



User-network interface for path-aware networking

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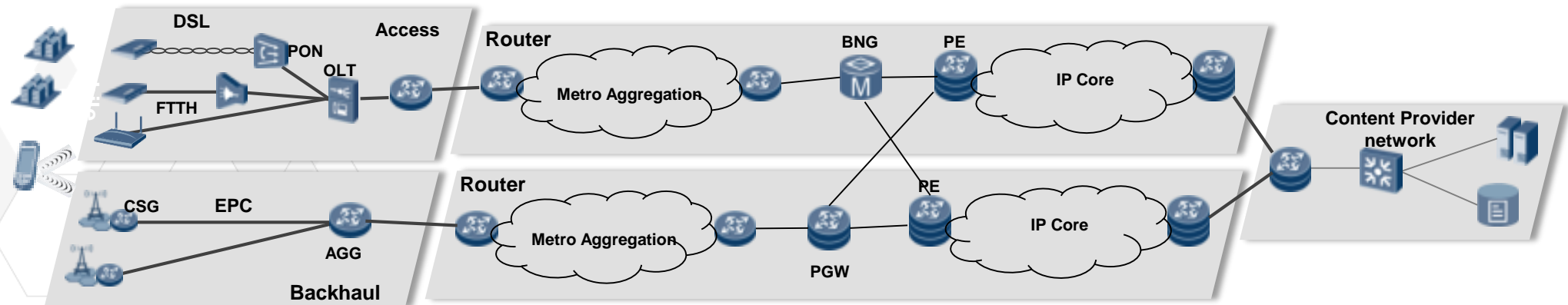


Goals of this presentation

- **Challenge of Path-aware networking**
- **Provide multi-path support in current Internet**
- **User-network interface**

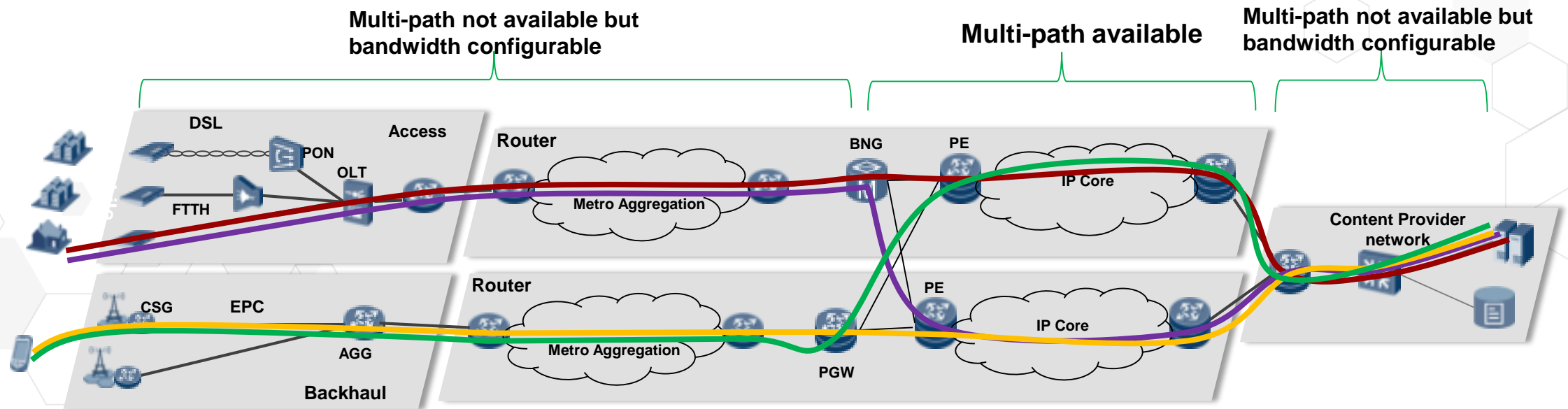
Challenge of Path-aware Networking

- **Lack of architecture that can be accepted/deployed soon**
 - › Current new architecture proposes (Scion, Nira, Pathlet...) are hard to be deployed
 - › More research needed for technologies that can lead to the path-aware for Internet., either by new architecture or evolving of current Internet
- **Current Internet**
 - › Only deployable scenario for MPTCP
 - › Wifi+LTE, or DSL+LTE,
 - › Current solutions only consider multi-path exists on access network, does not consider multi-path exists in other area of Internet:
 - › BBF TR-348 - Hybrid Access Broadband Network Architecture
 - › RFC8157 - Huawei's GRE Tunnel Bonding Protocol
 - › MPTCP proxy - KT's GiGA LTE, IETF97 Banana BOF
 - › What about one access interface/network?
 - › What if the multi-path is available in other areas?



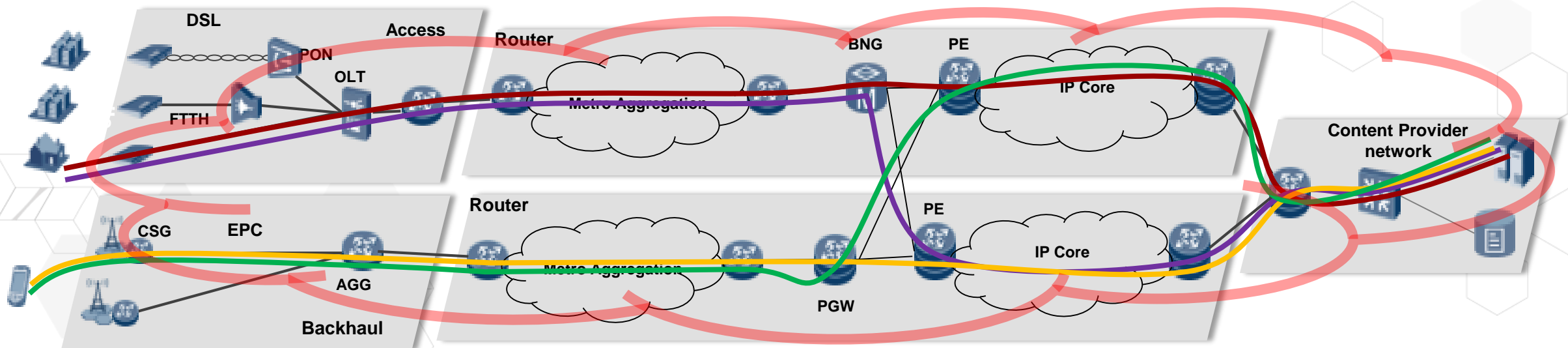
Can we have “path-aware networking” on current Internet?

- **Yes for some scenarios**
 - › Multi-paths exist in some areas between two ends
 - › One operator; multiple operators
- **and need more works**
 - › Provisioning, maintenance
 - › New control protocol



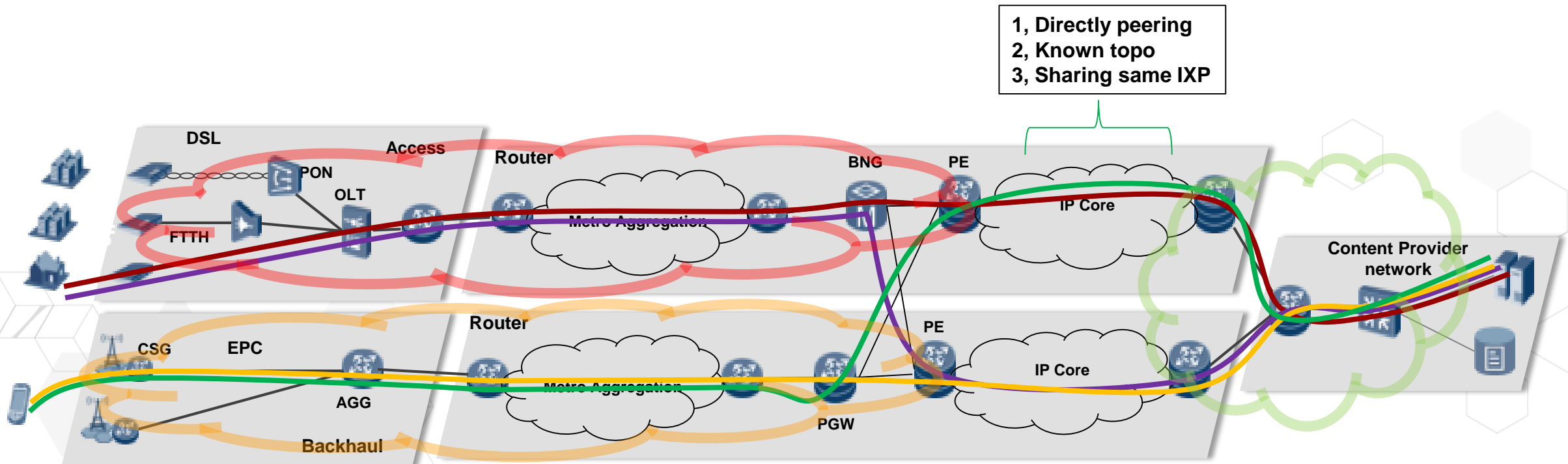
One operator

- One operator network E2E,
- More and more popular for 5G and beyond, MEC, cloudlet, private-cloud, etc
- Operator can manage multi-path by provisioning properly and provide path info to end user.



Multiple operators

- Topology is easy to figure out/check/maintain the disjoint multi-path



More works

- **Provisioning at access network:**

- › Majorly on the access network, depends on access network, different technologies are used (Eth, MPLS, IP, Optic, etc)
- › The bandwidth for the user's multi-flows are not constrained by MPTCP fairness principal (Multipath TCP should take as much capacity as TCP at a bottleneck link, no matter how many paths it is using); Two ways
 - › Provision each flow to disjointed path; by existing proposals (BBF TR-348, RFC8157, etc), or by SDN
 - › At key network device (bottleneck device), allocate expected bandwidth for specific user or sub-flows; by in-band signaling for flow level QoS (draft-han-tsvwg-ip-transport-qos-00), or by SDN

- **Maintenance:**

- › BGP multi-home and multi-path technology (RFC7911, RFC6774, etc)
- › multi-path are disjointed and available

User-network protocol

- **Between user and operator**
- **Purpose**
 - › Distribute the SR and other multi-path info to end-user before the Internet architecture can do so.
 - › End-user can tell operator his service expectation.
 - › Different data plane support, IP/MPLS/SR
 - » Different network may support different multi-path technology, SR, IP, MPLS, etc
 - » SRv6 is not efficient for mobile, too much overhead. Even using SRv6, the stack should not be added at user side.
 - » New data plane is expected to get better performance and efficiency.
- **Message exchanged:**
 - › User service expectation
 - › Network information for multi-path, properties,
 - › How to use multi-path for different data planes

Q&A