DATASHEET

Multi-Service Access Router with Optional Tibit MicroPlug Integration

Cost saving, scalable solution using pluggable PON and Ethernet transceivers.

Exaware EXA5200 model family.

TIBIT

Using Tibit transceivers as OLT access routers enables communications service providers (CSP) to offer their customers a cost saving solution for access routers.

Carriers need to support the growing demand for 'Broadband for All' and fiber-to-the-curb (FTTx) applications. Using ExaNOS (Exaware's network operating system) with Tibit transceivers provides carriers a disaggregated FTTx solution for up to half the cost of traditional equipment.

By vastly reducing the infrastructure costs normally associated with FTTx, CSPs can open new opportunities with customers.

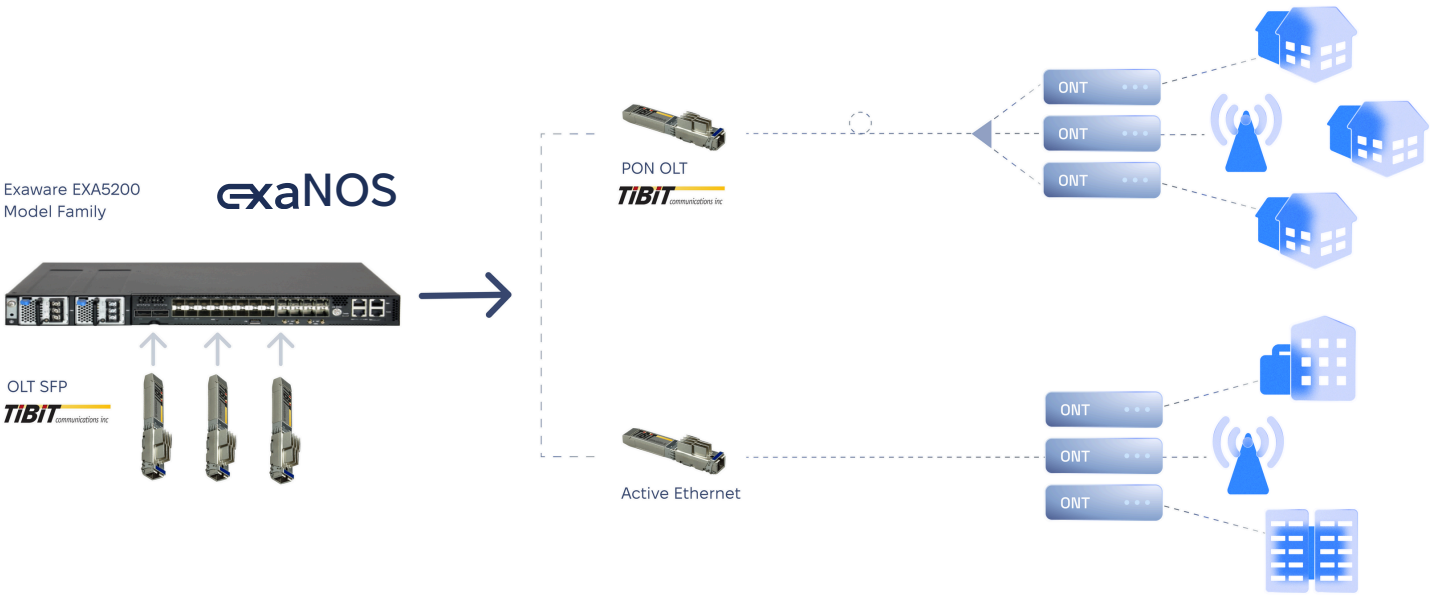
EASILY ONBOARD NEW SERVICES

With Exaware, CSPs can easily add third party applications quickly and cost effectively.

Using an Exaware EXA5200 model with integrated ExaNOS, you can add passive optical network (PON) access networks using PON transceivers from Tibit Communications.

ExaNOS features include:

- Add-on application option
- On-box driver for OLT SFPs
- Reduced connectivity burden, complexity, and latency of cloud-based controller architectures



Disadvantages of Traditional Solutions

Traditional access topologies and PON architectures use dedicated Optical Line Terminal (OLT) devices to provide the handoff between the access network and the PON physical layer connecting users. The OLTs are either a chassis or pizza box with integrated Gigabit PON (GPON) functionality.

Typically, the OLT operates as a Layer 2 aggregator, and includes the following components:

- CPU for management and GPON software
- PON PHY devices
- Pluggable optics
- Upstream (and possibly also user-facing) Ethernet interfaces
- A networking ASIC for traffic aggregation

In addition to configuration and monitoring, the PON manages the ONU Management and Control Interface (OMCI) protocol, which is the protocol used between the OLT and the Optical Network Unit (ONU) on the customer premises for managing configuration and operation of the GPON physical layer.

Historically, the reason for the separation of OLT hardware and everything else in the access network was mainly driven by the fact that there are different vendors for the access layer and the GPON layer. This separation in traditional access networks creates several disadvantages.

VENDOR LOCK-IN

There is high dependency on the chassis vendor with traditional PON architectures, with no flexibility to use different vendors for line cards, etc. Once a chassis is installed at a site, you're tied to that specific vendor.

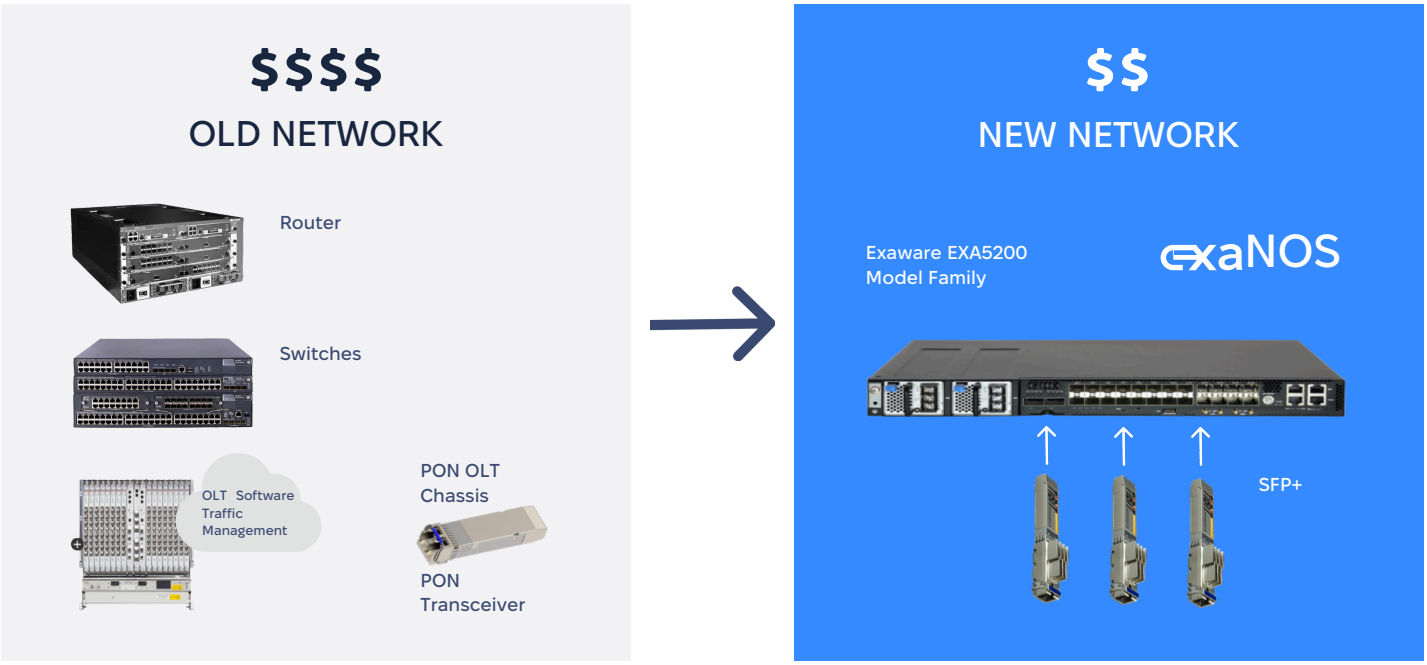
HIGH OVERHEAD

In traditional PON architectures, there is high overhead for space, CPU, and mechanics for the chassis, while the basic function of the PON is integrated into the physical layer device.

OLT ONU LOCK-IN

The closed ecosystems of OLT vendors mandates use of their own ONU devices with no allowance for third party ONUs.

COLLAPSED MULTI-SERVICES NETWORK SOLUTION



MARKET CHANGES DRIVING A NEED FOR NEW ARCHITECTURES

Several industry changes are driving new architectures — the creation of new standards by the ITU, the use of PON technology in rural areas, and the move from GPON (2.5Gbps technology) to XGS-PON (10Gbps technology).

TIBIT MICROPLUG

The Tibit MicroPlug OLT device integrates the OLT functionality of a single PON fiber into a regular SPF+ form factor that can be plugged into any router or switch SFP+ socket, assuming power and heat dissipation considerations are met.

The Tibit MicroPlug enables new architectures of integrated access and OLT solutions.

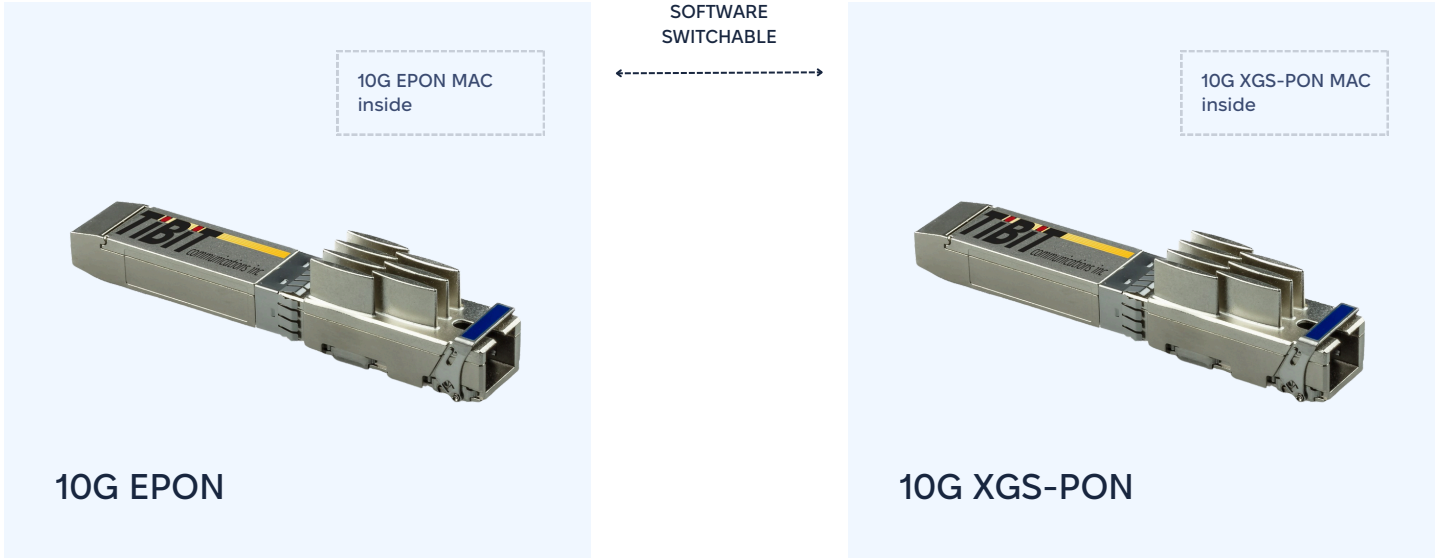
- An access device, traditionally serving only Ethernet interfaces, can support any combination of Ethernet and XGS-PON interfaces.
- For rural areas where only a small number of PON fibers are required per site, the need for dedicated OLT hardware is eliminated, which reduces power consumption, space, and installation efforts.
- The access network and PON management systems are unified.
- Open OLT interoperability supports a variety of ONUs from a variety of vendors.
- Open management API interfaces provide easy integration of the user provisioning, management, and monitoring aspects of the PON network.

The PON management application (as well as the OMCI operation) architecture for the Tibit MicroPlug includes the Tibit MicroClimate™ Management System (MCMI) software, which provides the gateway between the general configuration of the PON access network and the SFP management operation.

FEATURES

Features of the Tibit pluggable OLT include:

- SFP+ OLT optic modules provide PON connectivity for Ethernet switch or router ports
- In-band management enables local and remote administration and virtualization
- Low power and high-density with support for outside plant deployment
- MAC integration into SFP+ provides significantly better optical performance



Exaware Supports Third Party Applications

Because Exaware EXA5200 models support third party applications, some or all of the Tibit application components can reside within the router, which simplifies the connectivity between the Tibit MCMI and the MicroPlug SFPs.

Instead of a remote server that requires L2 connectivity between the SFP and the remote software, connectivity is achieved locally through the forwarding ASIC, while for remote management only IP connectivity to the MCMS is required for configuration, monitoring, or other tasks related to the PON operation.

The MCMS functionality can be split between the switch connected to the SFP and other remote cloud servers. For example, the mongoDB database can reside externally and serve multiple switches and locations while each switch is responsible for its local Tibit modules.

The Exaware software, ExaNOS, supports the Tibit integration in the following ways.

- The Tibit MCMS application is hosted within the router inside the 3rd party virtual machine
    - ▹ The elimination of L2 service connectivity between the remote server and the access device results in fewer failure points and direct access to the Tibit MCMS both in-band and out-of-band, as well as distributed architecture for better scale.
- CLI commands enable the VM image download and VM connectivity configuration.
- There is a direct interface between the forwarding ASIC and the VM.
- The internal service connects:
    - ▹ The MCMS to the SFPs using L2 bridging.
    - ▹ IP access to remote servers, either in-band or out-of-band.
- The N:1 forwarding mode allows the N:1 access profile, which is designed to enable the carrier-of-carriers model; the same switch can support multiple service providers sharing the same PON infrastructure while the traffic is fully separated between the ISPs.
- The advanced QoS features enable hardware shaping with deep buffering per customer or per service provider.

Use Cases Using Tibit MicroPlug Integration

USE CASE #1 – MULTI-SERVICE ACCESS ROUTER WITH TIBIT MICROPLUG INTEGRATION

The first use case is direct attachment of the Tibit OLT to the access node, serving residential users and enterprises via the PON network, while in parallel other users can be served from active Ethernet interfaces.

- Access networking solution with optional PON transceiver (white box hardware + ExaNOS + Tibit OLT SFPs)
- Support for 128 – 2,560 subscribers in a single device
- Eliminates the need for a dedicated OLT box (XGS-PON, 10G EPON)
- PON controller runs on ExaNOS hosted VM
- Available in C-Temp, E-Temp, and I-Temp

USE CASE #2 – WIRELESS AND FIBER SERVICES INTEGRATED ONTO A SINGLE DEVICE

The second use case is in combination with a microwave link connecting remote areas. The Tibit SFP is installed in the remote area, instead of connecting additional OLTs. The Tibit management application runs within the Exaware node.

To support microwave links, Exaware has implemented flow control and Ethernet Bandwidth Notification (EBN) functionality. With the EBN function, the Exaware router shapes the traffic to the microwave link's current bandwidth.

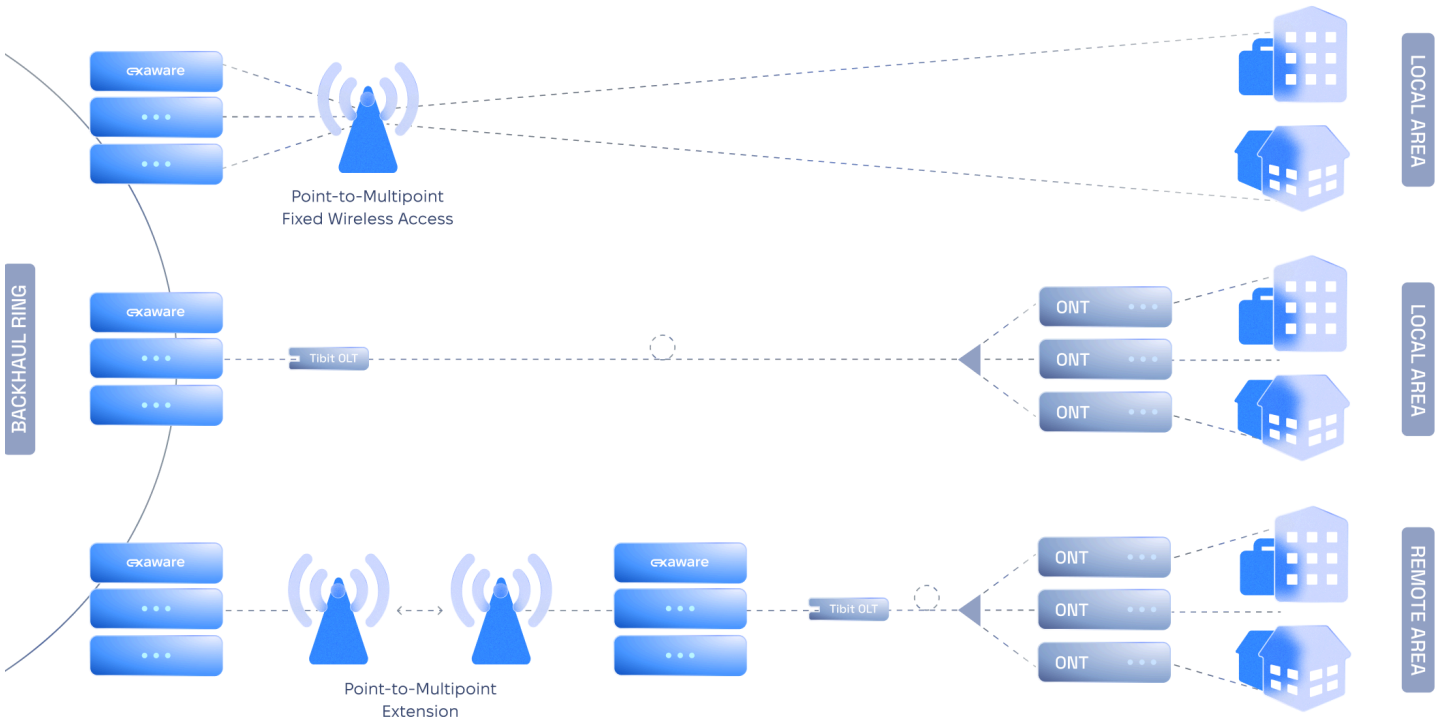
With deep buffering and priority queueing, there is no packet loss on the router to the microwave link due to rate mismatch (between the 10G physical link and the microwave bandwidth).

- Support fixed wireless and FTTx PON deployment using a single hardened access device
- Extend the Tibit smart OLT SFP onto the PTP far end microwave radio to remote areas
- Aggregate all traffic onto a protected backhaul ring

BENEFITS

In both use cases, CSPs can offer services ranging from simple access and L2 aggregation through internet access, L2VPN, and L3VPN services utilizing Exaware's MPLS and full stack IP routing capabilities.

Instead of the traditional L2 access and aggregation networks – which lack scale and ease of provisioning – the carrier can transform the network to a modern IP/MPLS network.



SCALE

The number and allowed locations of the Tibit SFPs are hardware dependent. Exaware has tested configurations of up to 20 Tibit SFPs with 128 ONUs on each PON.

FORWARDING OPTIONS

There are multiple options for forwarding traffic between the users, the switch, and the upstream network.

The simplest model is L2 forwarding. All SFPs and upstream interfaces share the same L2 VSI (Virtual Switch Instance).

Two modes are possible:

- 1:1 mode – Each user is represented as a separate VLAN, both on the SFP side and the upstream interface.
- N:1 mode – All users are sharing the same VLAN.

In N:1 mode, separation between users' traffic is achieved by avoiding any user to user traffic; that is, traffic is allowed only between users and the upstream interface.

Exaware VSI functions permit split-horizon mode, where multiple Tibit SFPs share the same VLAN, but traffic will always flow from the SFPs to the upstream interfaces and be blocked if a user on one SFP tries to communicate with another user on another SFP. Using this mode, the N:1 mode is supported at the access node as well.

Note: The Tibit SFP supports N:1 mode by implementing MAC learning on the Tibit side.

L3 FORWARDING

L3 forwarding can be achieved where the user traffic is terminated at the Tibit SFP level and routed toward the carrier's network. Exaware DHCP relay enables dynamic assignment of IP addresses per user.

This mode is applicable when the service authentication is based on IPoE, or cases where the PON infrastructure is used for business applications or mobile backhauling. This traffic can be handed locally to L3VPN services at the access node.

CARRIER-OF-CARRIER MODELS

A special case of N:1 is useful for carrier-of-carrier modes. In this model, multiple SFPs can share the same switch. Each ISP gets a dedicated VLAN (and respective VSI) for traffic separation. The ISP is connected to all SFPs and the upstream interface (each ISP using a separate VSI).

INTERNAL CONNECTIVITY

The Exaware virtualized environment allows for up to two VMs in addition to Exaware VMs that are an integral part of ExaNOS (one for the control plane and one for line card operation).

The internal connectivity scheme allows for direct access from the VM to the forwarding ASIC:

- Minimum latency
- No load on the control plane
- Direct access to the network inband for MCMS to management system traffic

SUPPORT FOR ADDITIONAL APPLICATIONS

In addition to the Tibit MCMS application, Exaware's infrastructure supports an additional VM. This VM has similar connectivity and enables the hosting of additional applications such as configuration control, SLA monitoring, and more.

ADVANCED QOS

Exaware supports advanced hierarchical QoS functionality, where shaping and queuing is available both per port and per VLAN.

In Tibit applications, the following functions are provided:

- 1:1 mode – shaper and 8 queues per user
- N:1 mode – shaper and 8 queues per ISP (or group of users sharing a VLAN)
- Shaping per SFP (limit overall downstream traffic per ISP)
- Shaping on upstream interface or per VLAN on upstream interface

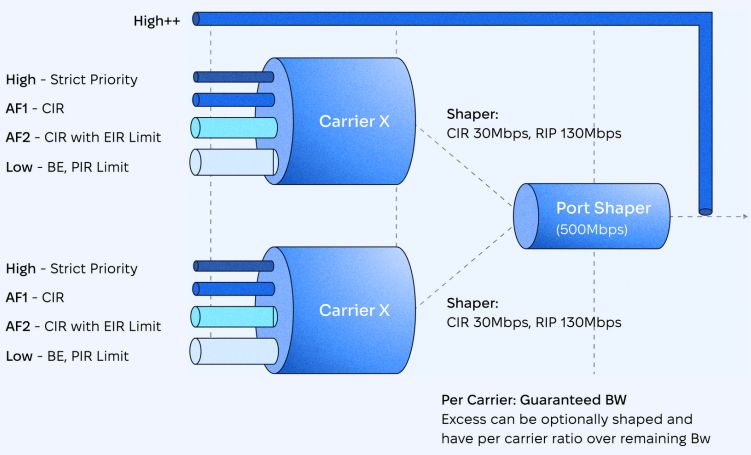
In multiple carriers mode (N:1):

- Each upstream VLAN represents a carrier
- VLAN shaping enables bandwidth control per carrier
  - ▹ Global upstream level
  - ▹ Per XGS-PON SFP downstream bandwidth for its group of customers
  - ▹ VLAN competition control - guaranteed and excess weight control

In 1:1 mode:

- Shaping per subscriber (e.g. VLAN)
- Cross subscribers control of:
  - ▹ Guaranteed bandwidth (CIR)
  - ▹ Optional excess peak bandwidth (PIR limit)
  - ▹ Cross subscribers competition ratio (weigh

Classification to internet queues available via any 5-tuple + PRI fields.



OTHER BENEFITS OF THE TIBIT XGS-PON

Using the Tibit integration provides the following advantages, in addition to connectivity and PON layer management:

- Open OLT—One of the methods current OLT vendors are using to maintain their closed ecosystem is to create interoperability issues across other ONU vendors, which creates vendor lock-in and limits flexibility and competitiveness for CSPs. Tibit focuses on OLT delivery has enabled an "open OLT" program that ensures interoperability across a variety of vendors, solving this economical and legal lock.
- Subscriber's Management—The integration of the PON network with the subscribers' provisioning and monitoring systems (either existing or new) is essential to the success of the deployment and lifecycle management of the network. Tibit provides an open API environment for this integration. One of the options is the use of VOLTHA architecture developed by the ONF (Open Network Foundation) which is becoming a key requirement for carriers in this field.

In Summary

exaware

OPEN ARCHITECTURE

- Modern software environment
- Open architecture for applications add-ons and programmability

UNIFIED SOFTWARE PLATFORM

- MPLS VPNs, L2VPNs, L3VPNs, VPWS and VPLS services
- Flexibly customize access networks in line with your preferences
- Third-party NMS/SDN controller

CARRIER GRADE ROUTING SOLUTION

- A decade of development with ExaNOS
- Successfully deployed among several Tier 1 service providers
- Critical redundancy
- Two-phase commit

REDUCED TCO

- Choose from plan-ahead (chassis) to pay-as-you-grow
- Generate new revenue streams with third-party applications
- Break the chains of vendor lock-in

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