

How can Multi-Topology Routing be used for Intradomain Traffic Engineering?

Amund Kvalbein

Olav Lysne

Outline

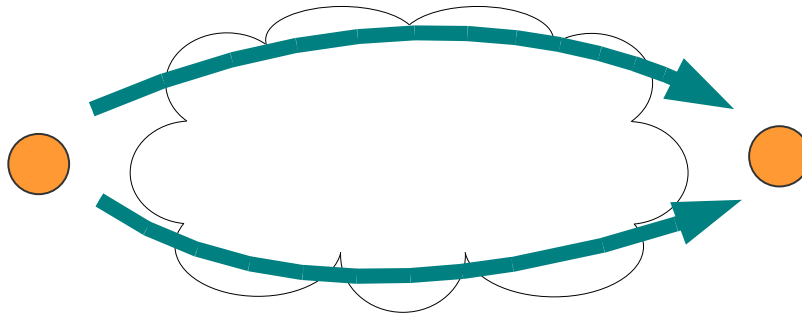
- Intradomain Traffic Engineering
- Multi Topology routing
- Approaches
 - offline
 - centralized online
 - distributed online
- Interdomain

Intradomain Traffic Engineering

- (MPLS)
- Link weight tuning
 - Network TM estimate as input
 - Achieve some TE objective
- Main problems
 - Hard to find good TM estimate
 - Hard to adapt to unexpected traffic

Intradomain Traffic Engineering

- Online TE
 - Requires multiple paths to the destination



MATE [INFOCOM2001], TeXCP [SIGCOMM2005],
REPLEX [CoNEXT 2006]

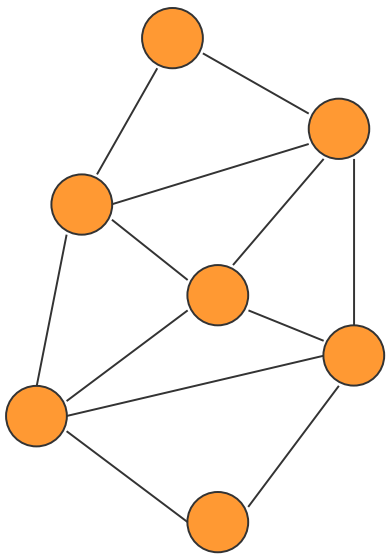
Multi-Topology routing

- Being developed for OSPF and IS-IS
- Allows multiple logical topologies in a network
 - Can route e.g. multicast or IPv6 traffic in special topologies
- Can calculate independent shortest path trees in each topology
 - Independent link weights in each topology

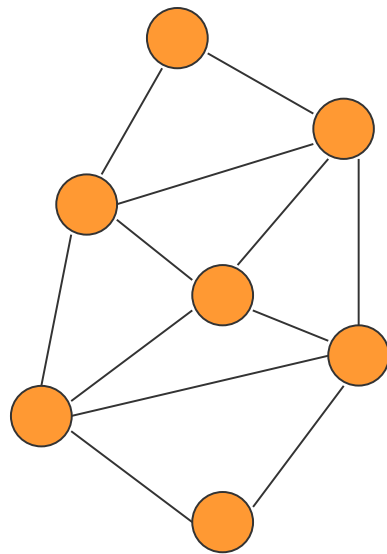
The main idea

- Build topologies so that any link is excluded from routing in one topology
 - All nodes reachable in each topology
 - A topology must be connected
- Spread traffic among the topologies to achieve your traffic engineering objective

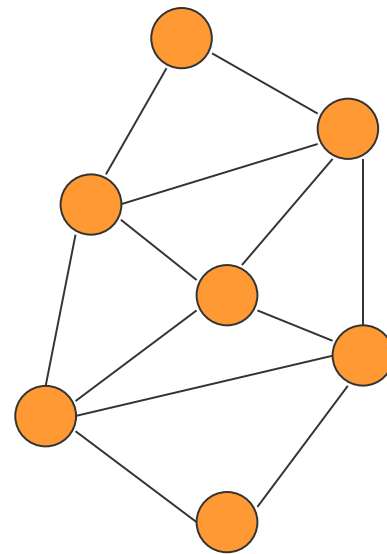
Building alternate topologies



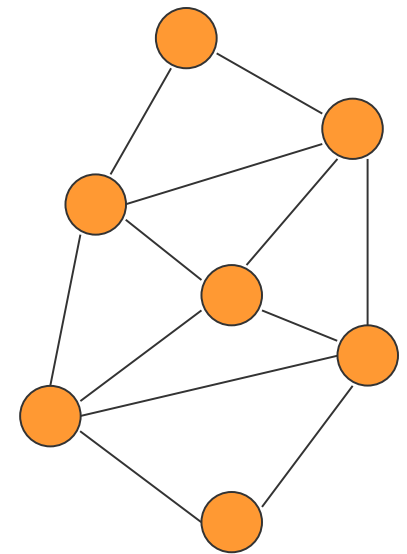
Original



T_1



T_2

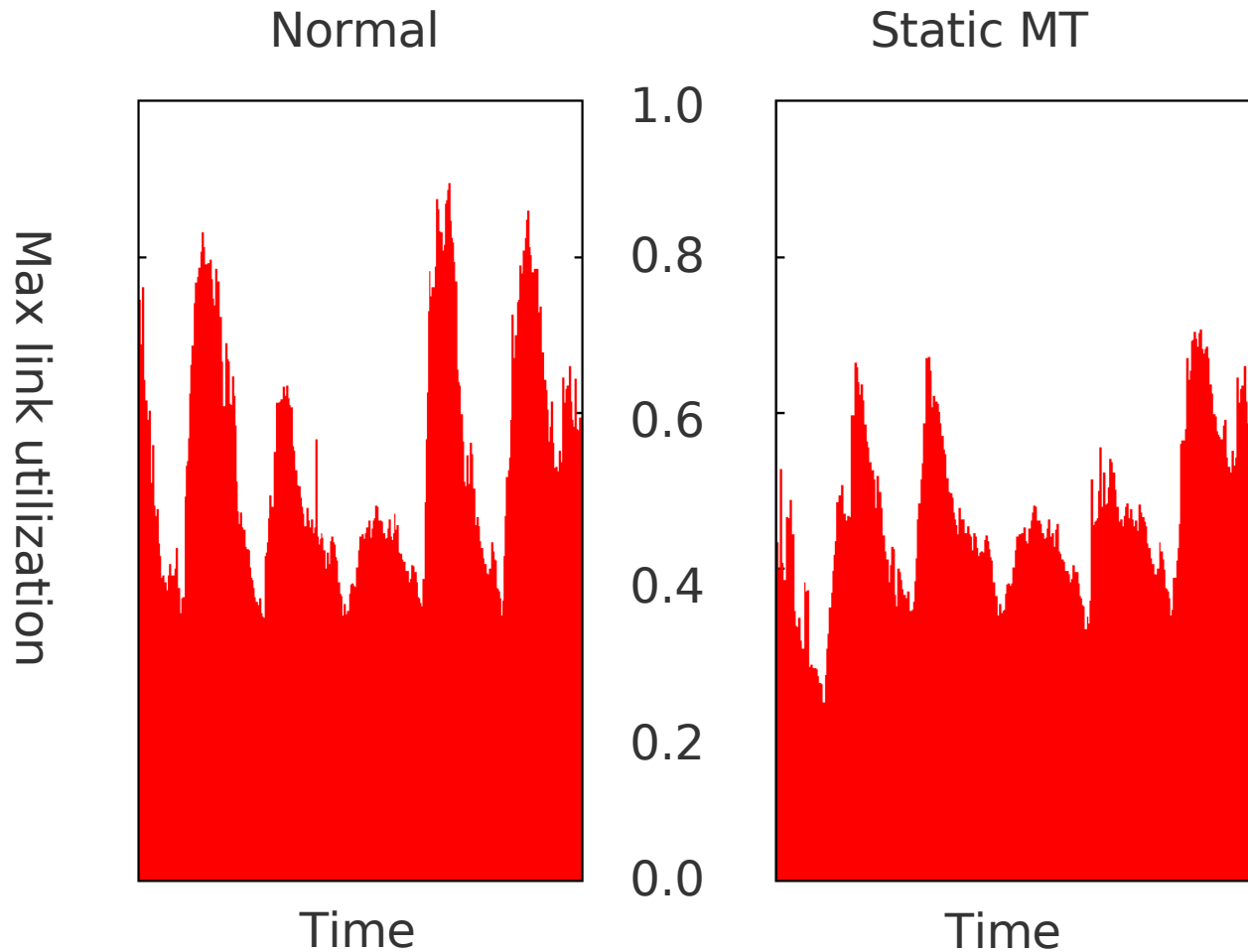


T_3

Offline TE

- Requires TM estimate as input
- Management system calculates flow-to-topology mapping
- Ingress router assigns flow to topology
 - Traffic follows topology to egress
- Advantage: cheaper to do changes

Example performance gain - GEANT



[**simula** . research laboratory]

Centralized online TE

- Does not require an input TM
- Management system monitors link loads
- Respond to increasing load by moving appropriate flow to alternate topology
 - Move back when load decreases
- Can be used on top of offline TE

Distributed online TE

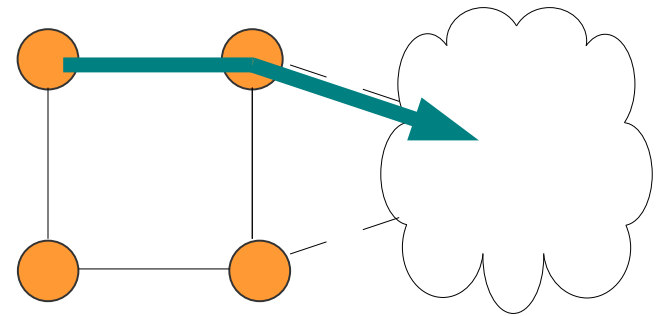
- Each (ingress) node
 - Monitors link utilization
 - Locally decides to move traffic to alternate topology when needed
 - Packets change topology in flight
- No use of global coordination
- Potentially very fast response to traffic dynamics
 - Challenge: avoid instability

Interdomain TE

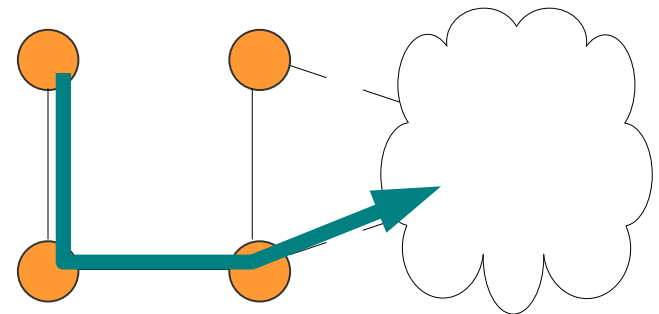
Can be used to give loadbalancing on outgoing links

- Only for links with same preference (hot potato)
- Does not violate policies

Original



T_i



Conclusion / Challenges

- MT routing can be used for TE
- Both offline and online strategies are possible
- Main advantage is responsiveness to load dynamics
- Main challenges
 - Balance responsiveness and stability
 - TCP-friendliness