



**The Future of Network Infrastructures** In recent years, there has been a change in the way Network Equipment Providers (NEPs) and Telecom companies develop their network infrastructure applications. Ever increasing demands on packet performance and the need for higher utilization of equipment vis-a-vis dynamic network architecture has presented a new challenge for the industry; implementing cloud based solutions in a high available network. With the dramatic increase in the world mobile data traffic, NEP's are challenged with scaling mobile networks more efficiently than the static networks of the past. Many are looking for a solution where their networks can change on demand. A network that is as dynamic as the data running on it. Telecom has looked to the IT world and cloud computing as inspiration for architecting and developing the future of mobile networks. These future networks much like a cloud, will be defined less by the statically deployed hardware/software combinations and more by the dynamic software that is managing these fluid systems.

**Carrier Grade Edition 7** MontaVista Carrier Grade Edition 7, CGE7, is the next generation platform for multi-architecture virtualization and abstraction for the Network Infrastructure Market. CGE7 platform provides new and updated technologies to enable the dynamic cloud based networks the market struggles with today, and the standards based solution brings enhancements to security and up-time availability. These new features enable providers of Next-Generation Networks to handle the explosive growth and increase in traffic, specifically the rapid adoption of cloud technology and the growth in multimedia and video rich content. MontaVista's CGE 7 meets the demands the virtualized network, providing application portability, dynamic configuration, and real-time performance in a single platform.

MontaVista's CGE7 delivers best in class open Carrier Grade technology and is complemented with services delivered by MontaVista's world-class Engineering Services group to assist customers in building solutions to support their specific use cases ranging from portability of legacy applications to scalable KVM implementations with real-time performance. In addition to the initial solution, the Engineering Services group can build out a full test and validation process and a long-term support and maintenance strategy to suit the requirements of any deployment strategy.

MontaVista recognizes that security is critical for uptime availability in a network. The Carrier Grade Edition 7 update leveraged the relevant features applicable to the embedded environment from Security Technology Implementation Guideline (STIG) and Common Criteria Operation System Protection Profile (OSPP) standards to build out the security features for the platform. As a trusted Operating System Vendor, MontaVista receives notification of all security fixes and CGE 7's security team provides rapid updates of any new security fixes to the CGE 7 platform. To help further improve uptime availability, Live Kernel Patching has been included in the product. This new feature allows kernel patching of a live system without bringing the system down, giving network managers more flexibility to schedule any down time required for maintenance of a system.

MontaVista's commitment to standards in the network infrastructure market has set MontaVista's Carrier Grade Edition 7 apart. MontaVista utilizes and is committed to the Bitbake and Yocto project, CGE 7 is compliant to the Yocto v1.2 specification. Other specifications that MontaVista includes for the network infrastructure market in CGE 7 are CGL 5.0, LSB 4.1, and IPv6 Certification Ready.

MontaVista Linux Carrier Grade Edition adds additional value over open source or proprietary solutions by including features only available from MontaVista. These include:

- Cross-platform support for Linux containers simplifies the resource allocation and control of multi-core processors
  - Bare Metal Engine™ which delivers bare metal performance in Linux and maximizes multi-core processor utilization
  - Field-serviceability that allows field engineers to fix and upgrade live systems while they are running, minimizing downtime

## Multi-core Resource Management

Carrier Grade Edition provides multiple options for maximizing the resource utilization of multi-core processors. With both AMP and SMP support, along with new partitioning and virtualization technologies, CGE provides the most flexibility and the highest performance for multi-core applications.

## KVM Hypervisor

KVM provides a full virtualized environment for hosting multiple guest OS's. KVM allows users to partition multiple OS's with maximum isolation and security. Currently available for all architectures that support KVM.

## Containers

Linux containers provide an isolated application space without the need for a complete virtualization solution. They are an operating system-level partitioning method for running multiple isolated processes. Containers do not provide a virtual machine, but rather provides a virtual environment that has its own process and network space allocated.

## Bare Metal Engine™

Bare Metal Engine (BME) provides a light-weight, run to completion environment that delivers bare metal performance, all inside a Linux environment. Based on standard Linux features, BME lets users create a dedicated environment to run Linux processes, providing bare-metal execution and performance in Linux. BME provides multiple configurations, allowing users to choose their own unique balance between system-services and no-overhead performance.

## Live Kernel Patching – Ksplice

One of the key benefits of the Open Source environment is the speed at which kernel developers respond to security issues. Repairing these vulnerabilities as quickly as possible with minimum disruption has always been a priority of IT organizations. In the past this has meant shutting down the system, applying the patch and re-booting the system, a process that can be costly and potentially critically disruptive to an organization.

With the addition of Ksplice system administrators now have the best of both worlds, security fixes can be implemented without any time consuming reboots. In addition to security updates Ksplice can be used to apply diagnostic patches and critical bug fixes all increasing security, reliability and availability of a system.

## Security Enhancements

CGE7 has also added enhanced Security capabilities. CGE7 incorporates the critical features that are relevant to the embedded market and discards those for other environments. CGE7 utilizes the following specifications as a basis;

- Security Technology Implementation Guide (STIG) UNIX version 5.0 r1.
- Common Criteria Operation System Protection Profile (OSPP) version 2.0.

## Virtual Routing and Forwarding

CGE is the only Linux distribution to enable virtual routing and forwarding (VRF) capabilities. VRF allows NEPs and Telecom carriers to use low cost COTS hardware to provide secure network communications, rather than costly proprietary hardware platforms to achieve the same level of functionality.

## Flight Recorder

When a system fails today, field engineers must wait until the next failure to investigate the first one. Engineers have no way of gathering enough data about what happened before and during a crash to conduct an effective post-crash diagnosis and take corrective action. CGE includes new Flight Recorder, which acts like an airplane black box to track and log system history. It keeps a scheduler history, which provides more information than a crash dump snapshot, and is user-extensible for customized tracking.

## Live application core dump

When field engineers need to perform a core dump to help them debug problems on a running application, MontaVista's live application core dump dramatically reduces the downtime required to make a core dump. With only a short (generally tens to hundreds of milliseconds) stop of the application, this new feature takes a snapshot of the running application. The application can continue running while engineers debug the snapshot to fix the application. MontaVista is the first to offer this capability.

## Integrated real-time response

Carrier Grade Edition is 100% native Linux with real-time performance features, including MontaVista enhancements plus integrated high resolution nanosecond timers (hrtimers) Additional real-time features include fast mutexes, threaded soft and hard IRQ handlers, and application-level priority inheritance and queuing, providing deterministic preemption response latency. Benchmark tests have proven that MontaVista's integrations of real-time features deliver much lower latency levels than non-MontaVista implementations.

## Microstate accounting

For the first time in a commercial Linux product, engineers can accurately measure process and thread utilization on a CPU. CGE performs high-resolution process accounting, so applications can be monitored to anticipate and prevent CPU overload situations. This enables engineers to design automated load balancing and graceful protocol degradation using reliable and accurate CPU load numbers. Engineers can accurately monitor and precisely predict CPU loads, increasing the accuracy of worst-case planning, preventing downtime, and reducing the purchase of backup equipment for traffic surges. Older systems report CPU and thread activities based on statistical sampling estimates, which can be very inaccurate, instead of the actual measurement now enabled by microstate accounting. Microstate accounting in CGE will improve the scalability, reliability, and cost of carrier networks.

## Integrated development environment

Carrier Grade Edition includes new runtime components that integrate with MontaVista DevRocket, an Eclipse-based IDE with development tools that enhance productivity for both kernel-level and application-level engineers. Integrated memory leak detection, performance profiling, memory usage analysis, and system tracing combine to accelerate system development and maintenance, and increase system availability.

## Carrier standards compliance

MontaVista is the only carrier grade Linux compliant with Carrier Grade Linux Specification 5.0 from the Linux Foundation, LSB 4.1 compliant, and IPv6 certification ready. CGE is also compliant with the SCOPE Alliance Linux Profile, and runs on hardware designed to support the PICMG Advanced Telecommunications Computing Architecture (ATCA) and MicroTCA specifications. CGE supports Intel's Extensible Firmware Initiative (EFI).

## About MontaVista Software

MontaVista Software, LLC, a wholly owned subsidiary of Cavium Networks (NASDAQ:CAVM) is a leader in embedded Linux commercialization. For over 10 years, MontaVista has been helping embedded developers get the most out of open source by adding commercial quality, integration, hardware enablement, expert support, and the resources of the MontaVista development community. Because MontaVista customers enjoy faster time to market, more competitive device functionality, and lower total cost, more devices have been deployed with MontaVista.

# SPECIFICATIONS

## Linux Kernel

- 3.4 Kernel
- LSB 4.1 Compliant
- posix\_fadvise(2)
- Kexec for fast reboot
- LSM
- NBD
- Real-time kernel
- corefile naming
- IMQ
- fumount
- NAPI support for drivers
- Panic handler enhancements
- Asynchronous events (Libevent)
- Machine Check Architecture (MCA)
- RAID disk mirroring
- RAID multihost
- Preempt\_none
- Preempt\_desktop

## Architectures Supported

- Intel x86/x86\_64 reference platforms
- PowerPC
- MIPS64
- ARM

## Multi-core Resource Management

- Containers
- Bare Metal Engine
- KVM

## Connectivity and I/O

- Virtual Routing and Forwarding
- TCP/IPv4/IPv6
- IPv6 certification ready
- IPSec
- IKEv2
- GTP
- VLAN Tagging (IEEE 802.1Q)
- SCTP
- Hotplug (ATCA, uTCA, AMC)
- Serial ATA
- USB2 Host
- USB Human Interface Device (HID)
- Input Core
- MTD
- ifenslave
- IPMI
- Logical Volume Management/Logical Volume Management2 (LVM/LVM2)
- Fibrechannel
- Proxy ARP
- AIC

# SPECIFICATIONS, CONTINUED

## High availability features

- DRBD
- TIPC
- Microstate accounting
- SCSI RAS
- SMART disk monitoring

## Field serviceability features

- Flight Recorder
- Dump
- Live application core dump
- Multithreaded Core Dump
- Performance statistics
- Forced block device removal (enables hot swap)
- Forced unmount (enables hot swap)
- SCSI hot swap

## File systems

- ext2/ext3/ext4
- FAT
- VFAT
- SMB
- XFS
- NFS
- NFSv2
- NFSv3
- sysfs
- ramdisk (ramfs, tmpfs, and initramfs)
- JFFS2 (dependent on flash)
- YAFFS (dependent on flash)
- YAFFS2 (dependent on flash)
- Squashfs
- dosfstools

## Kernel and application development tools

- MontaVista DevRocket Eclipse-based IDE
- Many additional tools from MontaVista partners

## System measurement tools:

- Kernel startup timing
- Execution tracing
- Performance profiling
- Memory usage
- Application measurement tools:

- Performance profiling
- Memory usage
- Memory leak detection

## Device management tools:

- View processes and change priority
- Remote file management
- Remote shell

## Other development tools:

- Automated remote debug
- Yocto V1.2 build engine
- Platform image builder
- LTTng (Linux Trace Toolkit Next Generation) support
- Memory debugger
- KGDB
- KGDB over Ethernet
- GNU Compiler Collection (gcc) 4.7
- GNU C Library (glibc) 2.15
- GNU Binary Utilities (binutils) 2.22
- GNU Debugger (gdb) 7.4

## Userland features

- pmtools
- tripwire
- MDADM
- scsirastools
- crash
- SMART
- SCTP tools
- NBD
- Extended Watchdog support
- ifenslave
- IMQ Tools
- libscsihotswap
- udev
- SNMP MIB support
- Wireshark (formerly Ethereal)
- Ethtool
- CUPS
- Elfutils
- hostDHCP
- Schedutils
- Dash
- net-snmp
- module-init-utils
- openOBEX

## Integrated real-time response

- MontaVista Linux preemptible kernel technology (100% native Linux; no double-kernel non-Linux add-ons)
- High resolution POSIX timers
- Threaded soft and hard IRQ handlers
- Application-level priority inheritance
- Priority queuing
- Robust mutexes
- Futexes
- Userland support
- Preempt\_RT

## Development environment hosts:

- Red Hat Enterprise Linux 5.5 and 6.3
- Centos 5.5 and 6.3
- Fedora 16
- Ubuntu 12.04

## Support

- MontaVista Zone customer portal
- Hands-on training classes
- 24-hour email and phone support
- MontaVista Professional Services
- Support and services from MontaVista partners