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The Wireless Internet Phone, Defining the Need for a Resilient Software Foundation

The exploding wealth of immediateand digitized information on the Internet - news, quotes, market intelligence, music and video - is defining new wireless and handheld applications, enabling a host of new network-based mobility services. But the rapid evolution of the latest wireless Internet protocols creates a mass of software taxing performance of digital pocket companion designs and challenges the execution embedded applications environment.

This increasing dependence on an ubiquitous Internet and the advanced"follow-me" delivery services drives expectations higher for the level and quality of service (QoS). Much like the traditional POTS telephone network, the wireless information infrastructure is now looking at real-time operating systems to meet the need for consistent end-to-end system performance and high (99.999 percent) reliability.

SMART PHONES REQUIRE RTOS

Take the new breed of "intelligent cell phones" coming on the market, like the Qualcomm pdQ Smartphone and the Nokia 9000 Communicator. To consumers, the most important features of the enhanced cell phones may still be the size, battery life and other ergonomic features, with the functional reliability of phone taken for granted. As those phones evolve, however, into a platform for data communications and Internet applications, the logic moves from a simple cellular chipset to a state-of-the art embedded CPU architecture. Now the reliability expected by the consumer is no longer a simple matter.

The newer 'smart-phones' usually include a low-power 32-bit embedded processors, several megabytes of RAM and some form of real-time operating system with an application portability layer to allow for the development of future functions.

RELIABLE SOFTWARE FOUNDATION

The real-time operating system (RTOS) is the foundation upon which reliable operation is built. The features and details of the OS becomes the key to the overall dependability and critical functioning of the device. This implies that the OS itself has been designed for non-stop reliability with built-in error handling facilities, robust fault resilience and has a proven record of embedded reliability.

To protect the device and therefore the user from unforeseen application errors, especially when executing Internet applications and Java applets, the RTOS must provide a robust and reliable software execution environment. The OS must make full use of virtual and protected memory with support for on-chip memory management unit (MMU) functions. The MMU erects 'walls' around the kernel, application code and data by defining memory segments for each and restricting access to those segments, allowing the OS and critical wireless event and call processing routines to execute in their own memory and code space. The browser, MAPI server, email reader, Java VM and other phone functions and programmatic facilities also run in their own protected memory partitions. Further reliability is gained by providing protected memory allocation to each application, or even thread of execution.

With this layer of automatic protection, software faults, not found in debug, are contained within an individual function and prevented from affecting the correct behavior of the phone. The failed function can be restarted either by the system software or by the user. With many application errors the fault will only occur within a particular web page or sequence of events and reloading the application will be sufficient.

If the problem persists, the segmented execution environment of a scaleable RTOS' allows new software modules to be loaded across the network and replace old ones without affecting the operation of the device. An RTOS supporting the full functionality of today's on-chip MMU, even at a fine granularity of software protection, has a very minimal impact on system performance. It provides significant reliability and performance benefits, makes efficient use of the hand-held device's constrained resources and supports an aggressive product rollout, introduction and field upgrade plans.

APPLICATION DEVELOPMENT AND PORTABILITY LAYER

An RTOS also needs to provide an application development layer - a rich set of APIs and facilities -allowing a range of communications applications to be easily

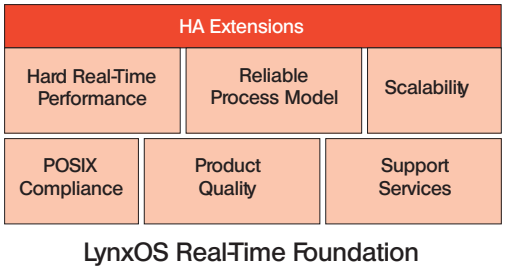

Figure 1. The COTS Real-Time OS Foundation for high reliability with high availability extensions.

and rapidly developed for the initial product implementation, and updated as necessary. For non-critical apps, like a 'datebook', a small-footprint, non-deterministic embeddable Java virtual machine (VM), like Chai would facilitate application portability so long as enough memory and CPU resources are available. For performance and 'bounded' response times, mission-critical control loops and phones apps will be written to real-time facilities. Fortunately, POSIX (Portable Operating System Interface) APIs provide the tight control, granularity and control threads for achieving real-time performance and application code portability.

An even more attractive option are commercial RTOS's, like LynxOS, that provide both POSIX and UNIX APIs and include an application toolkit of ready-to-run examples of typically desktop Internet programs: email; browser that can serve as an immediate foundation for a suite of mobile apps. UNIX application compatibility also provides immediate access to a diverse selection of display and device drivers, browsers, calendars, email and fax readers and any other type of application.

DETERMINISTIC RESPONSE

Fundamental to the cell phone's operation is a real-time OS with enough determinism to process critical event deadlines and respond as needed to a variety of time-sensitive protocols and messages. Many digital cellular and paging protocols are predicated upon synchronous signaling stacks. Some, like FLEX/ReFLEX paging protocols, encode subscriber information in periodic time slots. Regardless of whatever else the device is doing, the CPU must be monitoring its broadcast slot during the assigned time slot.

If the application execution design allows the handheld device to get distracted by a compute-intensive operation, the system ensures that over time messages will be lost and the user will diminish the real-

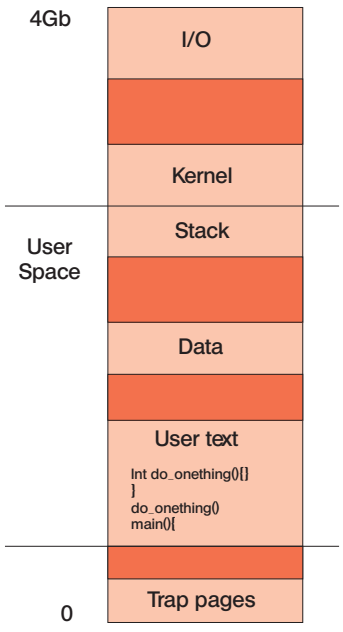

Figure 3. Kernel can extend a process data or stack space at the process request or as needed.

Figure 2. MMU erects "walls" around code and data and tames errant processes.

life value of the smartphone. For reliable operation, the smart cell phone OS must schedule and prioritize tasks, signals and events. Processing of critical events and tasks must be able to interrupt lower priority tasks, the user interface and even lower priority operating system processes.

HA RTOS IN THE BASE STATION

This type of critical-event processing is even more important on the other end of the radio link- the cellular base stations. These stations provide a variety of services from the basic connection, roaming services, intelligent network, cellular 911, Internet service portals and IVR services. Where the reliability of the cellular handset is measured in consumer satisfaction, the reliability of the cell site is measured by a more rigorous metrics -- 99.999 percent uptime.

To meet this demand High Availability (HA) systems maximizes availability of systems and applications by decreasing down time during both routine maintenance operations and unplanned system failures. In this environment, the RTOS must take corrective steps, such as fault management, system reconfiguration, error handling and software re-initialization automatially to avoid unnecessary downtime. HA system software, like Lynx HA, implements a programmable fault management plan that describes and controls the actions necessary to perform dynamic reconfiguration of the system.

CONCLUSION

The wireless services, Internet and data network markets are constantly evolving - driven by user needs for anywhere connectivity, Internet access, "follow-me" voice services, remote access to email and fax messaging all in a reliable cell phone package and price. The much-discussed convergence of separate voice, and data networks into an integrated service offering is happening today in the network infrastructure and now impacting the design of the next generation of cellular phones and PDAs ■

Brian J. Ramsey is Lynx' Marketing Director, Communications and High Availability, with a specific remit for heading up Lynx' activities in the fast growing telecommunications and datacommunications sectors. He has an outstanding track record in the embedded, semiconductor and OEM network market. Ramsey joined Lynx from networking IC vendor XaQti Corp., where he was Director of Marketing, and previously worked with Integrated Systems Inc., Cisco and Novell.