

GÉANT Network challenges



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Next gen GÉANT Network strategy - guiding principles

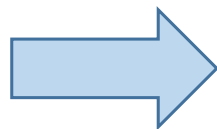


- Reduce cost of provisioning capacity on transmission layer
- Address scalability/cost on IP/MPLS layer
- Synchronise short/medium term strategy with longer term (post line system procurement)
- Increase modularity – address vendor locking
- Optimise architecture to take maximum advantage of recent disruptive trends

Recent disruptive trends

- DCI boxes with coherent DWDM
- Open line systems/ Alien waves
- Merchant silicon packet switching (e.g Broadcom Jericho II)
- DWDM Commodity pluggables
- Trend towards packet optical integration
- Disaggregation (software and hardware)



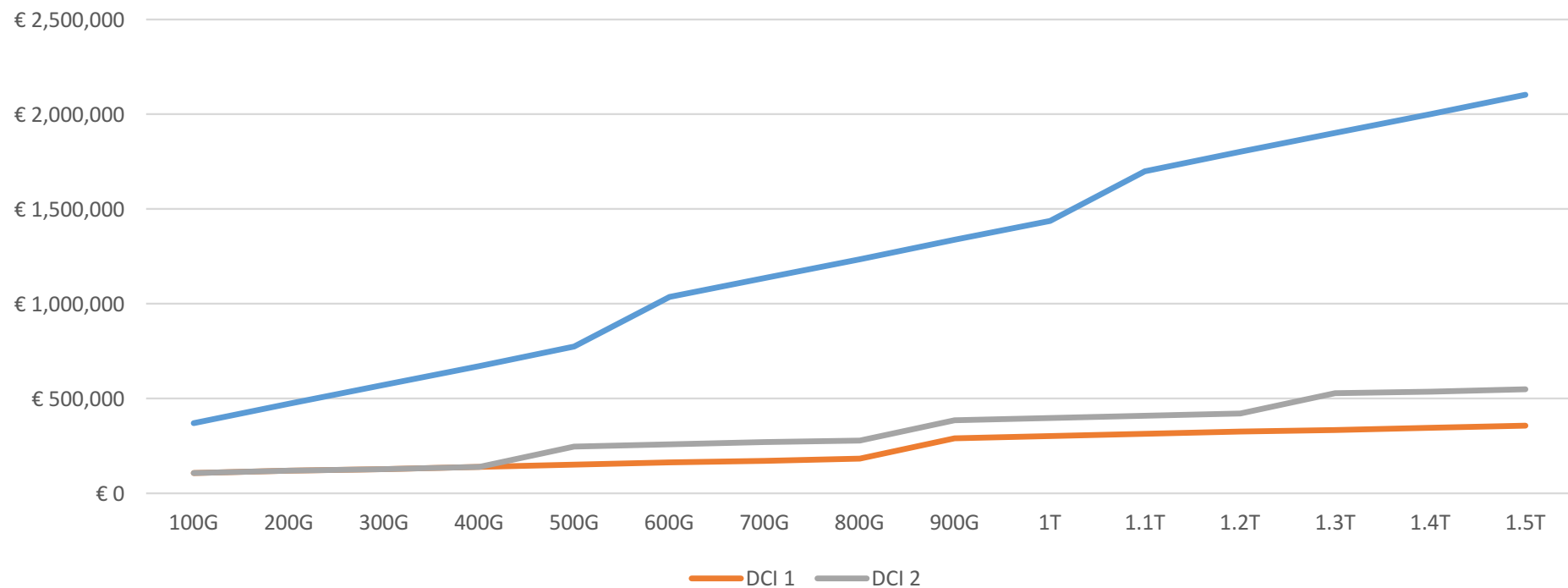


- Next gen of **commodity pluggable optics** has excellent performance
 - Data centre style 1 RU stackable form factor.
 - Up to **6 times reduction in cost** over traditional telecoms equipment architectures
 - Significant increase in **density** and reduction in **power consumption**
 - Modular – easy to scale up
 - Easy **upgrade path** to new technology
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- Loss of equipment integrity – not designed to be highly available as per ETSI etc.
 - No internal hardware redundancy
 - No in-service upgrades
 - Restricted temperature operation

Reduce cost of provisioning capacity on transmission layer – cost comparison



HW cost of delivering capacity between adjacent PoPs over a fibre link

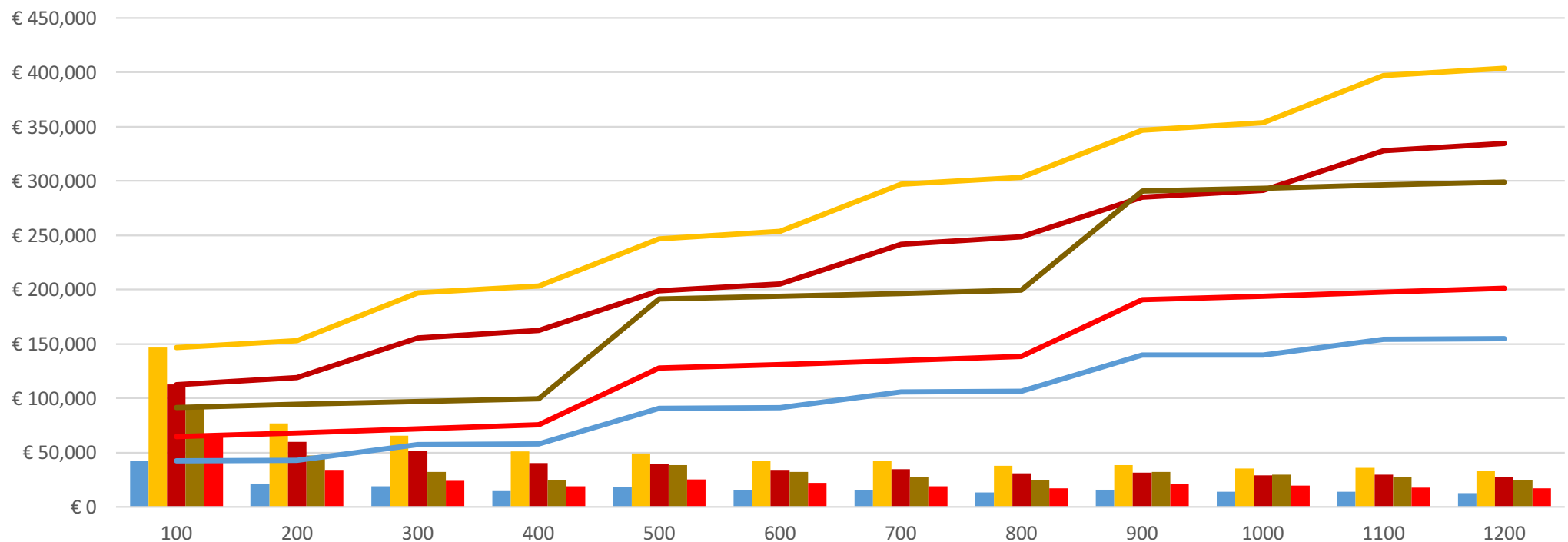


Cost of provisioning capacity from client to client in 100s of Gbps via DCI vs Infinera DTNxs – most and least expensive DCI solutions costs are shown – up to 90% cheaper bandwidth using Coriant solution vs DTNx

Reduce cost of provisioning capacity on transmission layer – DCI costs comparison



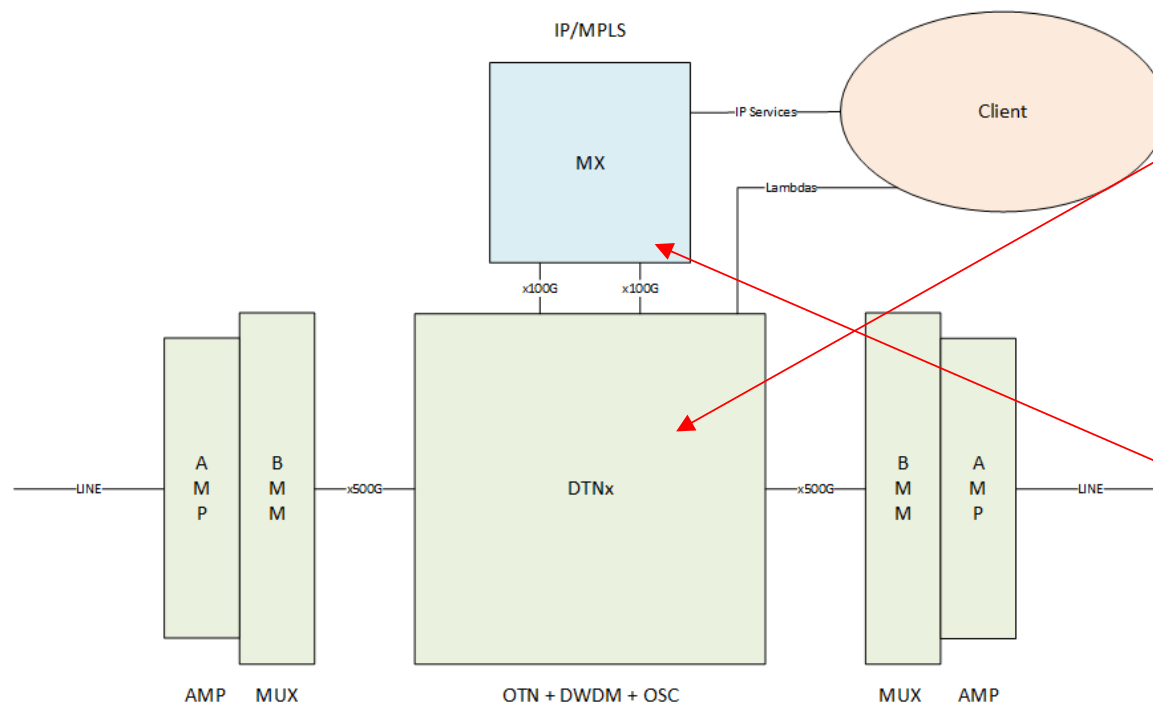
Cost comparison DCIs with 16 QAM



High variation in cost between DCI solutions

Current GÉANT cost pain points

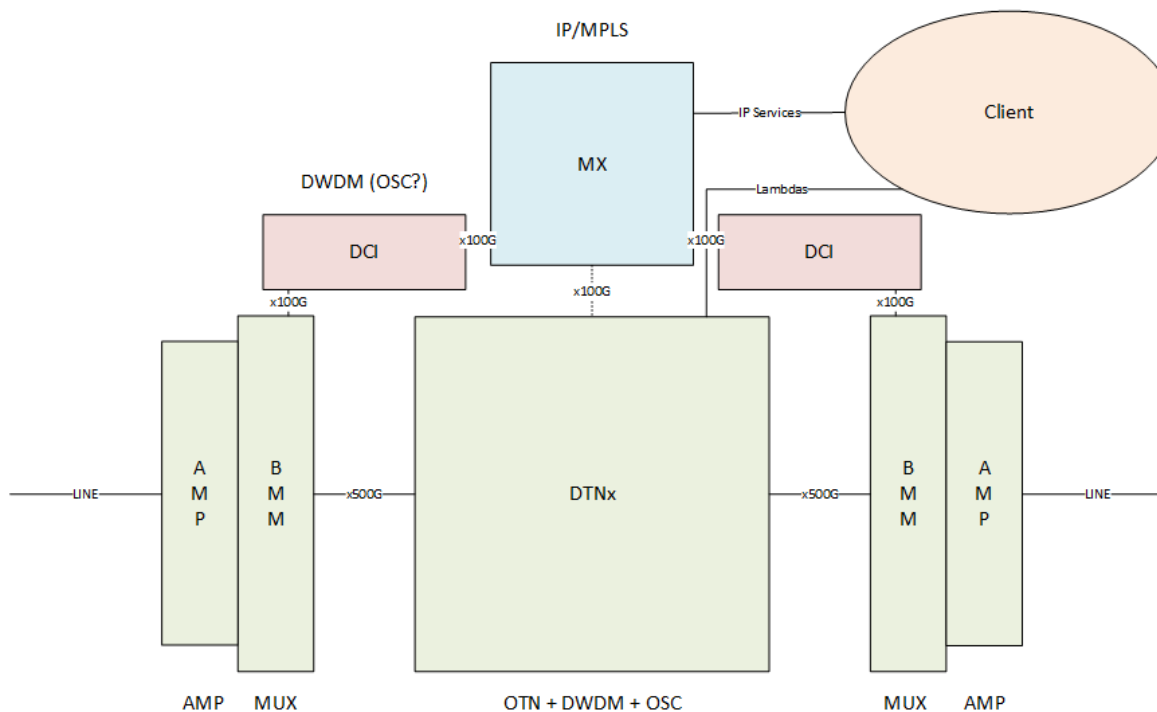
Current architecture



Problems with current architecture:

- OTN layer expensive
- DTNx chassis **running out of slots** in central PoPs
- OTN useful for protection switching and multihop but traffic is **70% unprotected** and next hop
- OTN chassis are **DC powered** full rack while DCI are AC powered 1RU
- Proliferation of **IP/MPLS**

DCI integrated solution

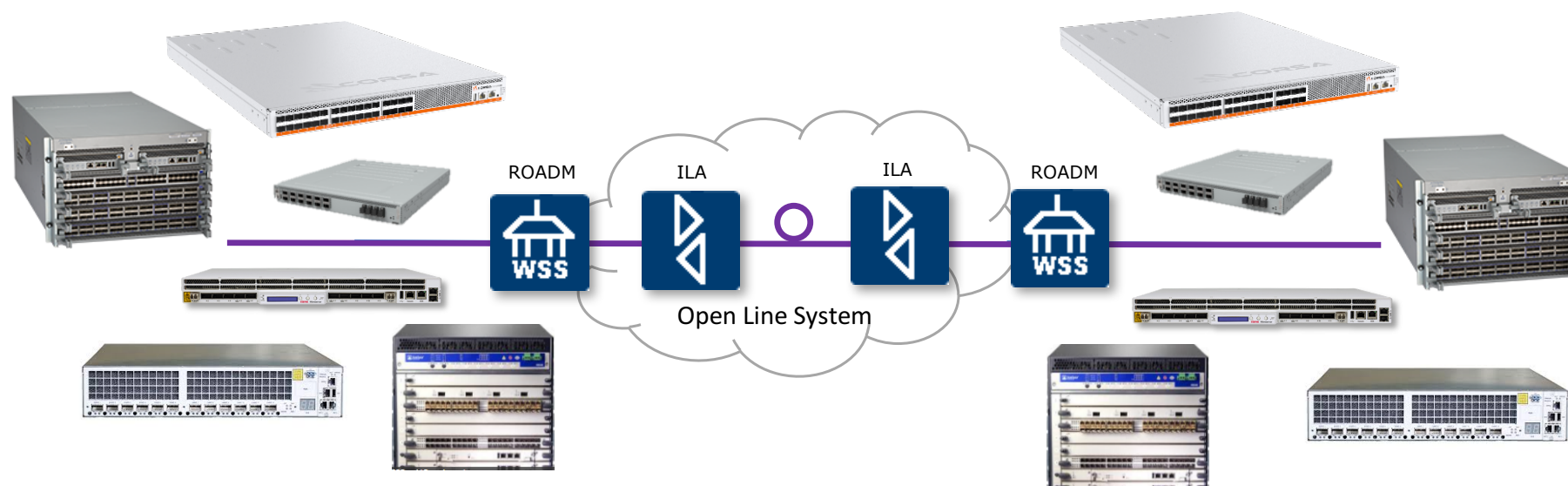


Solution

- Use DCI to provision bandwidth for high capacity IP/MPLS trunks
- DCIs are up to 6x cheaper than DTNx
- Keep DTNx for link management and lambda provisioning greatly simplifying DCI role and minimising risk
- Integration of DCI allows for growth offset and generate enough spares to allow to cease spending on DTNx platform

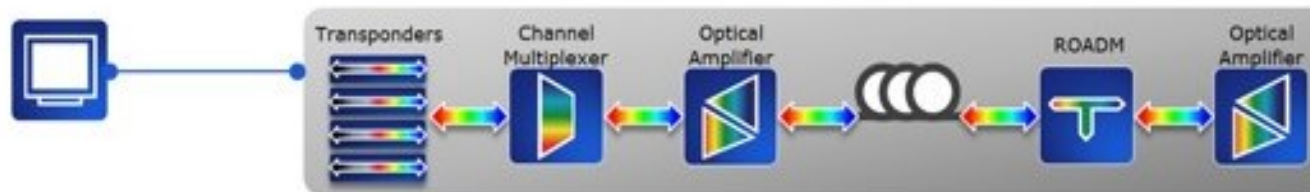
Medium-term solution: Alien waves over Open Line Systems

- Alien waves allow transponders from multiple vendors to operate on a single line system.
- Integrated 3rd party DWDM pluggables available in various terminal technologies and vendors.
- Still benefit from a single vendor providing end-to-end optical management: Channel & span equalization, DCN connectivity (OSC), ALS, Alarm reporting.



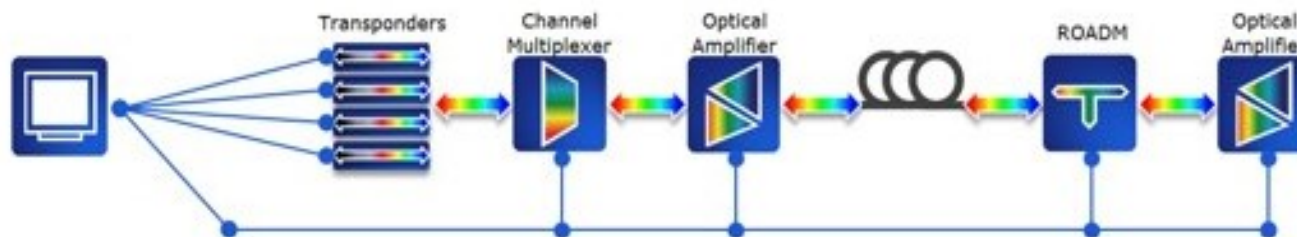
Medium-term solution: Open Line system.

- No Disaggregation: Entire transport network acts as one element



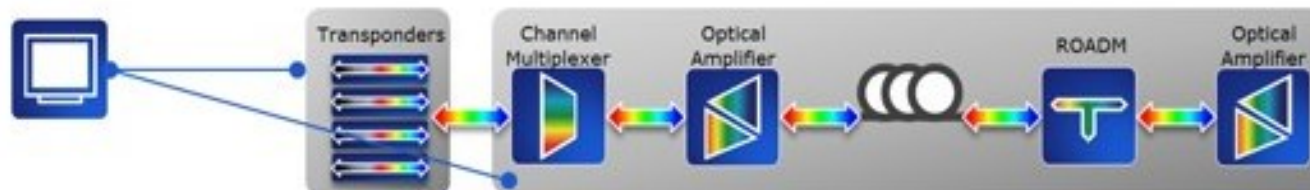
- This is the current closed management model

- Fully Disaggregated: Everything is a separate network element



- Long-term vision. But open standards and management not available yet

- Partially: Transponding is one element, OOLS is second.



- Medium term solution. Open access, single management plane for OLS

- Main focus on short term is addressing MX line cards fragmentation by introducing higher density cards in central location and moving lower density cards to the periphery
- MX480/960 platform remains viable till 2020+
- Vendor silicon based solution coming to the market as viable alternative to Juniper, however still 1 to 2 years away for full L3 support
- FlexE in MPC10 allows for link bundling with bit striping – address elephant flows
- Short term GÉANT to address maintenance costs of Juniper MXs by optimising cards utilisation and pursuing cost reduction strategy with vendors
- Medium term GEANT to test, validate and integrate alternative to MXs - P router, brite box, packet optical integration



Thank you

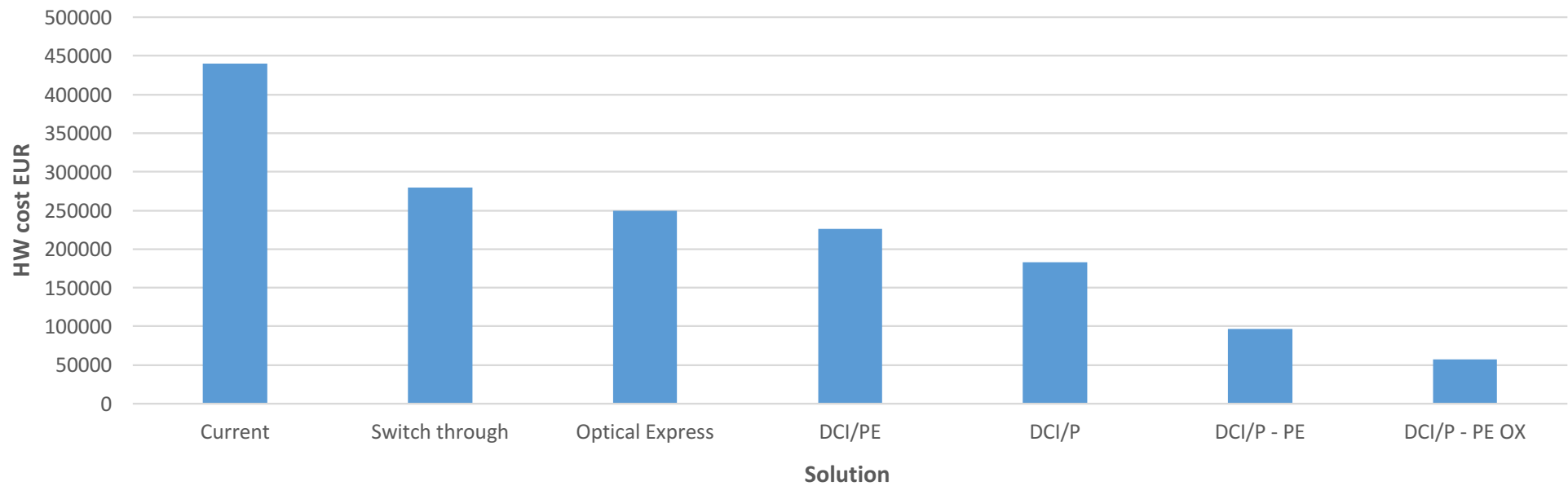
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Optimisation of cost per bit by diversifying delivery strategy

Cost to deliver 100Gbps Client to Client 1 hop



Push traffic to lowest possible layer