

## **RHCA Syllabus / Course Outline**

### **RH442 Red Hat Enterprise System Monitoring and Performance Tuning**

#### **Course Outline**

#### **Unit 1 - Elements of Monitoring and Tuning**

- Performance tuning is...
- Before you begin
- How much is how much?
- Calculating unit conversions
- Monitoring
- Monitoring vs. Profiling
- Whole-system view
- Sample application model
- Sample hardware model
- Before tuning the kernel
- Kernel tunables
- Using system documentation
- Recovering from problems

#### **Unit 2 - Simple Network Monitoring**

- SNMP
- SNMP versions
- Management Information Base
- The MIB hierarchy
- Referring to MIB objects
- Reading a MIB file
- Installing SNMP packages
- Finding MIB objects
- Using SNMP v1 for queries
- Using SNMP v3 for queries
- Configuring the SNMP client

- Enabling the SNMP agent
- Profiling SNMP host access controls
- Configuring SNMP v1 access
- Configuring SNMP v3 access
- Beyond RH442: Extending snmpd

### Unit 3 - Graphical Reporting

- MRTG
- Configuring MRTG
- Allowing access to MRTG
- Creating a dashboard in MRTG
- Ad-hoc utilities
- Installing iostat and sar
- Using iostat and sar
- Configuring sar
- Awk
- Using awk
- Gnuplot
- Using Gnuplot
- Creating a custom script
- Scheduling a custom script

### Unit 4 - Kernel-Level Profiling

- OProfile
- Installing OProfile
- Installing kernel-debuginfo
- Setting up OProfile
- Running a test
- Reviewing results
- OProfile architecture
- SystemTap
- Required packages
- SystemTap scripts
- The stap command

### Unit 5 - Queuing Theory

- Introduction to queuing theory
- Little's Law
- Queue length

- Queue length vs wait time
- Wait time
- A closer look at wait time
- How much user time is needed?
- Profiling time with time
- Finding hot spots in code
- Completion rate
- Arrival rate vs completion rate
- Finding a valid observation period
- Predicting system-wide limits
- Predicting resource limits
- Summary of strategies

## Unit 6 - Compensating for Physical Disk Characteristics

- Physical factors affect disk IO
- Disk storage density
- Choosing a peripheral interconnect
- SCSI bus considerations
- Electro-mechanical positioning
- Block IO requests and cache effect
- Tuning sequential read access
- Tuning the disk queue
- Tuning the deadline scheduler
- Tuning the anticipatory scheduler
- Tuning the noop scheduler
- Tuning the (default) cfq scheduler
- Fine-tuning the cfq scheduler
- Physical block device interfaces
- Virtual block devices
- Tuning virtual block devices
- Logical volumes and VBDs
- Implementing snapshot storage

## Unit 7 - Reducing Disk Visit Count

- The virtual file system (VFS)
- Layout of ext2/ext3
- Fragmentation
- Viewing fragmentation
- Tuning fragmentation

- Filesystem limits
- Journaling
- Improving journal performance
- Tuning journal placement
- Other mount-time options
- Finding lock contention
- Reducing visit count with RAID
- Calculating chunk size
- Calculating filesystem stride
- Tuning round-robin RAID
- Write overhead for RAID5 and RAID6
- Improving RAID1 performance
- Tuning RAID1
- Tuning RAID in SysFS

## Unit 8 - Processes and the Scheduler

- Characterizing process states
- Getting ready to run
- Types of CPU cache
- Locality of reference
- Improving locality of reference
- Multitasking and the run queue
- Preempting the current process
- Sorting the run queue
- SCHED\_OTHER
- Tuning scheduler policy
- Viewing CPU performance data

## Unit 9 - Kernel Timing and Process Latency

- How Linux tracks time
- Tuning system ticks
- Tuning processor speed
- IRQ balancing
- Tuning IRQ affinity
- Equalizing CPU visit count
- Tuning process affinity with taskset
- Tuning run queue length with taskset
- Hot-plugging CPUs
- Scheduler domains

- Configuring the root cpuset
- Configuring a child cpuset
- Important files for scheduler domains
- Virtual CPUs
- Tuning VCPUs at domain creation
- Tuning VCPUs dynamically
- Tuning VCPU affinity

## Unit 10 - Memory Addressing and Allocation

- Overview of memory addressing
- Virtual address space (32-bit)
- Viewing process address space
- Tuning process address space
- Physical address space
- Mapping virtual addresses (x86)
- Uniform memory architecture (x86)
- Overview of memory allocation
- Improving RAM performance
- Improving MMU performance
- Tuning the NUMA allocator
- Improving TLB performance
- Tuning TLB performance
- Viewing system calls
- Virtual domain memory
- Tuning memory at domain creation
- Tuning domain memory dynamically
- Recovering unassigned memory

## Unit 11 - Memory Caches

- Strategies for using memory
- A closer look at demand paging
- Tuning page allocation
- Tuning overcommit
- Slab cache
- ARP cache
- Tuning ARP cache
- Page cache
- Tuning page cache
- Anonymous pages

- SysV IPC
- Tuning SysV IPC
- Viewing memory with free
- Other commands to view memory usage

## Unit 12 - Memory Reclamation

- Characterizing page status
- Calculating dirty and clean memory
- Reclaiming dirty pages
- Tuning pdflush
- Reclaiming clean pages
- Out-of-memory killer
- Tuning OOM policy
- Detecting memory leaks
- What is swap?
- Improving swap performance
- Tuning swappiness
- Tuning swap size
- Tuning swap for think time
- Tuning swap visit count
- Monitoring memory usage

## Unit 13 - Essential Network Tuning

- Simplified transmit model
- Simplified receive model
- Kernel socket buffers
- Calculating total buffer size
- Calculating per-socket buffer size
- Tuning core buffer size
- Tuning TCP buffer size
- Tuning DMA buffer size
- Is packet fragmentation a problem?
- Tuning fragmentation buffers
- Network interrupt handling
- Improving interrupt handling
- Tuning interrupt handling
- Network sockets
- TCP sockets
- Viewing network sockets

- Tuning TCP socket creation
- Tuning TCP socket keepalive

## **RH436 Red Hat Enterprise Clustering and Storage Management**

### **Course Outline**

- Review Red Hat Enterprise Clustering and Storage Management Technologies
- Linux Dynamic Device Management
  - udev Features
  - udev Rule Configuration
- iSCSI
  - iSCSI as a Shared Storage Device
  - Configuring an iSCSI initiator
  - Configuring an iSCSI target
  - Authentication
- Advanced Software RAID
  - Types and Differences
  - Monitoring
  - Optimization Techniques
  - Growth and High Availability
- Device Mapper and Multipathing
  - Mapping Targets
  - LVM2 Snapshots
  - Multipath Device Configuration
- Cluster Suite Overview
  - Design and Elements of Clustering
  - Cluster Configuration Tools
  - Clustered Logical Volumes and Lock Management
- Quorum and the Cluster Manager
  - Intracluster Communication
  - Cluster Tools
- Fencing and Failover
  - Fencing Components
  - Failover Domains
- Quorum Disk
  - Heuristic Configuration
- Service Manager
  - Resource Groups and Recovery

- Hierarchical Resource Ordering
- High Availability Services
- Global File System (GFS)
  - Implementation and Configuration
  - Lock Management
  - Planning For and Growing On-line GFS
  - Monitoring Tools
  - Journal Configuration and Management

## **RHS333 Red Hat Enterprise Security: Network Services**

- The Threat Model and Protection Methods
  - Internet threat model and the attacker's plan
  - System security and service availability
  - An overview of protection mechanisms
- Basic Service Security
  - SELinux
  - Host-based access control
  - Firewalls using Netfilter and iptables
  - TCP wrappers
  - xinetd and service limits
- Cryptography
  - Overview of cryptographic techniques
  - Management of SSL certificates
  - Using GnuPG
- BIND and DNS Security
  - BIND vulnerabilities
  - DNS Security: attacks on DNS
  - Access control lists
  - Transaction signatures
  - Restricting zone transfers and recursive queries
  - DNS Topologies
  - Bogus servers and blackholes
  - Views
  - Monitoring and logging
  - Dynamic DNS security
- Network Authentication: RPC, NIS, and Kerberos
  - Vulnerabilities

- Network-managed users and account management
- RPC and NIS security issues
- Improving NIS security
- Using Kerberos authentication
- Debugging Kerberized Services
- Kerberos Cross-Realm Trust
- Kerberos Encryption
- Network File System
  - Overview of NFS versions 2, 3, and 4
  - Security in NFS versions 2 and 3
  - Improvements in security in NFS4
  - Troubleshooting NFS4
  - Client-side mount options
- OpenSSH
  - Vulnerabilities
  - Server configuration and the SSH protocols
  - Authentication and access control
  - Client-side security
  - Protecting private keys
  - Port-forwarding and X11-forwarding issues
- Electronic Mail with Sendmail
  - Vulnerabilities
  - Server topologies
  - Email encryption
  - Access control and STARTTLS
  - Anti-spam mechanisms
- Postfix
  - Vulnerabilities
  - Security and Postfix design
  - Anti-spam mechanisms
  - Configuring SASL/TLS
- FTP
  - Vulnerabilities
  - The FTP protocol and FTP servers
  - Logging
  - Anonymous FTP
  - Access control
- Apache security

- Vulnerabilities
- Access control
- Authentication: files, passwords, Kerberos
- Security implications of common configuration options
- CGI security
- Server side includes
- suEXEC
- Intrusion Detection and Recovery
  - Intrusion risks
  - Security policy
  - Detecting possible intrusions
  - Monitoring network traffic and open ports
  - Detecting modified files
  - Investigating and verifying detected intrusions
  - Recovering from, reporting, and documenting intrusions

## **RH401 Red Hat Enterprise Deployment and Systems Management Course Outline**

- Unit 1 - Essential System Management
  - Goals of Enterprise system management
  - Standardization, centralization, and scalability
  - Provisioning and automation
- Unit 2 - Installing a Red Hat Network Satellite Server
  - Introduction to RHN Satellite - features, prerequisites
  - Installing Satellite Server software
  - Understanding software channels and entitlements
  - Importing channel content into a Satellite Server
- Unit 3 - Red Hat Network Organization
  - Organization management and trust relationships
  - Managing user accounts
  - Assigning user roles (security)
  - Managing system groups
- Unit 4 - Managing Changes with Revision Control
  - Introducing revision control concepts
  - Basic Subversion repository administration

- Using Subversion to manage revisions
  
- Unit 5 - Red Hat Network Client Configuration
  - Secure communication with SSL
  - Red Hat Network registration
  - Creating and using activation keys
  - Registration automation with bootstrap.sh
  - Troubleshooting RHN registration
  
- Unit 6 - Red Hat Network Software Management
  - Software channel relationships
  - Cloning existing software channels
  - Managing custom software channels
  - Notifying clients of changes: managing errata
  
- Unit 7 - Building RPMs
  - Building open source software
  - Using RPM macros
  - Writing custom spec files
  - Using rpmbuild to create RPMs
  - Signing packages for security
  
- Unit 8 - RHN Application Programmer Interface
  - Uses for Red Hat Network API
  - Basic RHN API program structure
  - Sample programs
  
- Unit 9 - Configuration File Management with Red Hat Network
  - Managing configuration channels
  - Configuration file macros
  - Configuration file management using command-line tools
  
- Unit 10 - Provisioning with Kickstart
  - Anaconda kickstart options
  - Building a provisioning environment
  - Using Cobbler for provisioning
  
- Unit 11 - Virtual Machine Management

- Virtual host/virtual platform entitlements
- Controlling Xen guests using RHN
- Red Hat Network management of Xen virtual machines

- Unit 12 - RHN Satellite Server Administration
- High-availability options
- Embedded database management
- Certificate management
- Changing from disconnected to connected operation
- Inter-satellite synchronization (ISS)
- Exporting software channels
- Troubleshooting

- Unit 13 - Red Hat Network Proxy Server
- RHN proxy server installation
- Configuring a client to use a RHN proxy server
- Managing software with RHN package manager

## **RH423 Red Hat Enterprise Directory Services and Authentication**

### **Course Outline**

- Introduction to Directory Services
  - What is a directory?
  - LDAP: models, schema, and attributes
  - Object classes
  - LDIF
- The LDAP Naming Model
  - Directory information trees and Distinguished Names
  - X.500 and "Internet" naming suffixes
  - Planning the directory hierarchy
- Red Hat Directory Server: Basic Configuration
  - Installation and setup of Red Hat Directory Server
  - Using the Red Hat Console
  - Using logging to monitor Red Hat Directory Server activity
  - Backing up and restoring the directory
  - Basic performance tuning with indexes
- Searching and Modifying the LDAP Directory
  - Using command line utilities to search the directory

- Search filter syntax
- Updating the directory
- Red Hat Directory Server: Authentication and Security
  - Configuring TLS security
  - Using access control instructions (ACI's)
  - ACI's and the Red Hat Console
- Linux User Authentication with NSS and PAM
  - Understanding authentication and authorization
  - Name service switch (NSS)
  - Advanced pluggable authentication modules (PAM) configuration
- Centralized User Authentication with LDAP
  - Central account management with LDAP
  - Using migration scripts to migrate existing data into an LDAP server
  - LDAP user authentication
- Kerberos and LDAP
  - Introduction to Kerberos
  - Configuring the Kerberos key distribution center (KDC) and clients
  - Configuring LDAP to support Kerberos
- Directory Referrals and Replication
  - Referrals and replication
  - Single master configuration
  - Multiple master configuration
  - Planning for directory server availability
- Cross-Platform Centralized Identity Management
  - Synchronizing Red Hat Directory Server with Active Directory
  - Managing users with Winbind and LDAP
  - Mapping attributes between Linux and Windows