SRv6 network, Demand-Matrix and Use-cases

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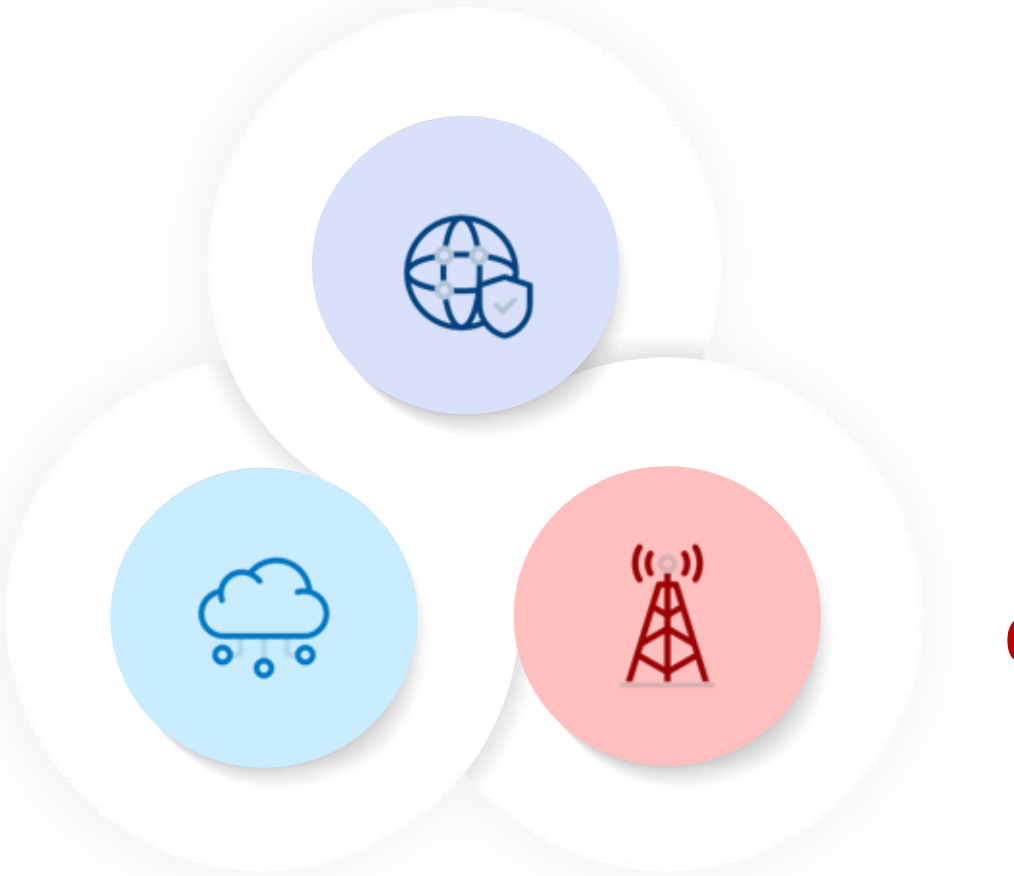
Driving Change with Innovation at the Center

IPv6



Cloud-native

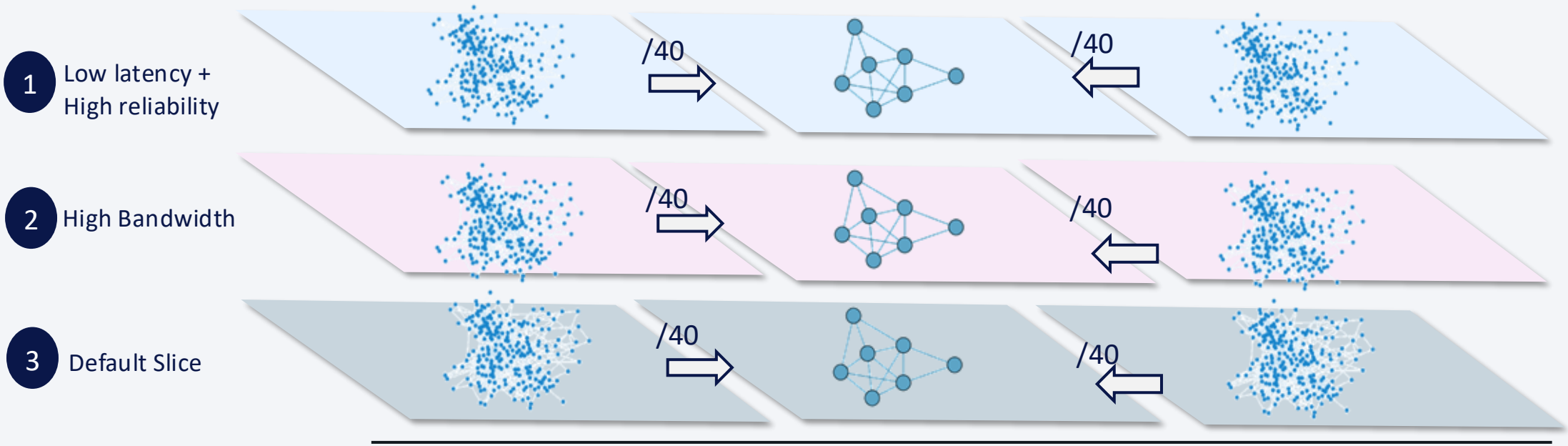
Open-RAN

Rakuten Mobile SRv6 uSID IP Transport Transformation

47 Prefectures	59 IGP domains	15000 SRv6 nodes
Largest u-SID SRv6 deployment	ISIS, BFD, BGP (vpnv4, vpnv6, rt-filter, evpn, bgp-ls)	4G,5G, L2VPN (EVPN), L3VPN

Rakuten IP Transport Transformation

SRv6 transforms Rakuten IP Transport network to world class converged 5G SDN-ready network



SRv6 network + Network slicing + ISIS summarization

Problem Statement

As the network continues to grow in scale and traffic volume, the main challenge is no longer just building the network — it is **operating it efficiently and safely**.

Planned Changes

- How to identify nodes that can be taken down simultaneously ?
- Combined impact of changes by different teams (Optical, IP)

Unplanned Changes

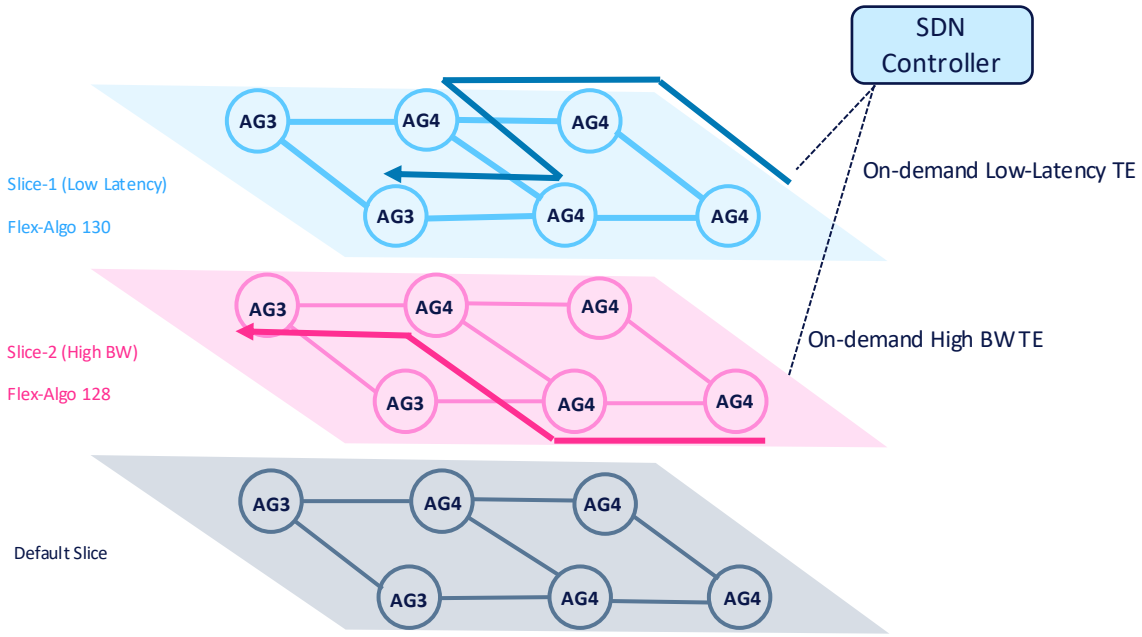
- What if a link/node fails ?
- How would traffic get rerouted ?
- Would it cause any congestion ?

Capacity planning

- How would network behave with 20% traffic increase ?
- How to avoid over or under network provisioning (optimal Capex)

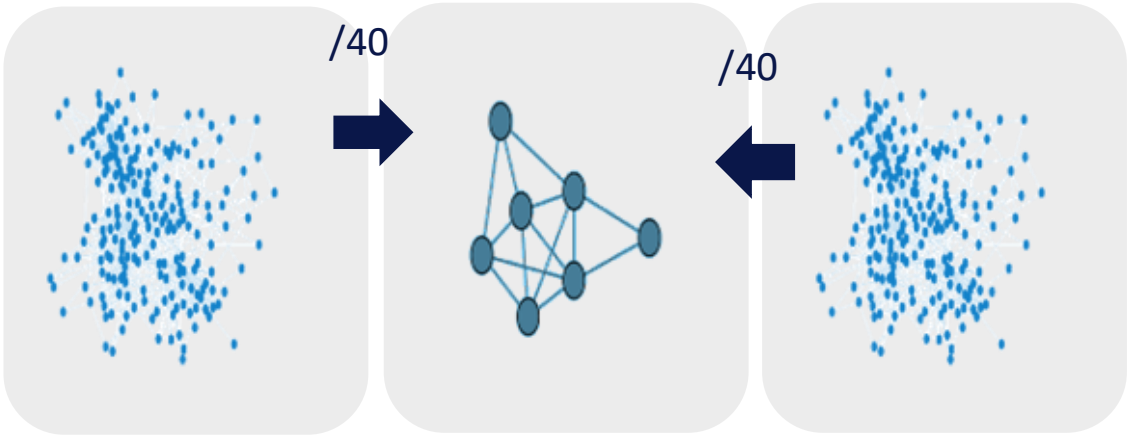
Additionally, different preferred paths across three IP transport slices, and impacts during planned changes.

Additional Challenges…



Each slice may follow **different path constraints**.

Different What-if analysis



summarization **hides topology details**

Aggregate DDM accounting to summary prefix f
inter-domain traffic.

A Simple Approach to Solving the Problem

The ability to perform “what-if” analysis in a simulated environment before making changes in the production network.

Topology awareness

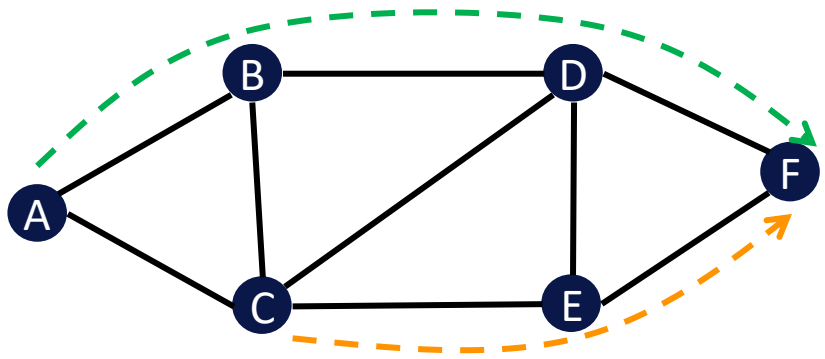
- BGP-LS
- ISIS Database

Routing info

- BGP-LS
- ISIS Database

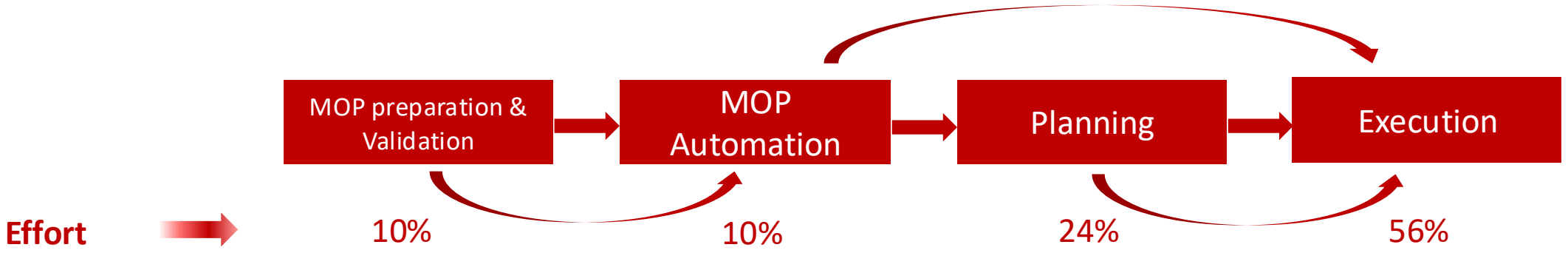
Demand Matrix

- DDM accounting



	A	B	C	D	E	F
A	-	0	0	0	0	5G
B	0	-	0	0	0	0
C	0	0	-	0	0	3G
D	0	0	0	-	0	0
E	0	0	0	0	-	0
F	0	0	0	0	0	-

Concurrent MW (problem statement)

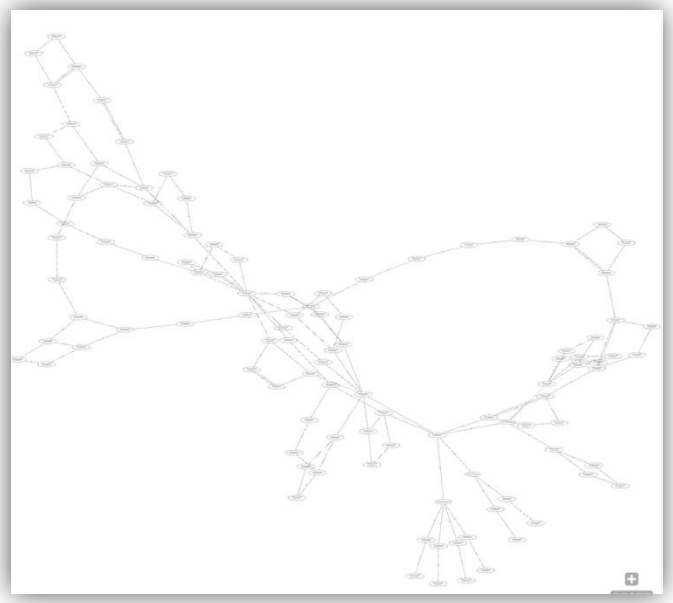


Planning (24%): Critical for scheduling, risk assessment, resource allocation, and fallback strategies given the scale.

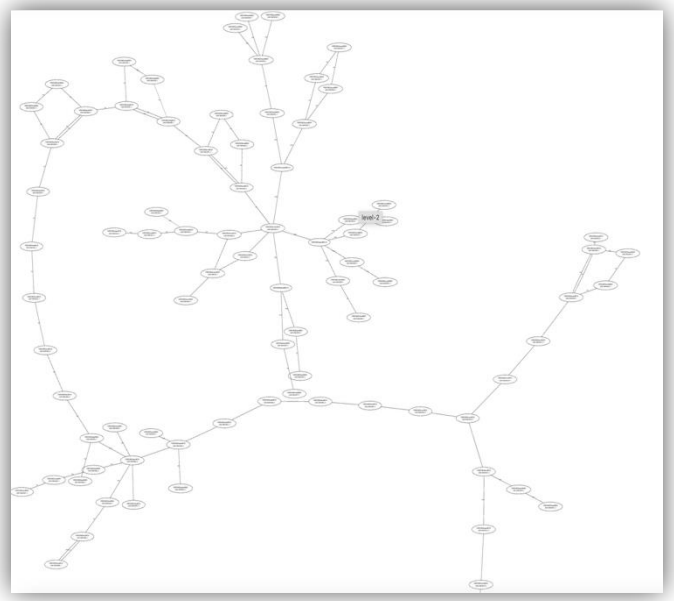
- Highly time- and resource-intensive (approx. 12 engineers involved)
- Any changes necessitate substantial replanning effort
- Prone to manual errors
- Planning is quite static in nature , true to that time topology.
- Potential execution delays
- Difficulty in evaluating risks across concurrent change activities

Concurrent MW – Connectivity vs Risk

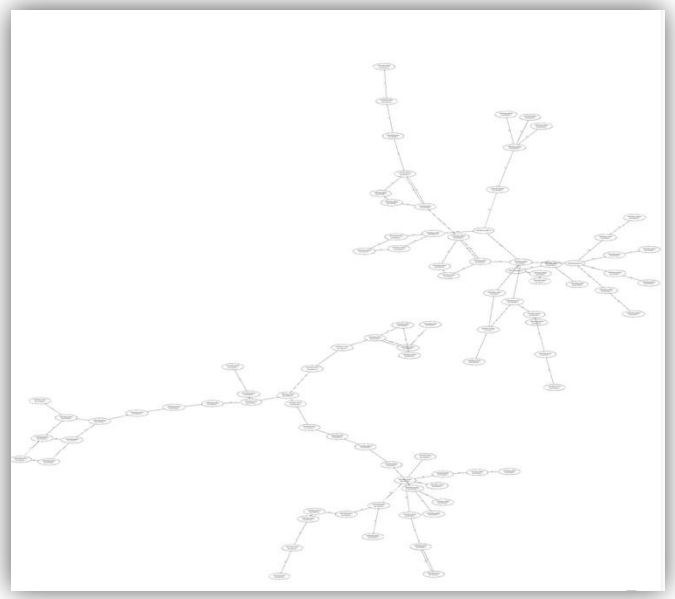
In an IP-based underlay–overlay routing model (SRv6 architecture), only IGP reachability needs to be ensured to at least one service node in a 1:1 redundancy setup within the SRv6 fabric.



Graph with all 106 nodes



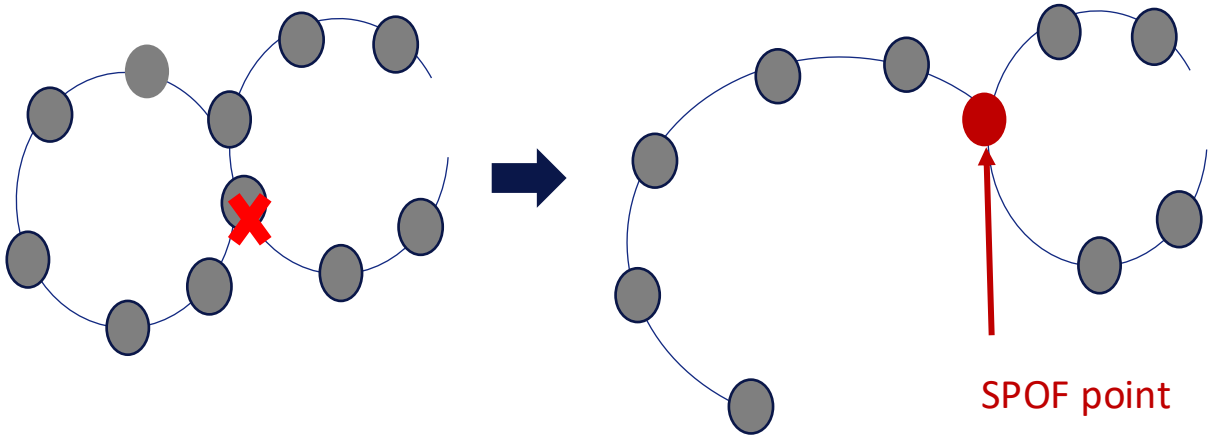
Graph when 20 nodes are taken out



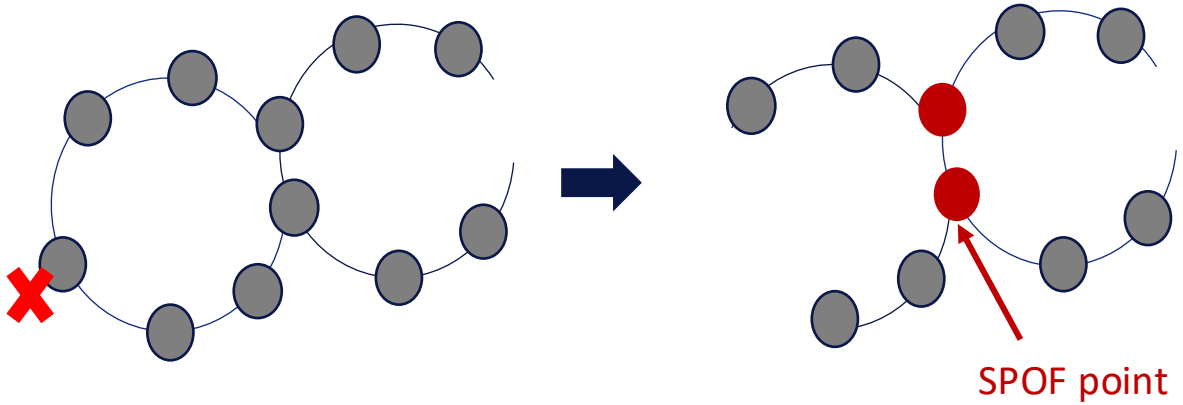
Graph when one additional node is taken out

Find maximum nodes, no other node gets isolated
Most optimized but introduces high risk in the network

Concurrent MW + Controlled Risk



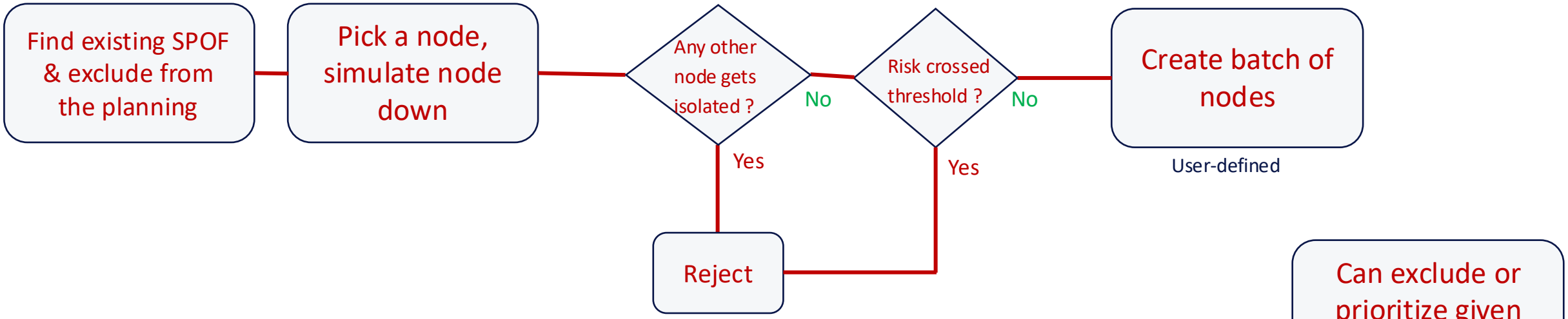
Risk Score = 5



Risk Score = 2

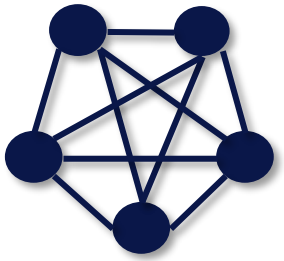
Higher the number of nodes below the SPOF point, higher the risk.
We aim to minimize the cumulative risk while selecting the nodes to upgrade.

Concurrent MW + Controlled Risk

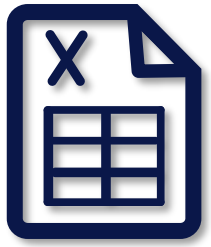


Candidate batch should not cause any node isolation or new AP that exceeds risk threshold

Topology can change..



Current Topology



Planned nodes

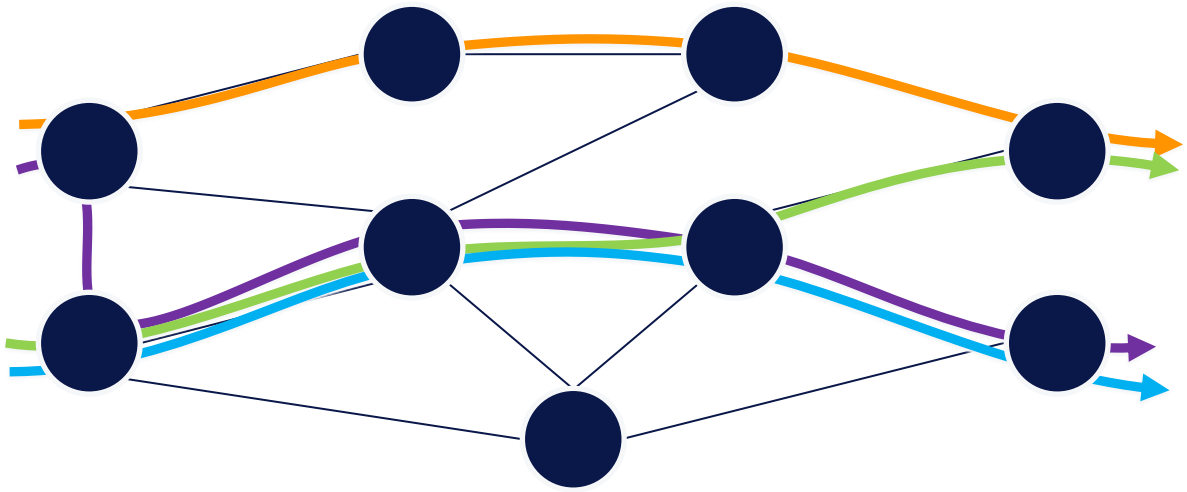
Check If any node gets isolated

Check before execution if planning still holds true

Connectivity vs SLA-compliant path

Alternate connectivity ensures reachability but not necessarily an SLA-complaint path

Demand Matrix: A Decades' Old Problem

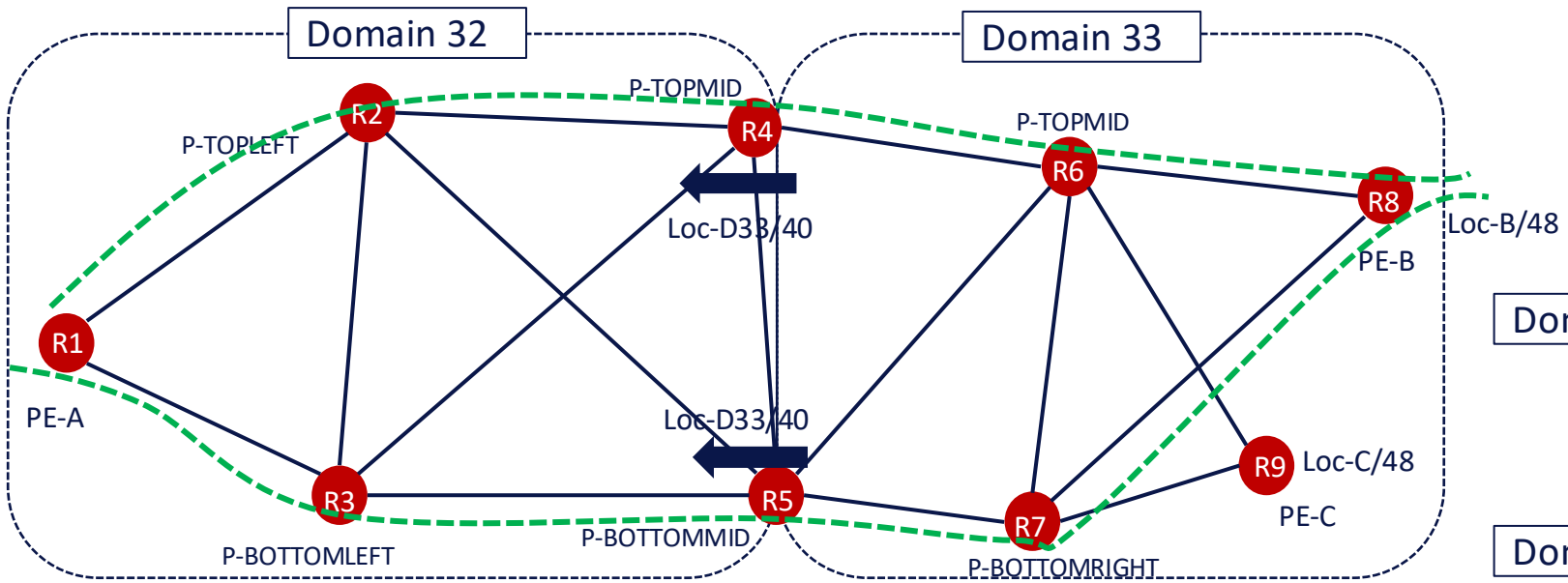


from \ to	D1	D2	D3	D4
S1	–	?	?	?
S2	?	–	?	?
S3	?	?	–	?
S4	?	?	?	–

- Automated: Not everyone can afford a dedicated team to acquiring the demand matrix.
- Realtime: Reflect the current state of the network.
- Deterministic: Show all the traffic. No sampling or approximations
- Lightweight: No heavy collection or processing infrastructure.

Ongoing IETF standardization (draft-ietf-spring-srv6-yang, draft-ietf-spring-sr-policy-yang

Demand Matrix with Redistribution & Summarization



Domain 32

Source	Locator Prefix	Destination	Algo	Traffic
R1	Loc-D33/40	R4	128	50Gbps
R1	Loc-D33/40	R5	128	50Gbps

Domain 33

Source	Locator Prefix	Destination	Algo	Traffic
R4	Loc-B/48	R8	128	50Gbps
R5	Loc-B/48	R8	128	50Gbps

Per IGP domain demand Matrix

Demand to destinations in remote domains are resolved to domain egresses

Supports ECMP, Flex-algo

What-if analysis (Capacity-Planning)

Topology awareness

Routing info

Demand Matrix

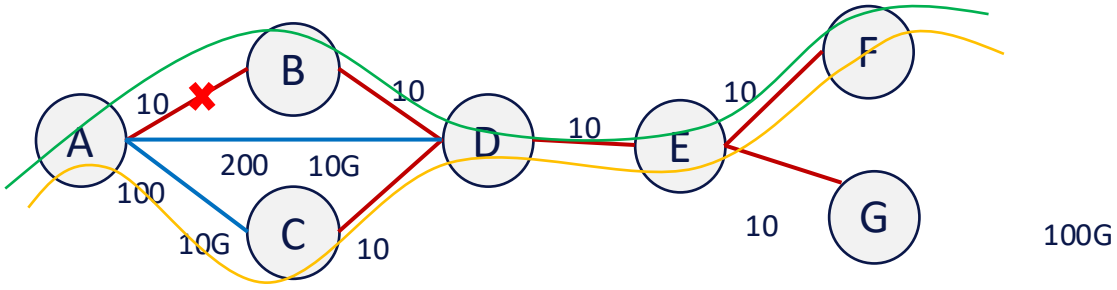
What-If Analysis & Failure-simulation

Demand Modeling

Capacity Forecasting & Augmentation Planning

Optimization Engine

Output & Insights
(Actionable intelligence)



Combining all, a logical topology of the network (Digital-Twin) can be created, induce traffic using demand matrix, simulate link/node failure and analyze resultant traffic-load post network convergence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