 11i v1 operating system.

It provides information about the marketing opportunities that ramD provides. In addition, the document describes the technology strategy, HP's offering, software availability, and etcetera.

In the subsequent sections, this white paper introduces ramD, its components, product architecture, and etcetera.

Problem Statement

The software needs to facilitate IPv6 routing on the HP-UX 11i v1 operating system.

Technology Strategy

HP's Offering – Pioneering the IPv6 Routing Efforts

HP-UX ramD supports the dynamic routing feature that eliminates the need to reset IPv6 routes manually. When network failures occur, routes are automatically re-routed. Dynamic routing makes it easier to add and administer nodes. In addition, it minimizes the cost of operating complex Internet systems. In case of a network fault, ramD allocates an alternate path and facilitates an effectual IPv6 routing process on HP-UX.

HP sees its IPv6 routing solution as being a profound and welcome change in the way IPv6 packets are routed over networks, and is committed to ongoing research and development in this area.

HP-UX ramD Overview

The ramD software encompasses the following routing protocols that facilitate IPv6 routing on the HP-UX operating system:

- ✓ Routing Information Protocol Next Generation (RIPng)
- ✓ Border Gateway Protocol (BGP)
- ✓ Intermediate-System to Intermediate-System protocol (IS-IS)

The Route Administration Manager (RAM) software for IPv6 is a software router that functions on the HP-UX IPv6 stack.

How RAM Works

Figure 1.1 illustrates a sample IPv6 network using RAM.

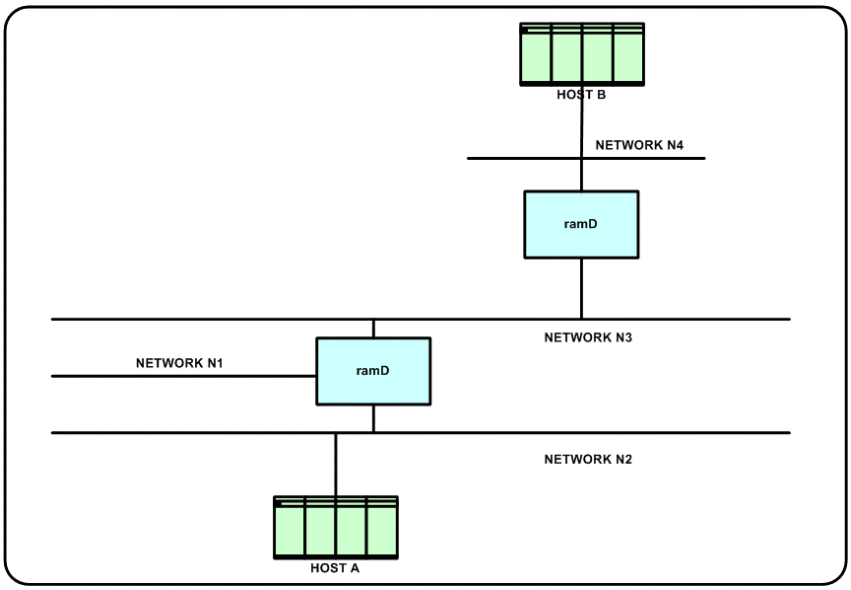

Figure 1.1 A Sample IPv6 Network Using RAM

The RAM framework incorporates the RIPng and other routing protocols that dynamically learn the network reachability information. They select the best route to reach a network and install that route in the HP-UX kernel routing table. The system uses the kernel routing table entries to route incoming IPv6 packets.

For example, in Figure 1.1, if host A on network 2 (N2) needs to establish a connection with host B on network 4 (N4), ramD learns information about a possible route between N2 and N4 and updates this information in the HP-UX kernel routing table.

Protocol Overview

RIPng

Routing Information Protocol Next Generation (RIPng) is a routing protocol that runs over User Datagram Protocol (UDP). It operates within an autonomous system (AS), which comprises one or more routers or networks controlled by a common network administrator. Each autonomous system must obtain a globally unique number from the Internet Assigned Numbers Authority (IANA).

RIPng uses the standard port number 521. Routers that use RIPng listen on the multicast address *FF02::9*, and send their update messages to this address.

It uses distance-vector algorithms to determine an optimal route to a destination, using hop count (number of routers between a source and destination network node) as the metric (a measure for calculating the next host for routing a packet). The RIPng protocol supports a maximum hop count of 15, and was designed to work as an Interior Gateway Protocol (IGP) in moderate-size autonomous systems. It is not intended for use in large-scale networks.

RIPng conforms to IETF RFC 2080. The following lists the characteristics of the RIPng protocol:

- ✓ Selects the route with the lowest metric value as the most preferred route for transmitting packets and installs this route in the routing table.
- ✓ Uses the standard port number 521.
- ✓ Exchanges IPv6 reachability information with routers that share the common data link layer.
- ✓ Functions in either split horizon or poisson reverse mode.
- ✓ Includes Simple Network Management Protocol (SNMP) support.
- ✓ Supports a maximum hop count value of 15.

Routers that use RIPng listen on the multicast address *FF02::9*, and send their update messages to this address.

BGP

Border Gateway Protocol (BGP) is an inter-autonomous system routing protocol. BGP transmits routing information across autonomous systems. BGP that exchanges route information with peers in a different autonomous system (AS) is referred to as External BGP (EBGP), and BGP that exchanges information with a peer in the same AS is referred to as Interior BGP (IBGP).

The basal function of a BGP-enabled system is to share network reachability information, such as the list of autonomous systems, with other BGP systems.

BGP conforms to the Internet Engineering Task Force-Request for Comments: IETF-RFC 1771, 2545, and 2858.

The following lists the characteristics of the BGP protocol:

- ✓ Runs over Transmission Control Protocol (TCP).
- ✓ Exchanges routing information with its peers. A peer in a different AS is an external peer, and the peer in the same AS is an internal peer.
- ✓ Uses the standard port number 179.

- ✓ Uses path-vector algorithms.
- ✓ Exchanges IPv6 reachability information with routers sharing the common data link layer via route update messages.
- ✓ Installs the best route in the routing table.
- ✓ Includes Simple Network Management Protocol (SNMP) support.

IS-IS

IS0 10589 specifies the Intermediate-system-to-Intermediate-system (IS-IS) routing protocol for Connectionless Network Service (CLNS) traffic. IS-IS is an extendible intra-domain routing protocol. The IETF RFC 1195 adds IP support, also referred to as integrated IS-IS. The IS-IS protocol conforms to the IETF draft RFC *draft-ietf-isis-ipv6-03.txt* for IPv6 support.

The following lists the characteristics of the IS-IS protocol:

- ✓ Runs over data link layer.
- ✓ Uses Shortest-Path First Algorithms (SPF) to determine the best route to a destination.
- ✓ Supports two-level routing hierarchy. Routing within an area is Level-1 routing and routing across areas is Level-2 routing. SPF runs over Level 1 and Level 2 databases separately.
- ✓ Learns only IPv6 route information.
- ✓ Encapsulates its packets directly on the data-link layer. IS-IS packets are referred to as network Protocol Data Units (PDUs).
- ✓ Includes Simple Network Management Protocol (SNMP) support.
- ✓ Installs the best route in the IS-IS routing table.

ramD on HP-UX

Figure 1-2 depicts the RAM software architecture.

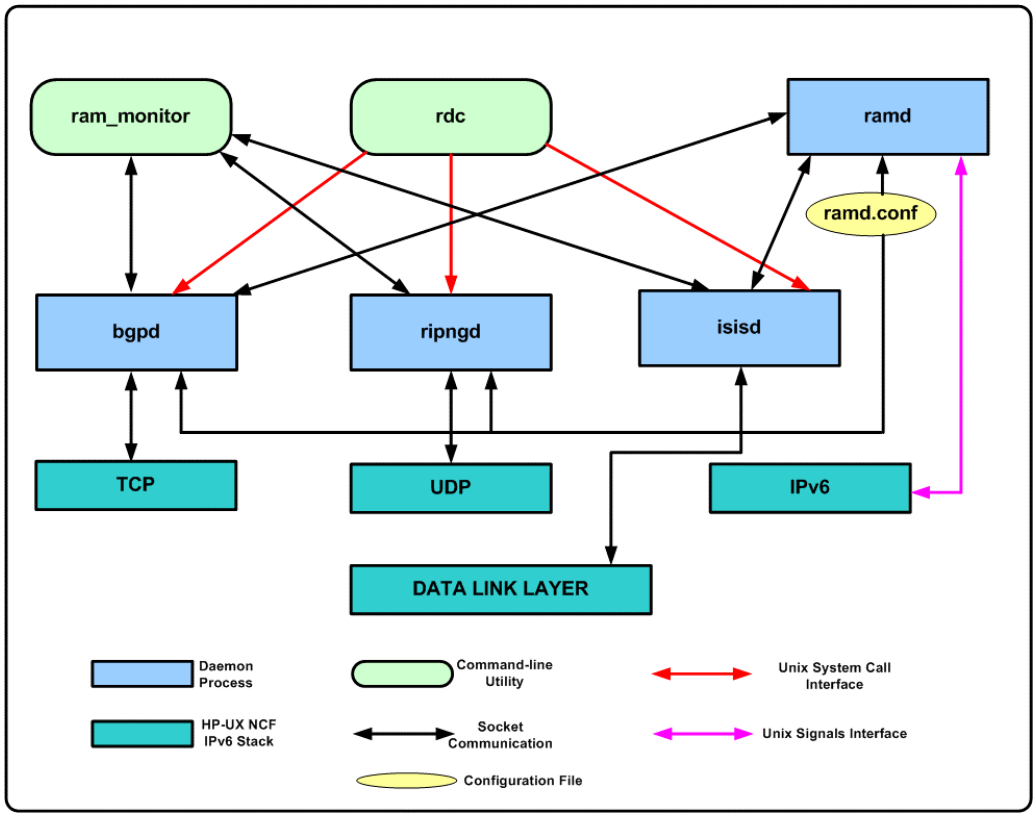

Figure 1.2 RAM Architecture

The ripngd, ramd, bgpd, and isisd router daemons run in the user space. The ripngd and the bgpd daemons use User Datagram Protocol (UDP) and Transmission Control Protocol (TCP), respectively. The ramd daemon manages and distributes the routes identified for an intended data transfer. The ram_monitor utility facilitates interaction between the user and the routing daemons. The ram_monitor utility establishes a TCP connection with the routing daemons in order to obtain the necessary routing information and display their data to the user.

The rdc utility controls how the routing daemons operate with ramd.

Role of the Routing Daemons

ramd

ramd, which runs as a daemon process, manages and redistributes routes between routing protocols. It reads the /etc/ramd.conf configuration file and spawns the ripngd, bgpd, and isisd processes. The routing daemons and ramd communicate with one another via the UNIX domain SOCK_STREAM type sockets. The ramd daemon retrieves information about the HP-UX kernel routing table and the interface table. Upon startup, the routing daemons register with ramd to obtain the HP-UX kernel interface and route information.

ramd maintains its routing table in the user space and synchronizes it with the HP-UX kernel routing table. When a route is added or deleted in the HP-UX kernel routing table, ramd adds or deletes the same route in its routing table and sends an update to the routing daemons. In addition, ramd communicates the operational status changes in the HP-UX kernel interface table to the routing daemons. The addition or deletion of routes can be achieved through the route (1M) command or ramd.conf, the configuration file for ramd.

ramd maintains a repository of static and direct routes learnt from the routing daemons. In addition, ramd assigns a preference value for a routing protocol. The preference value is based on the network interface or the routing protocol. When ramd obtains information about a single route from more than one routing protocol, it selects the route with the lowest preference value and installs that route in the HP-UX kernel routing table.

Routing Daemons

ripngd, bgpd, and isisd run as daemon processes on the HP-UX 11i v1 operating system.

Role of the Command-Line Utilities

rdc

rdc is a command-line utility that controls the operation of ramd and the routing daemons. The rdc utility instructs ramd and the routing daemons to carry out an intended operation via UNIX signals. It receives input from the user, invokes the appropriate command, and displays the results on the screen before exiting.

The rdc utility supports the following tasks:

- ✓ Starting and stopping ramD and ripngd.
- ✓ Restarting and reconfiguring ramD and ripngd.
- ✓ Checking the RAM configuration file for syntax.
- ✓ Producing the protocol status dump and core dumps.
- ✓ Requesting ramD to retrieve the HP-UX kernel interface table.

The rdc utility uses UNIX signals; it is mandatory that rdc, the routing daemons, and ramd run on the same machine.

ram_monitor

ram_monitor is a utility that acts as an interface between the user and the routing daemons. It uses TCP-based SOCK_STREAM sockets to connect to the routing daemons. The ram_monitor utility functions as a client whereas the routing daemons function as servers.

By default, the routing daemons do not service ram_monitor requests. This needs to be explicitly specified in the corresponding protocol sections of the ramd.conf configuration file. The ram_monitor utility is invoked with the IP address of the machine on which the routing daemons run and the port number on which they wait. It connects to the routing daemons running on the local machine or on a remote machine.

→ When ram_monitor establishes a connection with the routing daemons, it displays different user prompts. If ram_monitor and ripngd run on the same machine, ram_monitor displays the **ripngd>** user prompt. If ram_monitor and ripngd run on different machines, ram_monitor displays the **ripngd#** user prompt.

→ If ram_monitor and bgpd run on the same machine, ram_monitor displays the **bgpd>** user prompt. If ram_monitor and bgpd run on different machines, ram_monitor displays the **bgpd#** user prompt.

→ If ram_monitor and isisd run on the same machine, ram_monitor displays the **isisd>** user prompt. If ram_monitor and isisd run on different machines, ram_monitor displays the **isisd#** user prompt.

The ram_monitor utitlity provides detailed information on IO statistics, error logs, routing table, configured protocol interfaces, and configured filter policies.

Conformance to RFCs and Internet Drafts

The ramD routing software on HP-UX conforms to the following RFCs and Internet drafts:

- ✓ RFC 2080 - *RIPng for IPv6*
- ✓ RFC 1771 - *A Border Gateway Protocol 4 (BGP-4)*
- ✓ RFC 2545 - *Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain*

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- ✓ RFC 2858 - *Multiprotocol Extensions for BGP-4*
- ✓ Internet draft - *draft-ietf-isis-ipv6-03.txt*

Compatibility/ Interoperability

The following lists the prerequisites for installing ramD:

- ✓ HP systems running HP-UX 11i v1
- ✓ 1.3 MB of memory

This version of ramD is interoperable with CISCO routers, and it operates on HP-UX High Availability environment like Serviceguard.

Software Availability

The ramD (1.002) software is available as a web release on the software repository of HP at the following URL:

http://www.software.hp.com

Glossary

Following is a glossary of terms/acronyms used in this document:

Term	Description
RIP	Routing information protocol.
BGP	Border gateway protocol.
IS-IS	Intermediate-system-to-Intermediate-system
RAM	Route administration manager.
ramd	Route administrator manager daemon.
RIPng	Routing information protocol next generation.
RFC	Request for comments.
IETF	Internet engineering task force.

Additional Information

For more information about ramD, see the following documents available at http://www.docs.hp.com/hpux/netcom/index.html#Routing:

- ✓ *HP-UX Route Administration Manager (ramD) Administrator's Guide (5990-6689)*
- ✓ *HP-UX Route Administration Manager (ramD) Release Notes (5990-6688)*