

Empirix Offers Their Customers “Real-World” Test Solutions with the Help of C-Port Network Processors

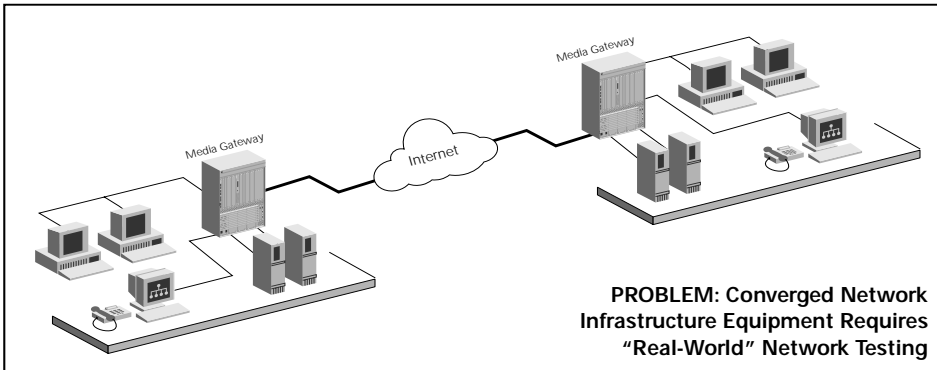
As the network infrastructure build-out and convergence accelerates, networking systems that compose the infrastructure must be more and more sophisticated to process the vast array of new services associated with converging voice and data networks. In addition, they must also support the number of different interface types, ranging from sub-T1 through OC-192 in the WAN space, and 10/100 through 10-Gigabit Ethernet in the LAN space.

Before these business-critical networking systems are deployed in a live converged network, networking OEMs and service providers must ensure that these systems can provide the end-to-end voice quality and reliability that end users have come to expect from the Public Switching Telephone Network (PSTN).

Empirix, the leader in telephony test solutions, recognized the need for a complementary set of applications for emulating and testing the data elements of converging networks and a platform capable of running those applications at wire speed. And they have responded with the *Hammer PacketSphere Platform*. This case study details the development of this innovative Empirix solution for testing next-generation networks.

Test Platform Architecture for Testing Next-Generation Networking Systems

Empirix recognized that testing next-generation networks and applications required a test platform architecture that would support a family of wire-speed test applications — applications that could emulate real-world network conditions as well as provide mechanisms for testing the users Quality of Experience (QoE). They also realized that traditional



Featuring...



“With the C-5 network processor’s high level of programmability and performance, we will be able to respond to our customers with multiple, ‘real-world’ test applications and interfaces.”

Steve Gladstone
Vice President and General Manager
of the Communications Infrastructure
Test Group at Empirix

ways of designing these systems would not meet their goals. Already providing the powerful Hammer VoIP Test System for end to end testing, Empirix focused first on the need to emulate the IP network over which voice packets are carried. Emulating the equipment that resides in the converged network infrastructure has typically been accomplished in three ways:

- Emulation tools based on ASIC or FPGA designs, which are limited in what they can test and cannot be upgraded in the lab as network requirements change.
- Software-based IP emulation tools, which are limited in that they cannot maintain stability beyond 10/100 Ethernet speeds.
- Lab networks made up of the systems under test and often using the internal LAN for more realistic IP network conditions, which is limited because it does not adequately test the voice quality under real IP network conditions, nor does it provide the repeatability of an emulation tool.

Empirix took a new approach to designing their test platform. They wanted to achieve the flexibility of a software-based solution with the performance of a hardware-based solution. Their specific requirements for the first application on

the Hammer PacketSphere platform were to:

- Emulate IP network conditions at Gigabits per second wire speed to meet the needs of their carrier-class gateway and switch manufacturer customers.
- Introduce network impairments precisely, in both directions while maintaining wire speed. For example, Empirix wanted to be able to hold packets longer (emulating the type of delays that might happen in a real network).
- And most importantly, to create a modular, platform that could be extended/modified by downloading new applications and changing physical interface modules.

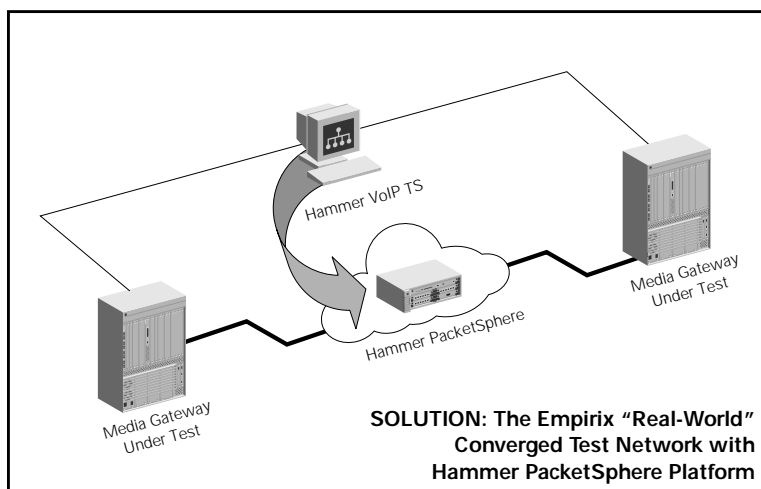
After researching various technologies, Empirix found the C-Port C-5 network processor to be the only solution for their design. The programming flexibility of the C-5 network processor would allow Empirix to provide various test applications for their customers, such as IP network impairments and VoIP stream analysis. In addition, the C-5 network processor would readily support the high-speed interfaces required for real-world network emulation, such as Gigabit Ethernet and OC-12. The final deciding point for Empirix was the comprehensive development environment

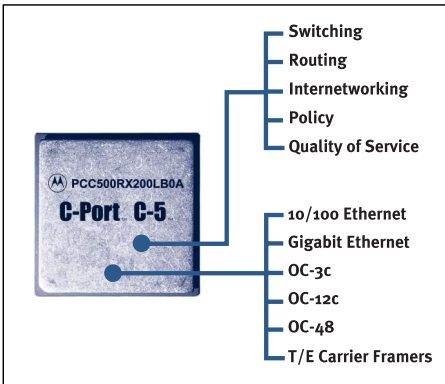
provided by C-Port, which they recognized could significantly accelerate their software and hardware development.

C-Port Network Processors Provide the Flexibility

The C-5 network processor incorporates an unprecedented combination of functionality, computing power, and data bandwidth in a flexible, patent-pending architecture. This architecture supports complete programmability from Layer 2 through Layer 7 of the ISO model, allowing the C-5 network processor to be used in a wide range of networking applications. By implementing the C-5 network processor in a test platform architecture, Empirix has taken a unique and creative step. Taking advantage of the programming flexibility of the C-5 network processor, Empirix is able to impair packet forwarding in various ways and emulate other problematic network behavior. This is counter to the more germane use of the C-5 network processor — wire-speed, reliable forwarding of packets and cells.

The C-5 network processor's architecture also supports a variety of industry-standard serial and parallel protocols and individual port data rates from DS1 (1.544Mbps) to OC-48. Integrated functions, including MACs and SONET Framers, speed system development, simplify device design, and lower total system costs. The physical interfaces of the C-5 network processor are programmed on a per port basis, enabling a single C-5 network processor to simulta-





neously support a wide variety of physical interface types.

The integrated design allowed Empirix to offer swappable physical interface modules, which allows their customers to have a high degree of interface flexibility without having to swap out a system. The Hammer PacketSphere platform initially supports 10/100 Ethernet and Gigabit Ethernet interfaces, with plans to support OC-3, OC-12, and Packet over SONET combination interfaces in the near future.

Software Development Acceleration

The Empirix software developers were able to apply their extensive C programming experience immediately to the C-5 network processor programming task. The C-5 network processor, designed from the ground up to provide a simple programming model, is fully programmable in C-language and supports a robust set of APIs that abstract the common functions of the underlying hardware.

After Empirix downloaded C-Port's C-Ware Software Toolset, they were testing and tuning their basic application on the C-5 Simulator within a few months. Soon after, they were running

their application on the C-Ware Development System, performing more complete system-level testing and tuning.

The C-5 Simulator is a performance and functionally accurate software model of the actual C-5 network processor. It is as accurate as a hardware model of the chip (for example, based on Verilog/VHDL models), but orders of magnitude faster, allowing more simulation bandwidth.

Using the C-5 Simulator and other tools, such as the C-Ware Performance Analyzer, Empirix was able to complete forwarding plane code development and performance characterization before any hardware integration.

As a first step in hardware integration, C-Port provides the C-Ware Development System, which contains a C-5 Switch Module, a PowerPC-based host processor module, and various Physical Interface Module (PIM) options so that vendors can do more complete system development prior to their target hardware being available. Empirix took advantage of this comprehensive prototyping environment to virtually complete their software development before early prototypes of the Hammer PacketSphere platform were available. As part of the C-Ware Software Toolset, C-Port also provides all the necessary host software and drivers, which enabled Empirix to easily integrate their software for the C-5 network processor with Motorola's line of PowerPC microprocessors, their chosen host processor.

About the Hammer PacketSphere Platform

The Hammer PacketSphere platform is specifically designed to provide rigorous real-world testing of next generation equipment and applications, including VoIP gateways, routers, next-generation switches, and e-business systems. The platform is based on a high-speed network processing architecture, with performance that FPGA and PC-based emulation/simulation tools cannot match.

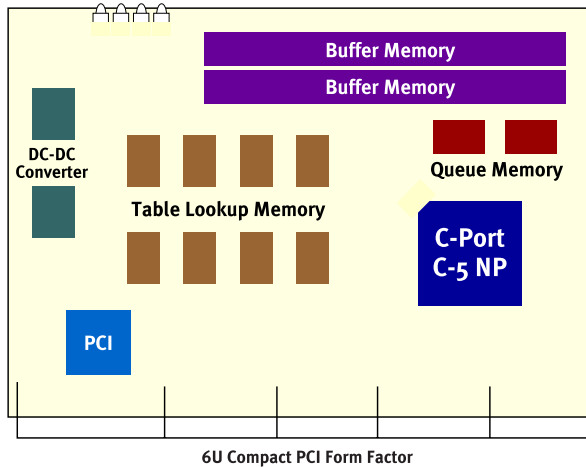
The first application for the Hammer PacketSphere platform, Network Emulator, provides the ability to emulate the behavior of real IP networks at true wire speed on 10/100/Gigabit Ethernet and OC-3/12 Packet over SONET connections — at over 1.4M packets per second, full duplex. Features of the application include the ability to drop packets, insert latency and jitter, and to emulate other network behaviors found in real-world networks.

The platform's second application is the PacketSphere Real Streamer that can generate real audio and video clips and analyze a device's ability to reliably and correctly transmit those streams. Both applications may be used stand-alone or integrated with the award winning Hammer VoIP test system. More applications will be made available over the months to come.





PacketSphere Network Processor Module



The highly integrated architecture of the C-5 network processor enabled Empirix to create a streamlined board design, saving on both cost and board space.

The PacketSphere Network Processor Modules connect to Physical Interface Modules through a mid-plane chassis design.

Hardware Development Design Aids

C-Port also provides hardware reference designs for the C-Ware Development System, to demonstrate board layout techniques for the C-5 network processor. These reference designs, including schematics, bill of materials, and CAD files, proved invaluable to Empirix.


Empirix was able to design their boards in the industry standard form factor and pack a lot of processing power in a relatively small amount of space. They were also able to get their boards right the first time, saving them months of iterative development and re-testing.

Empirix Customers Win with Platform Approach

Finally, ‘real-world’ testing of equipment that supports the converging network infrastructure is possible. Empirix is able to offer their customers the most flexible, comprehensive next-generation network testing solution today. And they can quickly support their customers’ future testing needs by developing new applica-

tions for the Hammer PacketSphere platform — upgrades are as simple as a software download.

The Hammer PacketSphere platform currently supports two network processor cards, allowing their customers to run multiple tests of the same network test application — or different test applications at the same time. Empirix plans to provide a range of network emulation and analysis applications for the PacketSphere platform, which will allow their customers to continually expand and enhance their testing capabilities. The development and delivery of these additional applications can be measured in months rather than quarters because of the programming ease and flexibility of the C-5 network processor.

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