TOPOLOGY EXCHANGE AND PATH FINDING

SC14 17-20/11/2014

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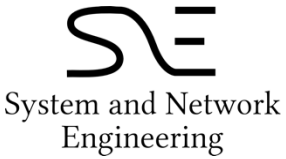


General Remarks

- We present the topology exchange solution that supports:
  - Different topology representations (NML example)
  - Different (optimal) path-finding algorithms are supported for given topology
  - (finding of) disjoint paths
  - Security (not discussed here)
  - Topology provisioning based on
    - requesting party
    - peering agreements
    - other policies

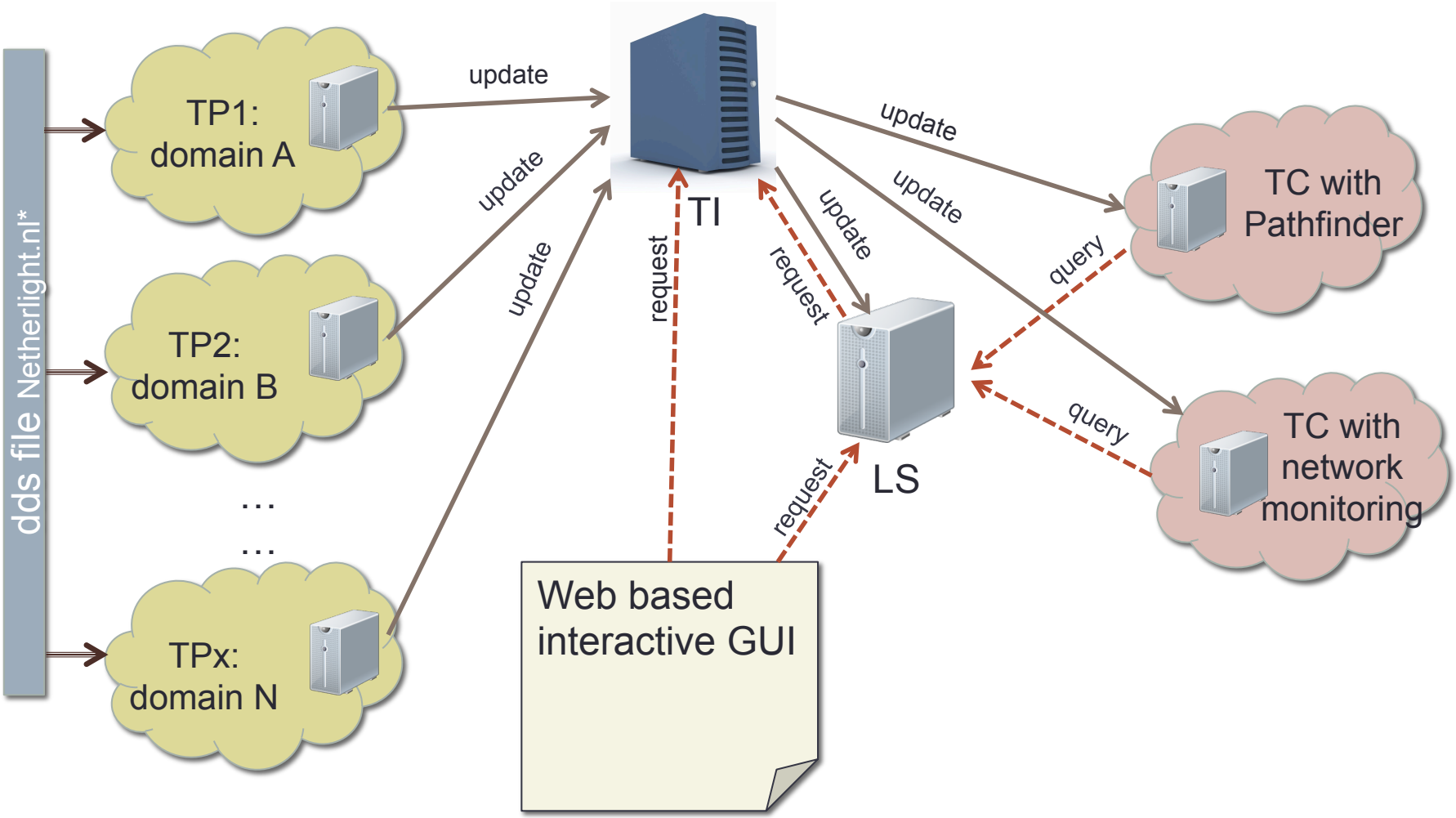
Components

- We distinguish three main components (can be implemented as services):
  - **Topology Index (TI)** stores the location of the served topologies
  - **Topology Provider (TP)** serves the topology files.
  - **Topology Consumer (TC)** processes the topology information
  - However, other entities can be used in parallel:
    - A Lookup service (for keeping an STP-Domain mapping)
    - A PathFinder service (for calculating inter-domain paths),
    - A Monitoring service (for monitoring changes of the topologies)
    - etc.

Considerations

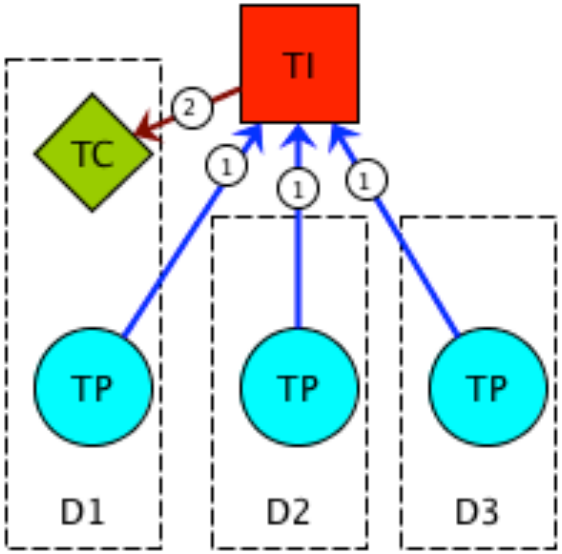
- The **Topology Index** is never the true source of information, those are the topology providers
- The **Topology Provider** deals directly with the consumer and decides what to show or what exceptions to make based on local policy
- The **Topology Consumer** decides what to do with the given information and what is relevant for it to work (signed topology updates and encrypted connections)

Architecture implementation (SC14)



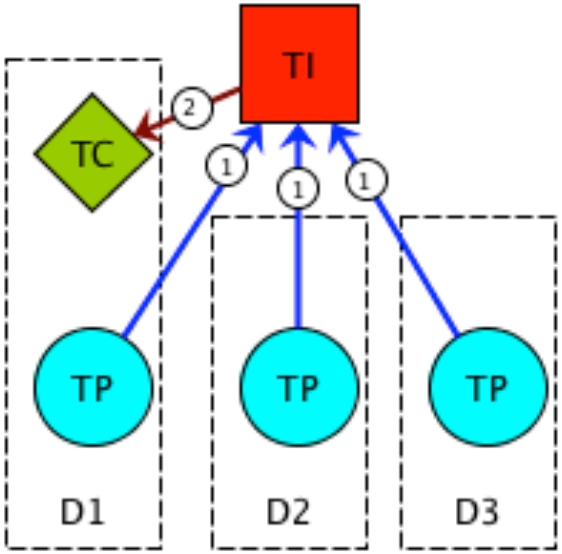
*https://agg.netherlight.net/dds/

Topology Distribution 1/2



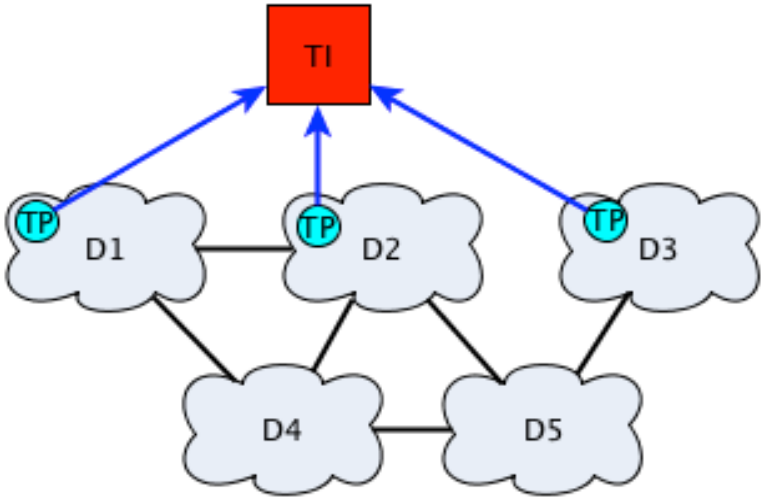
1. The Topology Providers send their updates to the Topology Index
2. The Topology Index notifies the subscribed topology consumers (clients)

Topology Distribution 2/2



1. The Topology Consumer (client) fetches the summary information from the Topology Index
2. The Topology Consumer (client) obtains the topologies from respective providers

Index format example



domain	version	location	neighbours	foreign
D1	01	http://d1.net/topo/	D2	D4
D2	01	http://d2.net/topo/	D1	D4, D5
D3	01	http://d2.net/topo/		D5

Neighbors vs Foreign domains

- Neighbors: a list of domains that are directly connected (have peering relationships) and report topology information to the TI.
- Foreign domains: a list of domains that have direct data plane connections to domains listed in the TI but do not report
- The TI is responsible to process the updates of the TP and re-arrange the neighbors/foreign domains list.

Synchronization & fail over

In case if TI fail over:

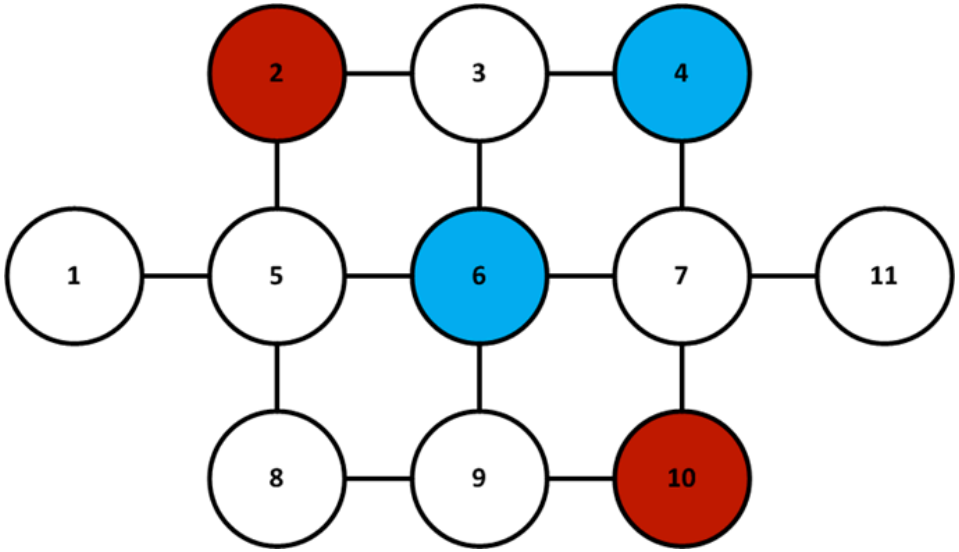
- Degradation of performance is expected but
- Topology information is available (TPs) and retrievable

- TI replication can solve the problem
  - Example: A TC which plays the role of a TI for another TC
  - When a conflict arises TI can request from TPs to resend their summary information
  - TCs need to be aware of this backup server

Path finding

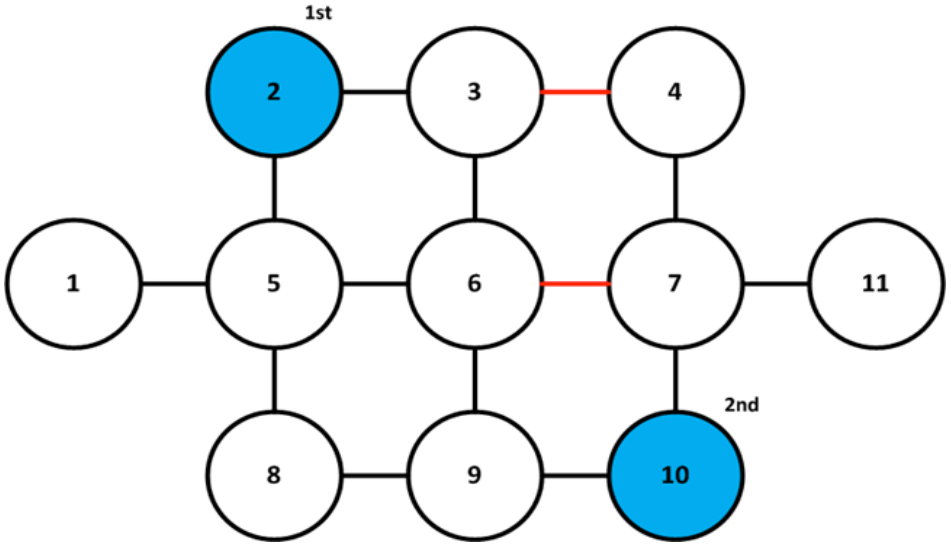
- The multi-domain routing algorithm
  - Needs to accept more path requirement details
  - Provides an inter-domain path that satisfies the given requirements
  - Inter-domain links may be described using many attributes
  - Multi-constrained (optimal) path problem
  - May or may not support loops

Path requirements



- For an **Inter-Domain (ID) path,** the following requirements may be specified:
  - Certain domains must (or must not) belong to the ID path
  - Certain domains or ID links must be **in** a predefined sequence
  - Certain ID links must (or must not) belong to the ID path

Example



- Find the shortest inter-domain path from domain 1 to domain 11, "not-via" inter-domain links (3,4) and (6,7), and "in-order" domains 2,10.
  - The answer is (1-5-2-3-6-9-10-7-11)

Architecture implementation pros and cons

- Advantages
  - Simple easy to re-use components (do one thing and do it well)
  - Uses real topology information from the Automated GOLE
  - NSA implementation independent

- Drawbacks
  - Security has not been implemented yet
  - A full API needs to be defined

Future work

- Index replication methods need to be researched more in depth
- Research on using foreign domains information
- Inclusion of dynamic link information
  (e.g. actual bandwidth used/available)

Thank you

- Questions?

Security concerns

- We use public key techniques to validate topology information
  - Topologies and topology updates are signed by the TP
  - Index Information is signed by the TI
- Public keys have to be known by all parties. This can be achieved by:
  - Distributing public keys via a PKI
  - Managing the Topology Index, adding domains and keys manually
  - Use DNS to distribute keys and DNSSec to sign