Building data centres on open standards
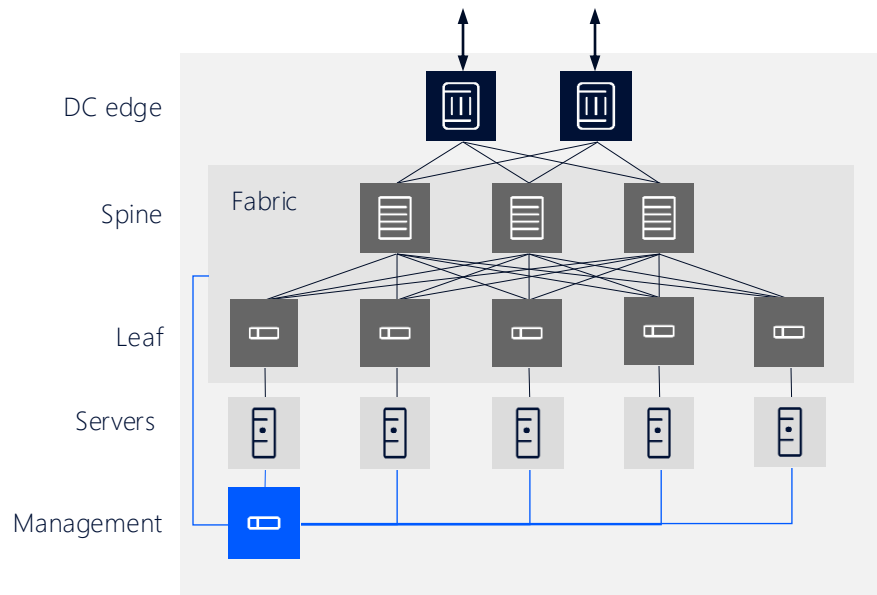
Bastien Claeys

Regional Product Manager at Nokia

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Data center network architectures

The industry has converged

Non-blocking fabrics
- IP and EVPN fabrics
- DC gateway or border leaf derivatives
- Collapsed core for edge DC
- Scale via super spines / pods

ASICs tailored per use case
- Range of different ASICs on the market
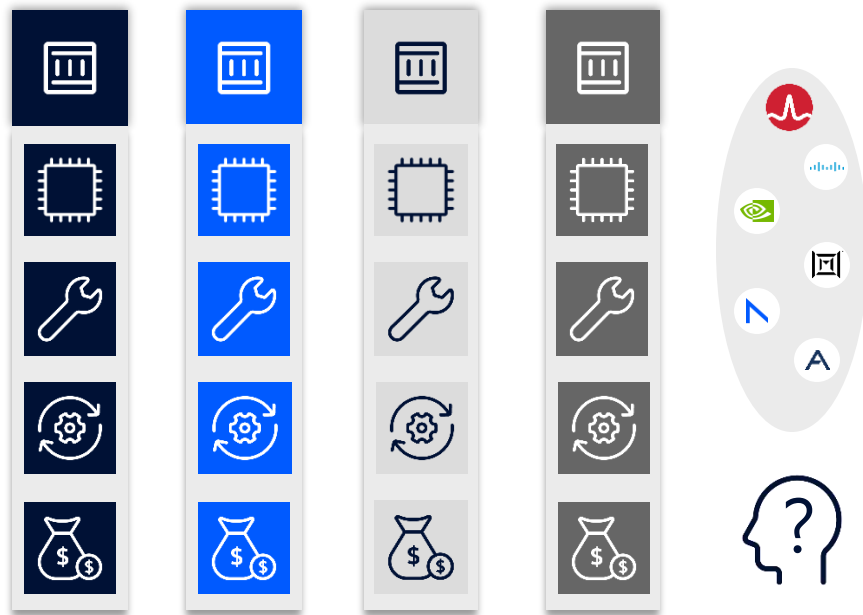- Key properties: latency, programmability, port speed & density, feature set

OOB management
- Merchant silicon
- 1G/10G port speeds

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The myth of the ultimate switch
Why one vendor never fits all (forever) in data center networking

- Deciding factors when selecting a platform
  - Port density, feature set, ease of operation/automation, cost

- Using equipment from a single vendor seems practical
  - Train for a single network operating system, easy to support and maintain

- Requirements evolve over time, e.g. data centre renewal
  - Sticking with the same vendor can be costly … and change require time and effort

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Breaking free

## Escaping vendor lock-in with multivendor networks

- Being locked into one vendor reduces flexibility but not only
  - Operators are more sensitive to supply chain delays and high cost
  - Massive blast radius in case of bug in the network stack implementation
- There's a need for a multivendor approach - how do we manage this efficiently ?

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One network, many vendors

## Standardisation as the key to multivendor networks

- Proprietary solutions can be effective, as a vendor has then full control on its solution design. However, it doesn't have to be this way.

- Today, underlays can be deployed in many ways using OSPF, IS-IS or BGP. Overlay networks are typically deployed with BGP-EVPN. There are mature solutions for designing data centres that simply works.

- Opting for standard practices is a way for operators to remain flexible and agile when it comes to using equipment from different vendors

- How do we get there ?

Fabric

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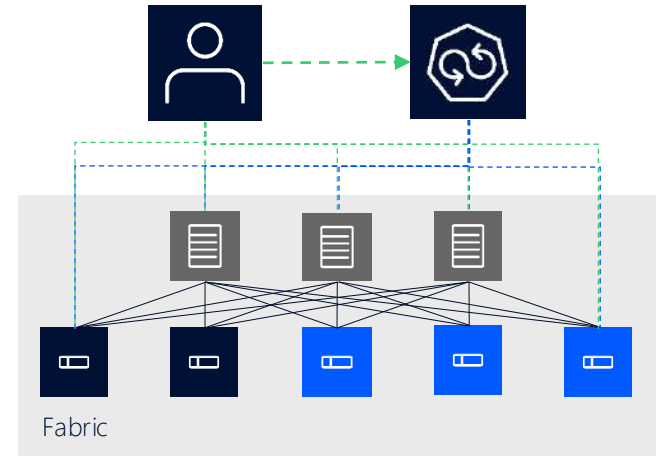
Moving away from proprietary solutions
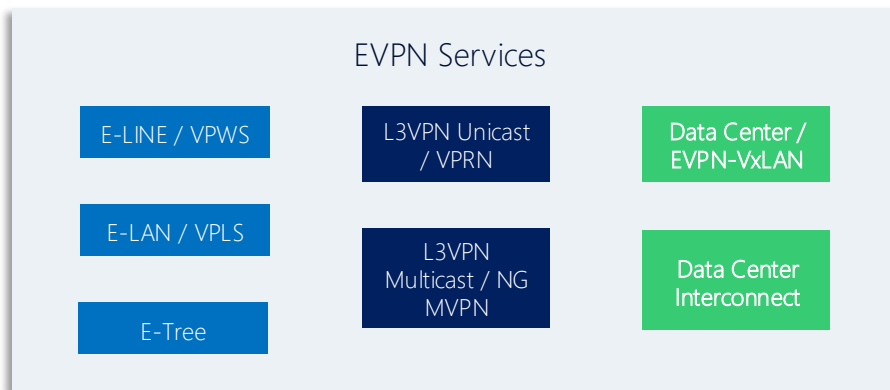## Running VxLAN in Data Centres

- Early 2010's : first VxLAN-based fabrics
- Flood & learn approach
- Remote VTEPs statically assigned
- Traffic flooded to all VTEPs without service knowledge
- Vendor-specific solution and not scalable ☹

- 1-2 years later : VxLAN-based fabrics running IP multicast
- 1 multicast group per service
- VTEPs subscribe to relevant groups
- Traffic is only sent to other members
- Better traffic replication than flood & learn
- Vendor-specific solution and multicast is needed ☹

- Then, emergence of HW VTEP with SDN controllers
- Decoupled control plane and data plane
- Scalable but proprietary solution ☹

Flood and learn fabric

RP (Rendez-vous point)

Multicast fabric

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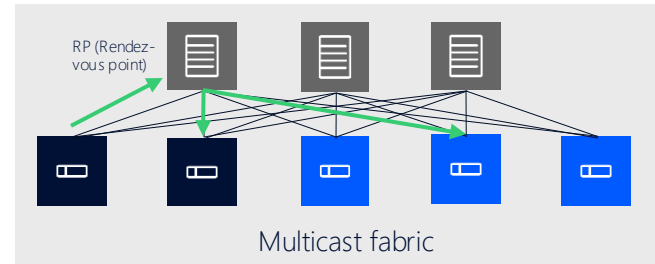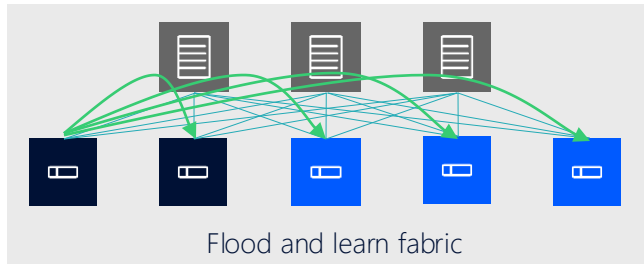
Ethernet VPN : the standard for modern networks
Ensuring seamless connectivity across vendors

- VPN services were traditionally delivered using different technologies depending on the service type: BGP/LDP for VPLS and VPWS, MP-BGP/MPLS for IP VPNs, and BGP/PIM for multicast VPNs.

- Ethernet VPN (EVPN) : standardized BGP-based control plane solution that enables scalable, efficient, and flexible Layer 2 and Layer 3 network virtualization across data centers and service provider networks

- EVPN is today a key component of a standardised architecture and an IETF workgroup is taking care of future improvements.

EVPN Services

E-LINE / VPWS	L3VPN Unicast / VPRN	Data Center / EVPN-VxLAN
E-LAN / VPLS	L3VPN Multicast / NG MVPN	Data Center Interconnect
E-Tree		

February 2015 : RFC 7432 BGP MPLS-Based Ethernet VPN Ethernet VPN
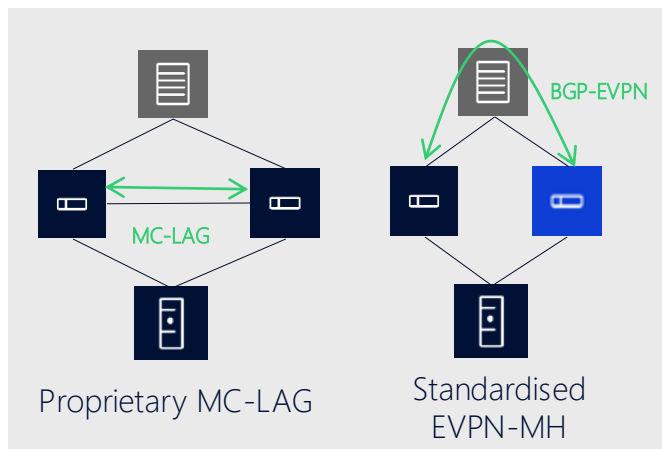
...

August 2024 : RFC 9625 EVPN Optimized Inter-Subnet Multicast (OISM) Forwarding

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Moving away from proprietary solutions (2)
EVPN and beyond

- Multihoming has for long been provided through MC-LAG
- EVPN Multihoming is a standardised solution that works between platforms from different vendors

- In 1994, Cisco Discovery Protocol was introduced
- LLDP is now the industry approach, compatible with practically all NOS and OS
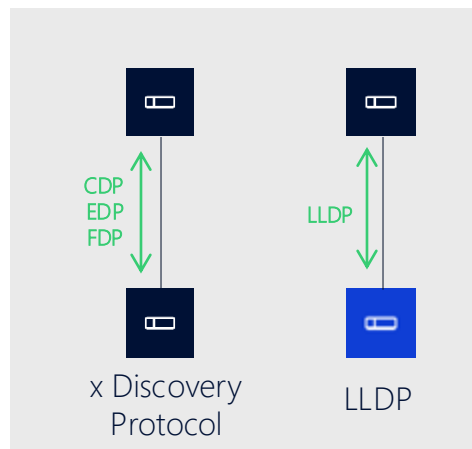
- Multi-Source Agreements (MSA) make sure form factors are designed following the same guidelines
- While not being official, those agreements ensure interoperability between equipment
- Examples
  - Optical transceiver form factors (SFP, QSFP, ...)
 - Optical transmission (CLR4, CWDM4, ...)

BGP-EVPN

MC-LAG

Proprietary MC-LAG

Standardised EVPN-MH

CDP
EDP
FDP

LLDP

x Discovery Protocol

LLDP

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EVPN-VxLAN fabrics

Best practices and repeatable blueprints

- With EVPN control plane properly defined by RFCs, one can easily deploy this protocol on different silicon as long as the routing protocol stack follows standards

- For instance, multiple ways to deploy a fabric underlay (IS-IS, OSPF, BGP), but sticking with a standard implementation allows to bring diversity

- Tuning of specific parameters to reach the best configuration possible, such as BGP timers to reach faster convergence for instance

- It's a fact - vendors define blueprints that are easily reproducible
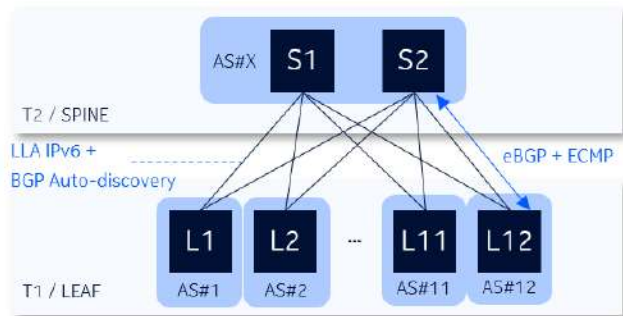
Example of fabric underlay design
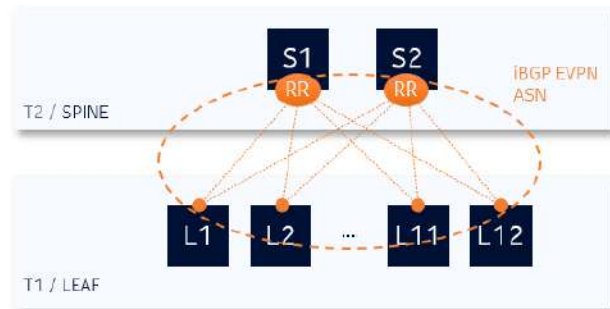
Example of a fabric overlay design

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EVPN in the real world

Validation across vendors

- Standardisation is important and vendors know it : some of them publish validated designs that operators can execute

- If following standards is important, so is validation. Interoperability tests make sure equipment from different vendors are compatible, e.g. EANTC.

- Interop tests driven by vendors and involving operators to define test scenarios or evaluate results

- Use cases as close as possible to the field to confirm compatibility and inspire confidence in each vendor's network protocol implementation.

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Programmable interfaces
Why model-driven matter so much

- Model-driven interfaces relying on abstraction via data models

- Transactional approach to ensure predictable changes

- Benefits
  - Validation, rollback
  - Favours automation
  - Easily integrated as part of a feedback loop

- Effective on CLI, even more powerful through management interfaces
  - NETCONF or gNMI

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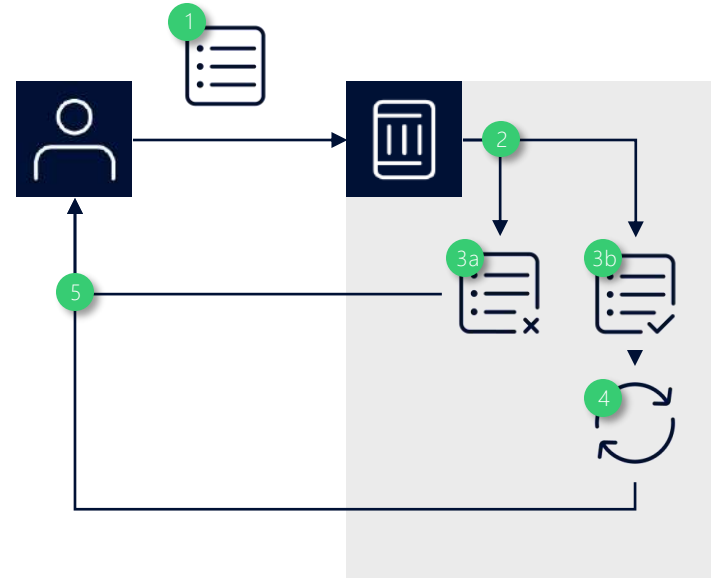
Programmable interfaces

gRPC framework for network equipment

gRPC
HTTP/2 - Protobuf

| gNMI - gRPC Network Management Interface	gNSI- gRPC Network Security Interface	gNOI - gRPC Network Operations Interface	gRIBI - gRPC Routing Information Base Interface
Management protocol	Security infrastructure services	Operational commands	Route injection
Configuration modification, state retrieval etc.	AAA, certificates and key management	Reboot, upgrade, file management, ping etc.	Programmatic route installation into a router's RIB

MD + standardised interfaces ▶

Automation
CI/CD integration

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Multivendor fabric management

Bringing different vendors together

- Multivendor environments are the most cost effective and robust way to build data centres

- Fabric management is key to make this possible

- Emergence of intent-based controllers emphasise this aspect. They manage switches using standardised interfaces and network protocols.

Fabric

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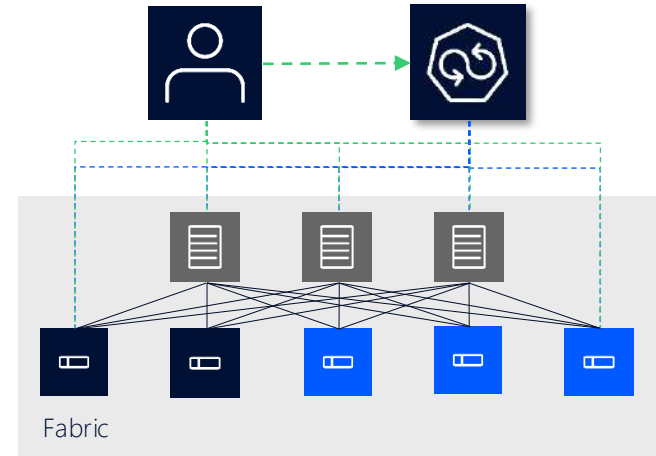
Key takeaways

Vendor lock-in exposes customers to supply chain delays and higher costs

Open standards enable robust multi-vendor interoperability

Model-driven interfaces for config and state are critical for modern DC networks

Automation and observability are day-0 requirements

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