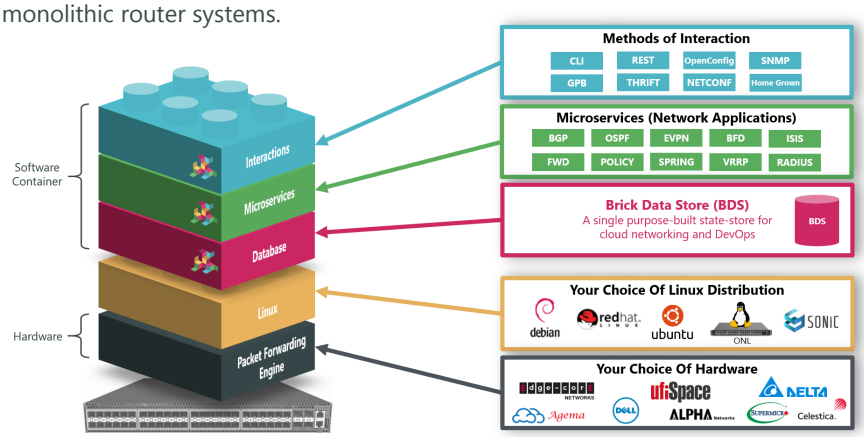
Data Sheet

Disaggregated BNG (Broadband Network Gateway)

Over recent years, 'cloud-native' service providers have developed ways to build and run massive data centers with a high degree of automation, to reduce operational overheads and deliver levels of service agility beyond traditional carrier infrastructure. RtBrick's disaggregated open BNG brings these same benefits to carrier access networks, by using agile methodologies and the same battle-hardened DevOps cloud automation tools that have been adopted by the world's biggest cloud providers.

Architecture

The RtBrick BNG is delivered using RtBrick Full Stack software, which takes advantage of the latest merchant silicon running on powerful bare-metal switches to give you high-performance at a fraction of the cost of conventional monolithic router systems.



The RtBrick BNG is delivered as a Linux container and packaged for bare-metal switches within an Open Network Linux (ONL) installation for a seamless experience out-of-the-box. ONL handles peripherals such as LEDs, temperature sensors, and other platform management tasks. The entire networking stack, including the forwarding elements, is implemented in userspace as containerized processes.

The platform provides an in-memory database custom-built to meet networking scale and performance requirements and also provides primitives needed to build network applications. Application instances can themselves be scaled out to meet performance requirements.

Deployment at any Scale

The BNG's subscriber management capacity is provided in a Spine-Leaf scale-out architecture called the Point-Of-Deployment (PoD). A large-scale PoD consists of Access Leaves aggregated by a layer of Spines in an auto-provisioned CLOS topology (see Figure 2). The Access Leaves deliver subscriber management functionality and the Border Leaves provide connectivity to the core of the provider network.

The leaves or spines can be scaled out horizontally to increase the number of subscribers supported on the PoD, providing a pay-as-you-grow architecture.

For smaller concentrations of subscribers, or deployment in more remote hardened environments, spine-leaf functionality can be collapsed onto a single switch as a *Consolidated BNG*, offering all the functionality on a single physical switch. The RtBrick BNG software can also run on an x86 server.

Benefits

RtBrick's disaggregated open BNG delivers some significant benefits compared to traditional monolithic systems:

- **Greater agility** – you can add new services in minutes rather than weeks
- **Reduced risk** – no more vendor lock-in and a simpler automated operating environment
- **Cloud cost-levels** – leverage low-cost merchant silicon and automate your operations like an 'Internet-native'

Agility

ZTP (Zero-Touch-Provisioning) ensures that each switch is booted, provisioned and operational without requiring manual intervention. This means that you can add capacity, or roll-out new service features, in a matter of minutes instead of days or weeks.

The software itself is developed using Agile methodologies so that features are rapidly prototyped and implemented, reducing the time-to-market for new services.

Reduced risk

RtBrick's BNG software also allows you to pick and mix between the latest silicon and the best available software . It is also compiled for your specific use-case, using only the features you need. With an order of magnitude fewer lines of code, and a single state database rather than hundreds, the whole system is less complex, less prone to bugs and has much faster restart times.

Cloud cost-levels

Now you can take advantage of the low cost-points of merchant silicon on your choice of bare-metal switches, significantly reducing your capex bill. And opex costs can be reduced by automating your operations, using ZTP and the same Web2.0 operational tools that the 'cloud-natives' use to run their infrastructure.

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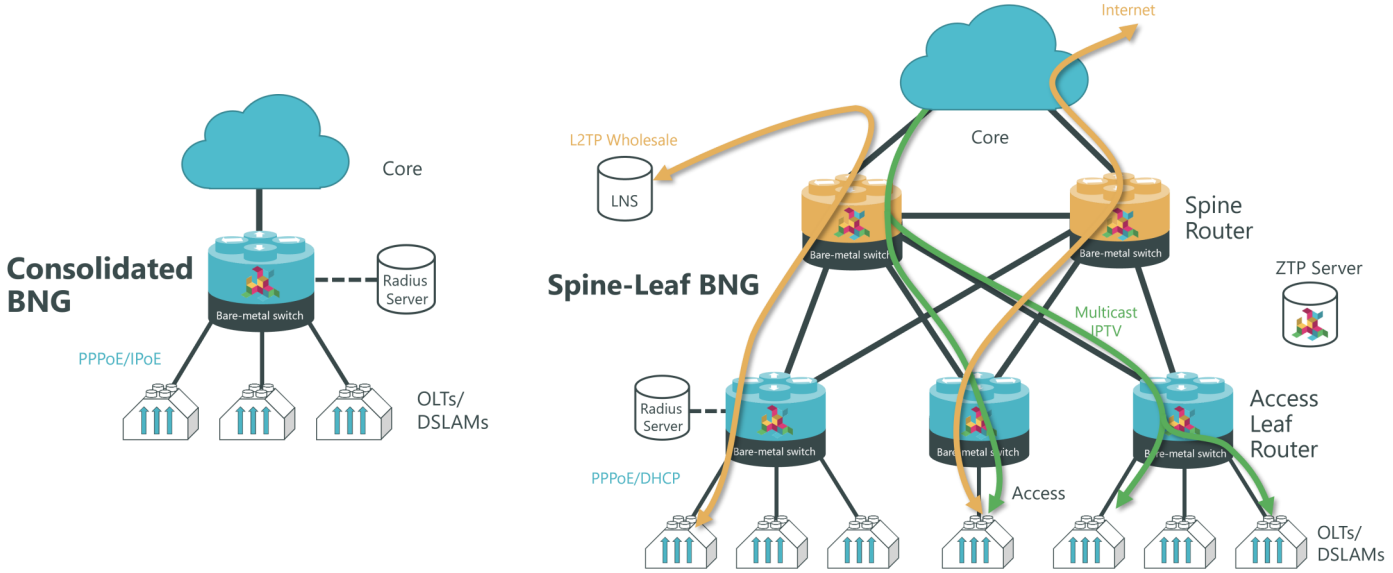
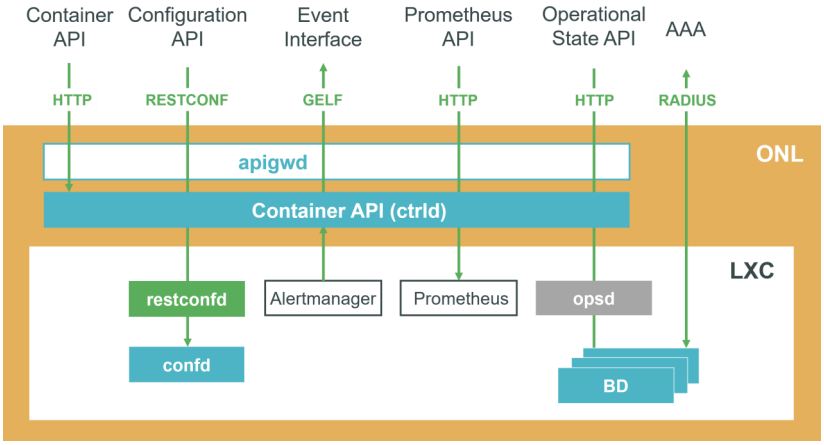
Broadband subscribers can be terminated on the Access Leaf Routers or tunneled to an LNS over L2TPv2. L2 Cross Connect (L2X) allows subscriber traffic to be tunneled out of the PoD at Layer 2, providing wholesale connectivity or connectivity for legacy services. This allows you to re-use your existing infrastructure to continue to provide lower volume legacy services, and optimize the rest of the network for the bulk of your traffic - providing large volumes of high bandwidth services at a lower cost-point with a web-scale operating environment.



So your RtBrick BNG can also act as a service cross-connect, routing each subscriber to the appropriate network infrastructure and extending the life of your high-cost legacy BRAS or BNG systems, for example.

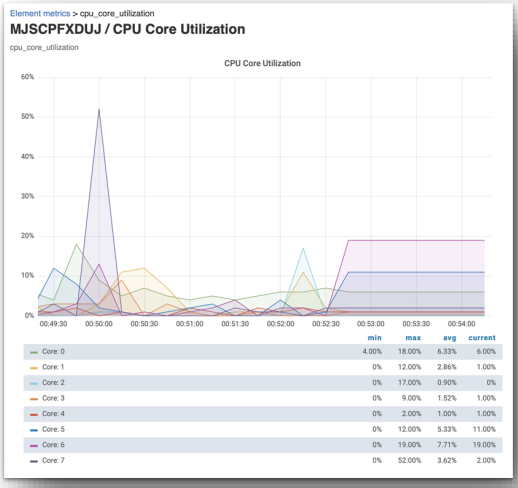
Management and Operations

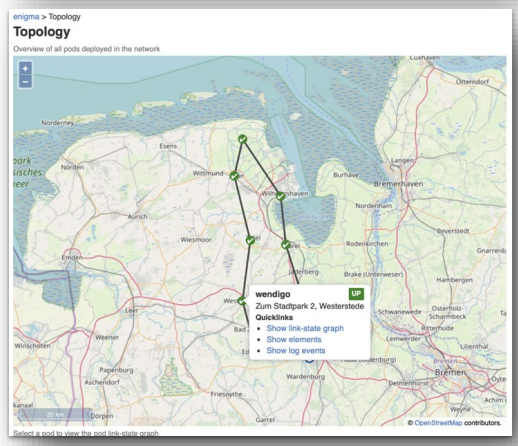
RtBrick's Management API has been designed to simplify the integration with your existing OSS and BSS systems. It reduces the amount of time and effort required to make your disaggregated network operational, and it leverages widely-adopted industry tools and programming languages. RtBrick's API is 'consumer-driven' – which means you can use the formats and languages of your choice, rather than have them imposed on you by a vendor. This allows you to build a client in Python, Go or Java, for example, as you prefer. And the APIs are all edited in Swagger, which is also a widely understood tool used by developers.



As an alternative to integrating directly into your own OSS system, you can use the RtBrick Management Suite (RBMS), which is an 'off-the-shelf' client that we have built using our own Management API. It is available to you as open-source software. It can be used as a standalone system for software management, ZTP (Zero-Touch-Provisioning) and switch inventory. Or you can use it as an open reference model to build your own client.

RtBrick Management System example screenshots





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License and Support Options

RtBrick's BNG software is offered in multiple consumption and licensing models, as either one instance per physical switch, or a single license for a whole network, based on the total number of subscribers.

In the first case (instance-based) two distinct images are available for different roles within the PoD – the Access Leaf and the Spine. Leaf licenses vary depending on the underlying silicon in the switch, for example Q2A or Q2C chips from Broadcom. Once booted up, the images connect to the RtBrick Licensing Server and run with the relevant scale and functionality based on their license entitlement.

An additional instance-based option is for a Consolidated BNG license, which provides both Spine and Leaf functions on a single hardware platform.

Instance-based licenses are perpetual for the hardware they were purchased on.

All licenses require separate purchase of service and upgradability licenses on an annual basis. Service licenses entitle the operator to maintenance support for existing deployments as well as to receive release updates i.e. newer versions of the same functional release.

Subscription pricing is also available as an option, which includes support and upgrades.

RtBrick BNG Features

The following list may include some roadmap features—please check with us for the latest details.

Feature	Description
Base OS	• RBFS LXC container based on **Ubuntu 22.04 LTS** with Open Network Linux (ONL) Host OS
Supported Hardware (Network role)	• **Edgecore:** CSR320 (L2 Wholesale Leaf), CSR440 (Consolidated BNG), AGR400 (Spine), AGR420 (Access Leaf, Consolidated BNG) • **UfiSpace:** S9500-22XST (L2 Wholesale Leaf), S9600-32X (Spine), S9600-72XC (Access Leaf, Consolidated BNG), S9510-28DC (Consolidated BNG) • **Delta:** AGCVA48S (Access Leaf)
Access Protocols*	• **General** - PPPoE, IPoE, L2BSA, L3BSA, co-existence of subscribers of different types, multiple subscriber profiles, RADIUS (AAA), Dual-Stack IPv4/IPv6, Double, Single, Untagged interfaces, Local/Remote Authentication, Local/Remote Address Allocation, Chained Address Pools, Ascend Data Filters, multiple RADIUS Servers, Change of Authorization (CoA), Volume and Time based Accounting, Access Line Attributes • **PPPoE** - LCP, IPCP, IP6CP, DHCPv6 for IPv6 support, Multiple address support (Framed-Address, frame-ipv6-prefix/IA-NA, delegated-IPv6-Prefix/IA-PD), N:1 and 1:1 VLAN support RFC 1332, 1334, 1516, 1661, 5072, 4679, 6320 • **IPoE** - DHCP Server, DHCPv6 Server, 1:1 Redundancy, Multiple address support (Framed-Address, frame-ipv6-prefix/IA-NA, Framed-Route, Framed-v6-Route, delegated-IPv6-Prefix/IA-PD), 1:1 VLAN support RFC 951, 1542, 2131, 2132, 3046, 8415 • **RADIUS** - Rich set of VSA's in addition to Standard Attributes, Session and Traffic Class Counters, Redundant Servers RFC 2865, 2869, 3162, 2866, 4372, 4679, 6320, draft-lihawi-ancp-protocol-access-extension-04 • **Lawful Intercept**- support for PPPoE, IPoE, RBAC Security, Direction Selection • **HQoS** - multi-level Policing, Classification (Behavioral Aggregate, Multifield, IPv4/IPv6, Ethernet, MPLS), Remarking, Queuing, Shaping and Multi-Level Hierarchical Scheduling, Header Compensation, Priority Propagation, Programming Model that supports full capability of the underlying Chipset • **L3BSA (L2TPv2)** - LAC only, multiple LNS server support RFC 2661, 5515, 2868, 3145 • **L2BSA** - A10-NSP interface for subscriber wholesale

Feature	Description
L3 Protocols*	• **BGP** - Multi-Protocol BGP (Families IPv4, IPv6, VPNv4, VPNv6, IPv4-LU, IPv6-LU, 6PE, MVPN), L3VPN, Segment Routing, Enhanced Route Refresh, Authentication with TCP MD5/TCP AO, Route Reflection, Multipath, Addpath, 4-Byte AS, BGP Capability Advertisement, BGP Communities (Normal, Extended, Large), Revised Error Handling, Route Policy, Rib-in visibility, Hostname Capability RFC 1997, 2385, 2545, 2918, 3107, 4271, 4360, 4364, 4456, 4486, 4659, 4760, 4798, 4893, 5492, 5549, 6513, 6608, 6793, 7313, 7606, 7911, 8092, 8669, draft-walton-bgp-hostname-capability-02, draft-kumar-idr-link-local-nexthop-02 • **L3VPN** - IPv4 and IPv6 overlay, IPv4 and IPv6 underlay, Route Policy, Multicast, BGP, OSPFv2, Static and PIM as PE-CE protocols, RFC 4364, 6513 • **OSPFv2** - Refresh and Flooding Reduction, Route Policy, Segment Routing, Loop prevention in L3VPN, Multi-area Adjacency, Opaque LSA RFC 2328, 3137, 3509, 4136, 4576, 4577, 5185, 5250, draft-ietf-ospf-segment-routing-extensions-24 • **ISIS** - RF IPv4 and IPv6, Transient Blackhole Avoidance, Route Policy, Segment Routing, Hostname Exchange Support, Cryptographic Authentication, Restart Signaling, Extended IPv4 and IPv6 reachability, PoI TLV Support, Flood Filtering RFC 1195, 3277, 5301, 5302, 5303, 5304, 5306, 5308, 6232, 7775, 7794, ietf-isis-segment-routing-09 • **MPLS** - LDP, Segment Routing (ISIS, OSPFv2, BGP) • **LDP** - Authentication with TCP MD5/TCP AO, Support for IPv4/v6, Targeted-LDP, Route Policy RFC 5036
Multicast	• **Multicast** - PIM, MVPN, IGMP v2/3 RFC 2236, 3376, 4609, 3569, 6513
L2 Protocols*	• **Static Ethernet Pseudowire (L2X)** - Local and Remote Pseudowires, ingress VLAN Operations, Uni & Bi-directional, QoS support, incoming Traffic match
User Interface	• **CLI** • **RBFS REST API** - authenticated access, finegrained access and control • **RESTCONF** - abstracted model based configuration • **OpsD** - Abstracted Model based Operational Commands • **RBMS** - GUI based access and control
RBMS RtBrick Management System	• Device Inventory Management • Image Lifecycle Management • Metric sampling and monitoring • Configuration Store and Template Engine • Zero Touch Provisioning • Log & Event Management • Auto DNS Provisioning

*RFC and draft compliance partial except as specified