

Delivering A Total Continuous Service Solution for CarrierClass™ Embedded Ethernet Systems

Protecting embedded Ethernet packet transport services
from interruption within CarrierClass environments
requires a complete end-to-end IP transparent solution.

A White Paper from ZNYX Networks

**Continuous Service Solution for
CarrierClass Embedded Ethernet**

- OpenArchitect/HA Suite manages the redundant embedded Ethernet hardware providing fast failover High Availability
- OpenArchitect/HA Suite's virtual IP functionality enables Service Continuity
- OpenArchitect/HA Suite is the only end-to-end software platform for embedded Ethernet

**OpenArchitect/HA Suite
Compliments Industry Efforts
Towards Delivery of Continuous
Service**

ZNYX Networks is working with several industry initiatives to deliver High Availability systems such as the Service Availability Forum, PICMG, and ODSL Carrier Grade Linux

Executive Summary

The relentless pressure on telecom equipment manufacturers for faster innovation and lower costs has accelerated the adoption of Open Standards based solutions. A major element of this Open Standards movement is equipment chassis powered by embedded Ethernet. For example, equipment manufacturers and application integrators are now providing embedded Ethernet solutions with commercial off-the-shelf chassis, embedded switches and application blades based on the CompactPCI Packet Switching Backplane (CPSB) PICMG 2.16 specification.

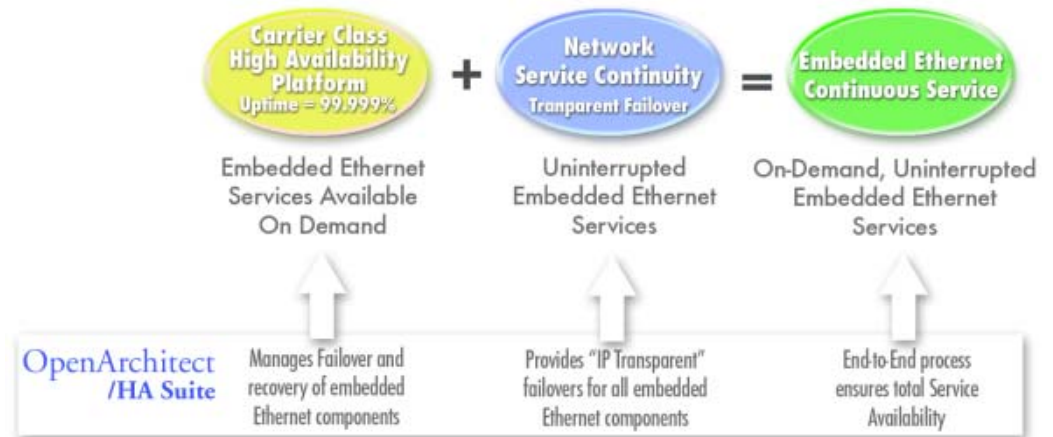
CPSB uses Ethernet instead of a backplane bus, to provide IP-based communications services between chassis components. CPSB defines a high performance, cost-effective alternative to proprietary bus architectures. It also specifies hardware redundancy for the embedded Ethernet subsystem. But physical redundancy is just half the requirement for true continuous availability. CPSB needs software to manage packet transport, implement CarrierClass levels of High Availability (HA) and ensure Network Service Continuity.

ZNYX Networks fills this need with OpenArchitect/HA Suite – the first end-to-end software platform that integrates all CPSB components into a CarrierClass High Availability, Service Continuity embedded Ethernet subsystem. The OpenArchitect/HA Suite technology addresses redundancy, failover, recovery and restoration of the embedded Ethernet subsystem at a level of granularity not provided by application level HA technologies. This white paper presents an overview of how OpenArchitect/HA Suite delivers the only complete Continuous Service software platform for embedded Ethernet.

Delivering A Total Continuous Service Solution

Users of CPSB solutions expect that services and applications will be delivered on demand without interruption. Creating the high standard of embedded Ethernet Continuous Service entails two aspects: CarrierClass High Availability and Network Service Continuity.

- **CarrierClass High Availability** is the measure of the probability that a service is available for use at a given instant (point of demand). Telecommunications systems are called highly available if they are working 99.999% of the time or better. This so-called “five nines” availability guarantees no more than five minutes of annual downtime.
- **Network Service Continuity** is the uninterrupted delivery of Ethernet and IP routing services between an application to a client. This means an application service is never interrupted – even as a physical fault in the embedded Ethernet environment is detected, isolated and repaired.



Why Use Embedded Ethernet?

The reign of traditional, proprietary platforms in telecom equipment offerings is over. Manufacturers are adopting “open systems standards” such as embedded Ethernet platforms for two reasons: faster implementation and lower cost. The most significant difference from proprietary platforms is the communications path between system components – embedded Ethernet backplane versus a proprietary bus.

Embedded Ethernet chassis use the industry's most successful open standards: Ethernet and the Internet Protocol. As implemented in the CompactPCI Packet Switching Backplane (CPSB) 2.16 specification, embedded Ethernet uses a dual star network for redundancy. Every component communicates with IP through a pair of redundant embedded Ethernet switches. At full line speed Fast Ethernet provides throughput many times greater than the previous H.110 backplane standard. And, the emerging Gigabit embedded Ethernet will provide an order of magnitude increase in throughput to power the next generation of applications.

On the business side, products built using embedded Ethernet open standards shorten time-to-market and reduce costs. Open standards create active markets with many competitors providing an array of ready-to-use components. System integrators build their solutions by selecting from the market proven, cost-effective components. By comparison, proprietary designs have longer development cycles and higher costs.

Delivering Network Service Continuity is more demanding than just providing High Availability. HA refers to the state of a system, while Service Continuity refers to specific instances of service on that system. Service Continuity solutions do more than simply provide HA failover– they protect revenue-generating applications from being temporarily interrupted, lost or dropped during an HA failover process.

CPSB specifies the redundant hardware architecture for HA but does not define software to implement and manage the fault detection, isolation and repair process. OpenArchitect/HA Suite implements this functionality and provides Network Service Continuity. The software is the industry's only Continuous Service solution for CarrierClass embedded Ethernet subsystems.

Virtual Routing Environment for Embedded Ethernet

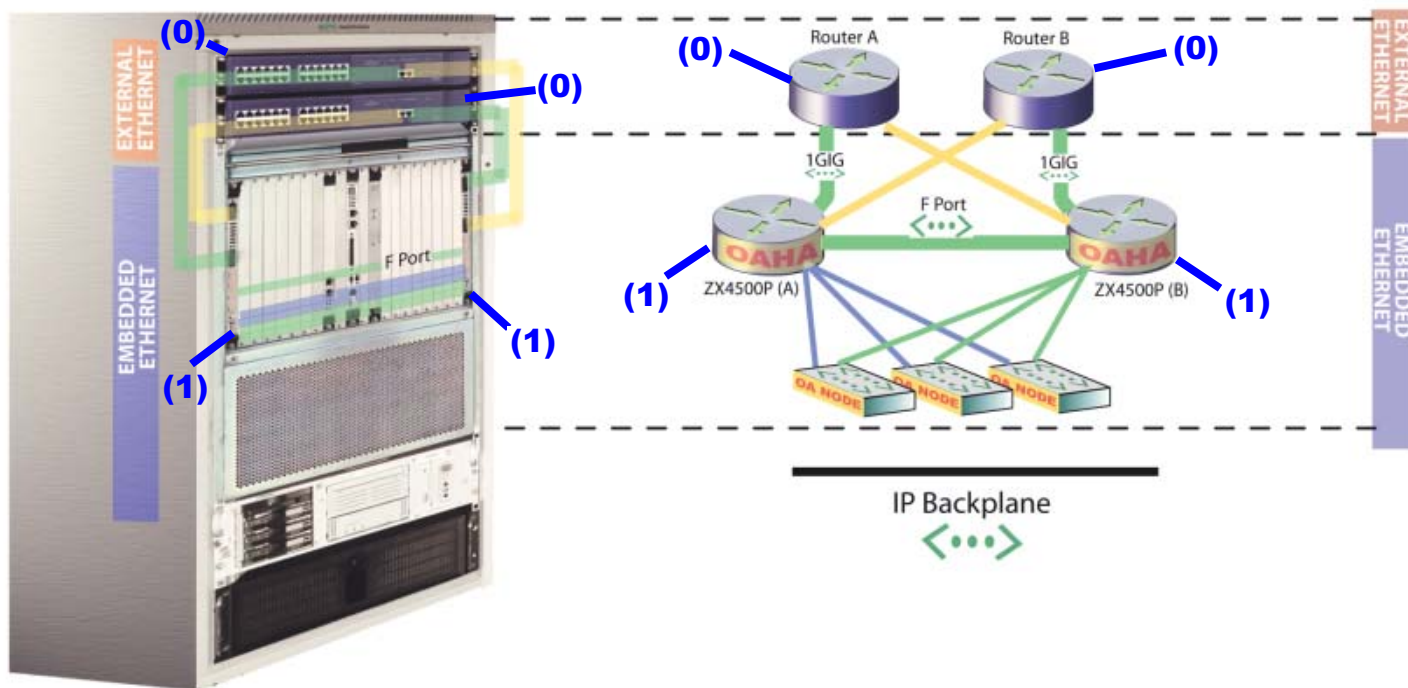
OpenArchitect/HA Suite provides embedded Ethernet Continuous Service by creating a virtual routing environment for all the components – application node cards and embedded switch fabrics. The virtual IP path between each of the components masks the actual physical connections used to route packets. Applications running on node cards interact only with this “persistent” virtual Ethernet environment.

The benefit of the virtual IP environment is Network Service Continuity when handling Ethernet failures. Failovers to backup services are accomplished transparently. The applications continue to use the same virtual IP addresses before the failure and after the recovery. During a failover, Network Service Continuity is thereby provided between an application running on a node card and a client using the application services because the virtual IP address of the node card never changes.

Implementing Embedded Ethernet Continuous Service in the Equipment Rack and Chassis

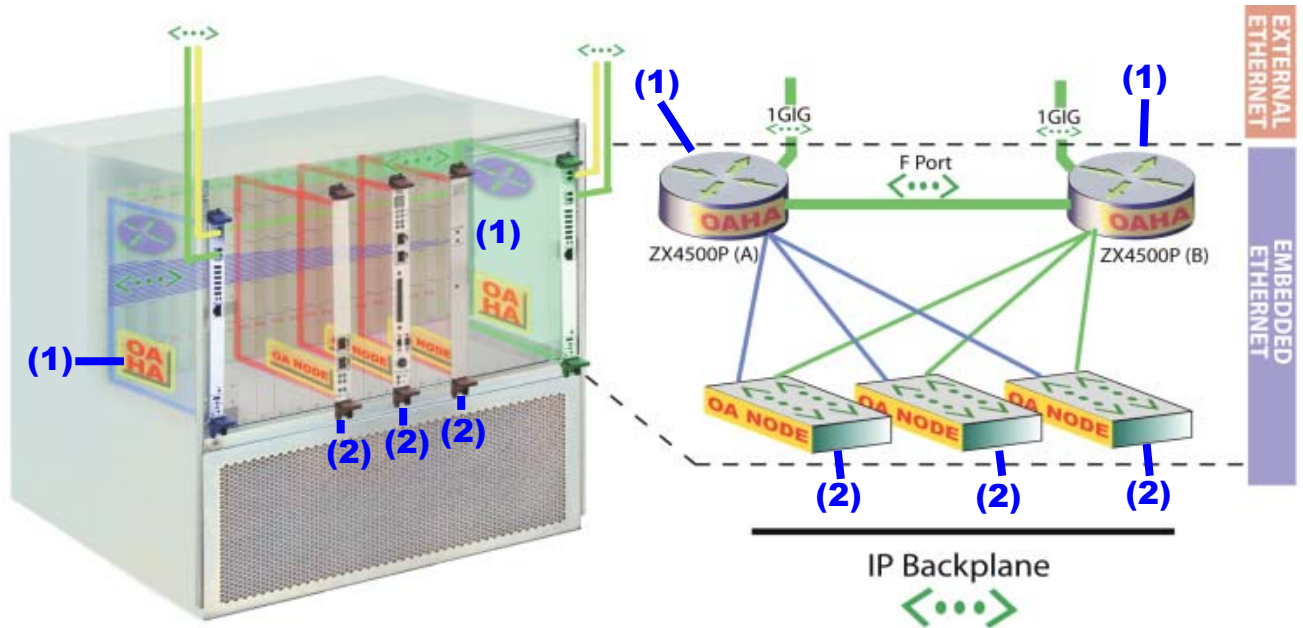
The diagrams below show physical devices and network schematics for an embedded Ethernet solution within a typical equipment rack. The illustrated equipment rack shows (from top to bottom) a pair of redundant aggregation routers used for external Internet access, the embedded Ethernet CPSB chassis, and other application chassis. This diagram illustrates the HA functionality between the embedded Ethernet of the CPSB chassis and the external Ethernet. Redundant embedded switches (1), managed by OpenArchitect/HA, are cross linked to redundant routers (0).

Embedded Ethernet External HA Links: Rack & Schematic



The next diagram details the internal components of a typical CPSB chassis. Components include a pair of redundant embedded Ethernet switches and, in this example, three application node cards. OpenArchitect/HA Suite implements packet transport for intra-chassis communications on the Ethernet backplane using IP routing protocols. Thus, internal and external communication have merged into a single technology - Ethernet with IP routing protocols.

Embedded Ethernet: Chassis & Schematic



OpenArchitect/HA Suite Components

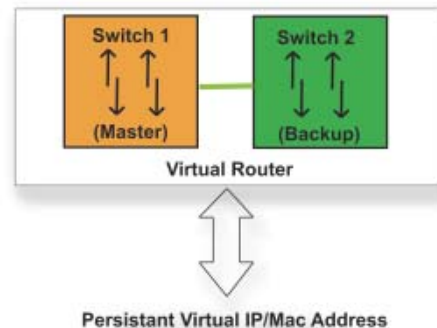
OpenArchitect/HA Suite control and management software provides the industry's only end-to-end virtual IP environment for embedded Ethernet. As shown in the above diagram, OpenArchitect/HA Suite software resides on each chassis component:

- **OpenArchitect/HA** is software installed on each switch (1). This is a software extension to powerful IP routing functionality provided by OpenArchitect (see OpenArchitect Datasheet for full description). OpenArchitect/HA is installed on both embedded switches. OpenArchitect/HA integrates this redundant switch hardware into a "Virtual Router" (see "OpenArchitect/HA Virtual Router" section) that creates a High Availability, Service Continuity environment. The software provides automatic detection, recovery and repair of link and switch failures.
- **OpenArchitect/Node (OA/Node)** is Ethernet driver software, installed on each node card (2), that manages the two CPSB Ethernet ports on the card. These ports provide redundancy with an Ethernet path to each switch. OA/Node integrates this hardware into a "Virtual Interface" (see "OA/Node Virtual Interface" below) that creates a High Availability, Service Continuity environment. The software provides automatic detection and recovery of Ethernet port or link failures.

OpenArchitect/HA Virtual Router

One of the most powerful features of OpenArchitect/HA is the creation of a “virtual router” using the redundant embedded switches. OpenArchitect/HA extends the Virtual Router Redundancy Protocol, which is an IETF specification for a shared media network, to work in the dual star Ethernet configuration of a CPSB chassis..

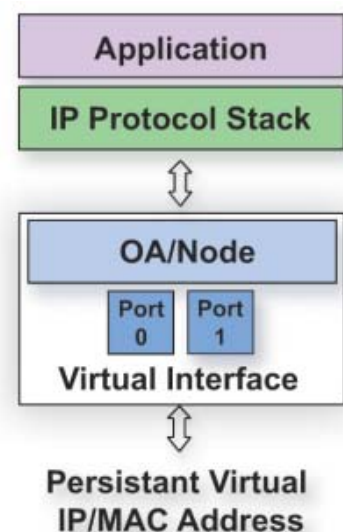
The Virtual Router, created by OpenArchitect/HA, allows node cards on the chassis to access the active switch with one IP/MAC address – a “virtual” location that works even after failure of a switch or node port. Thus, node cards are unaware of the physical Ethernet link change because failover is completely IP transparent.



In addition, the SurvivingPartner™ functionality of OpenArchitect/HA automatically reconfigures a HotSwapped replacement switch with the same virtual router address.

OA/Node Virtual Interface

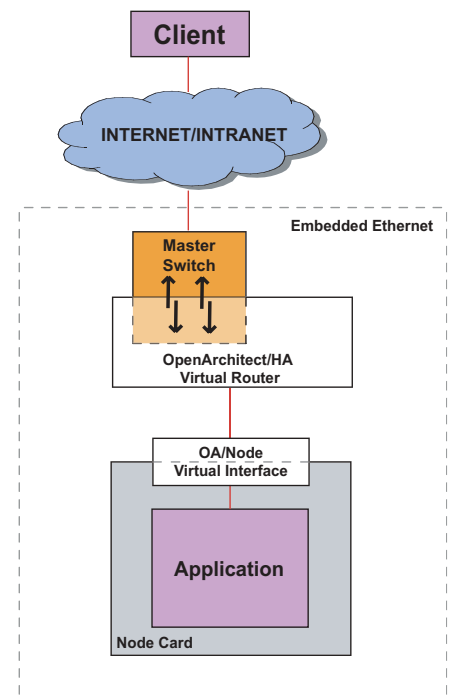
OA/Node creates a “Virtual Interface” for the two redundant Ethernet ports on a node card (one port connects to each switch fabric card). This Virtual Interface creates a persistent IP/MAC address for the node card regardless of which port is active. Thus, clients accessing the application services provided by the node card are unaffected by failure of a port or Ethernet link connection because the failover process is IP transparent. This provides Service Continuity to active clients. Unlike other Ethernet drivers, connections are not lost because of an IP address change.



Service Continuity with OpenArchitect/HA Suite

Together, OpenArchitect/HA and OA/Node provide the industry's only end-to-end IP transparent failover for embedded Ethernet environments. This Virtual IP environment delivers a total Service Continuity solution between node card applications and their clients.

A client requesting services from the application on the node card uses only the card's virtual IP address. Changes in physical links – a failover to recover from a port or link failure – are invisible to the client. The Service Continuity solution is achieved because the client continues to address packets to the Virtual IP address with OpenArchitect/HA Suite transparently managing the physical routing within the embedded Ethernet environment.



Resources

See the references below and the ZNYX Networks web site at www.znyx.com for more details about OpenArchitect, OpenArchitect/HA Suite, and a line of embedded Ethernet switches – or contact your ZNYX Networks sales representative at sales@znyx.com.

- “What is the Service Availability™ Solution?” – a white paper published by the Service Availability Forum, 2001. http://www.saforum.org/downloads/white_paper.pdf
- “Network Level Resiliency for High Availability (HA) in Ethernet Networks” - a white paper published by ZNYX Networks, 2002 <http://www.znyx.com/software/openarchitect/OAHA>
- “ZX4500P with OpenArchitect™ Switch Management - specifications at-a-glance” - A list of protocols and features supported in OpenArchitect. http://www.znyx.com/products/pdf/ZX4500P_glance.htm
- “OpenArchitect/HA Suite Feature List” - A list of protocols and features supported in OpenArchitect and OpenArchitect/HA Suite. <http://www.znyx.com/software/openarchitect/OAHA>

OpenArchitect/HA Suite™

Software Platform Adds High Availability
And 100% Continuous Service to
Embedded Ethernet Solutions



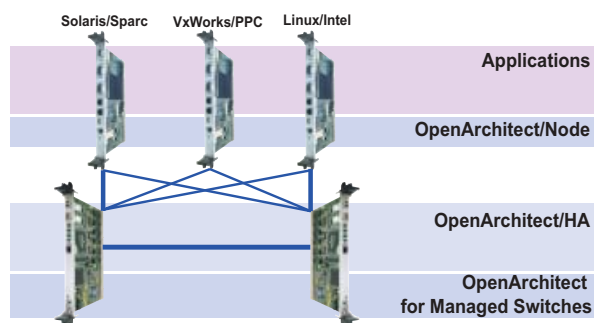
The First HA and Service Continuity Platform for Embedded Ethernet

OpenArchitect/HA Suite allows telecommunications and network equipment manufacturers, and application integrators to immediately begin reaping the fiscal and engineering benefits of embedded Ethernet. OpenArchitect/HA Suite taps the full High Availability and Service Continuity capabilities of the CompactPCI Packet Switching Backplane environment – including transparent IP failover. OpenArchitect/HA Suite is the industry's premier software solution for ensuring continuous service within embedded Ethernet solutions.

With the High Availability and Service Continuity enabled with OpenArchitect/HA Suite, developers can quickly implement a variety of applications requiring this stringent level of service quality. For example, the Service Availability Forum lists the following as applications demanding quality service.

- Circuit-switched telephony (e.g. POTS)
- Circuit-switched data network (e.g. frame relay)
- Cable-telephony network (e.g. cable modem head ends)
- Wireless network (e.g. cellular base stations and controllers)
- Internet network (e.g. routers and load balancers)
- Other packet-switched networks (e.g. soft switches, feature and media servers, gateways)

OpenArchitect/HA Suite in an Embedded Environment



OpenArchitect/Node, the embedded Ethernet component providing HA and Service Continuity for application node cards, is operating system and CPU independent. OpenArchitect/Node versions are available for Solaris, VxWorks and Linux operating systems, plus SPARC, PowerPC and Intel processors. Contact ZNYX Networks for the latest information on CPU/Operating System support.

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