Network-Aligned content delivery through collaborative optimization

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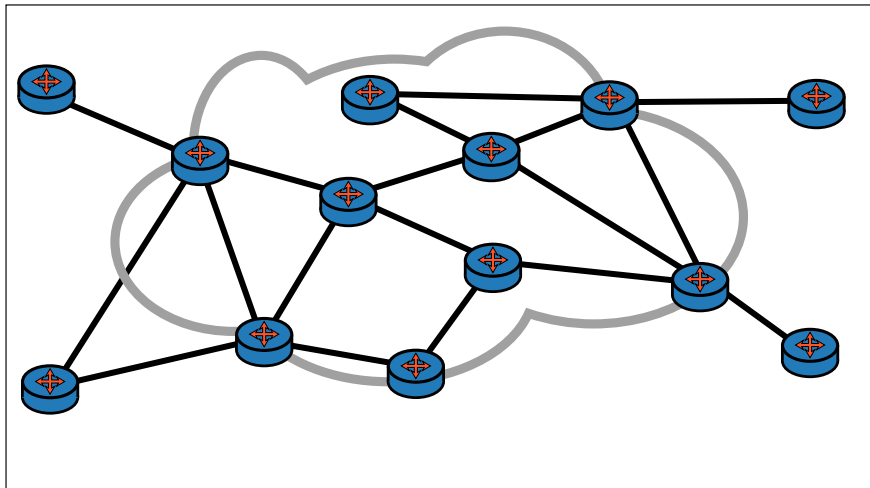
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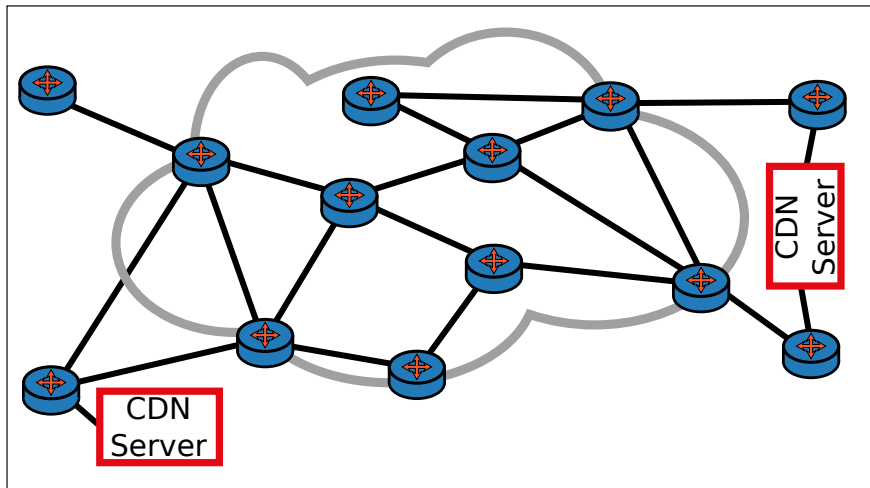
Introduction

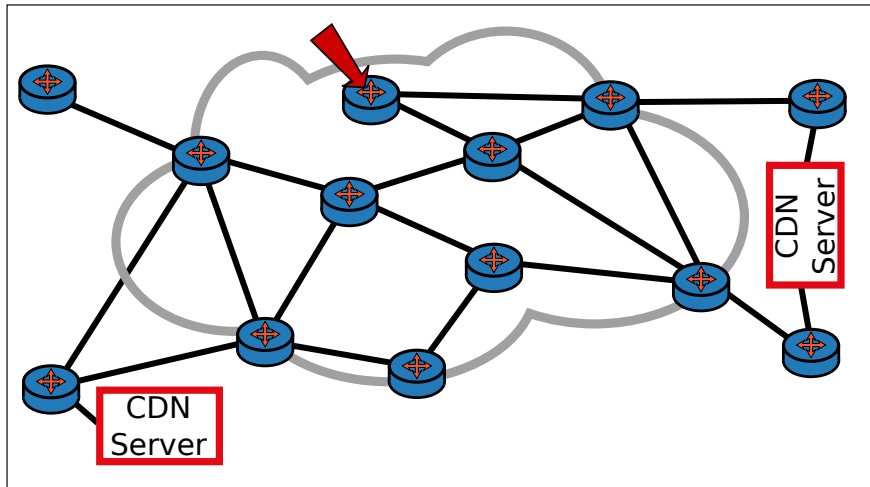**Lets assume there is a network...**

Introduction

Lets assume there is a network **that is connected to CDN server...**
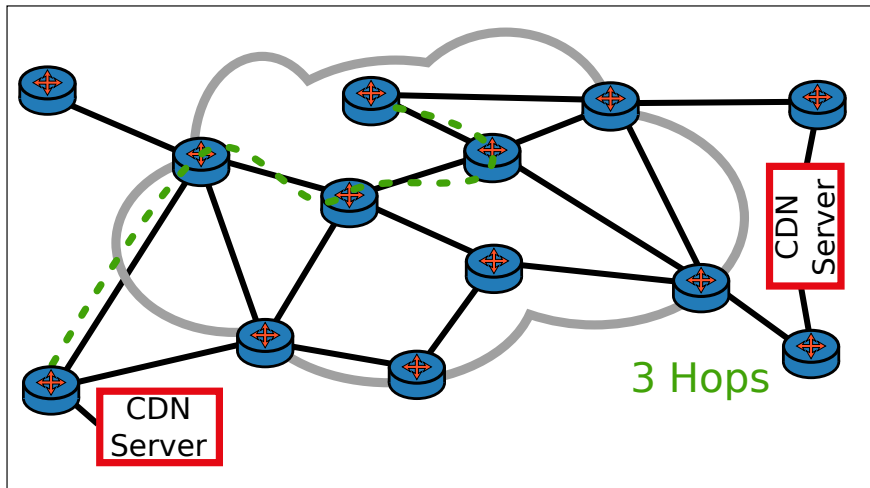
Introduction

Lets assume there is a network that is connected to CDN server **which delivers content to the network...**
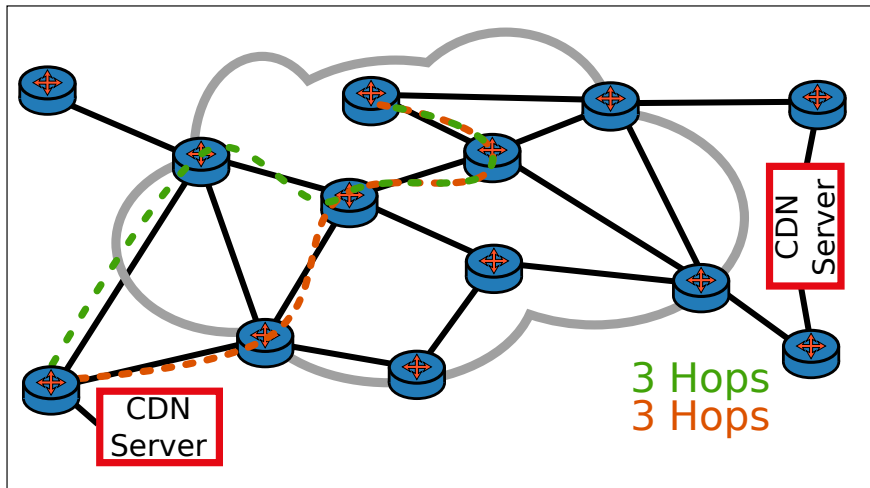
Introduction

Lets assume there is a network that is connected to CDN server which delivers content to the network **via path 1...**
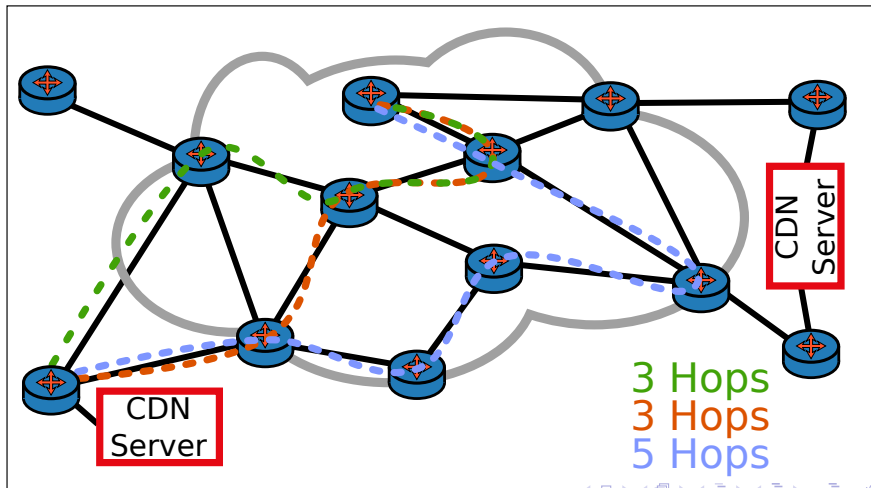
Introduction

Lets assume there is a network that is connected to CDN server which delivers content to the network via path 1 **or path 2 ?**
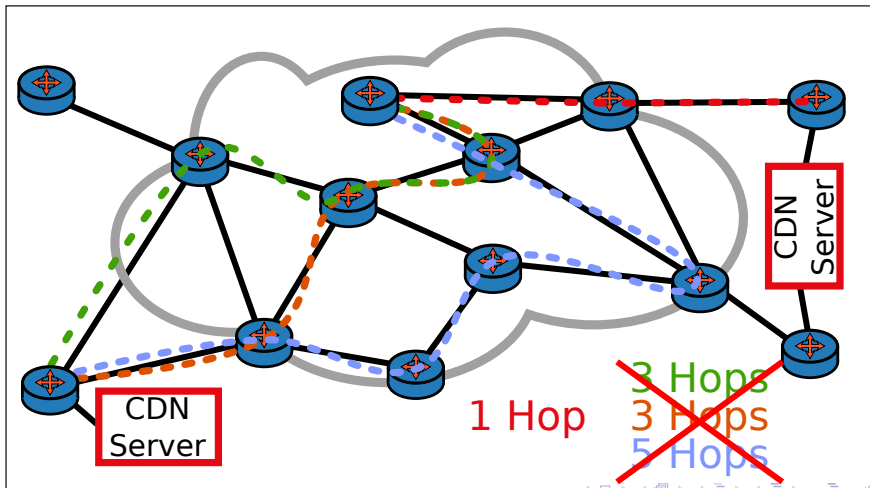
Introduction

Lets assume there is a network that is connected to CDN server which delivers content to the network via path 1 or path 2 **or maybe path 3 ?**
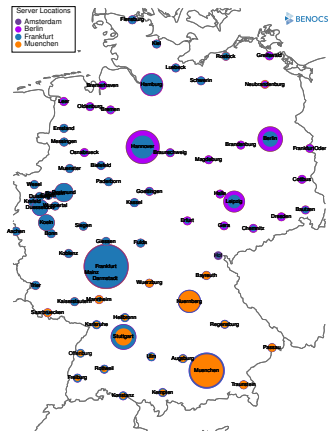
Introduction

Routing cannot change the ingress source.
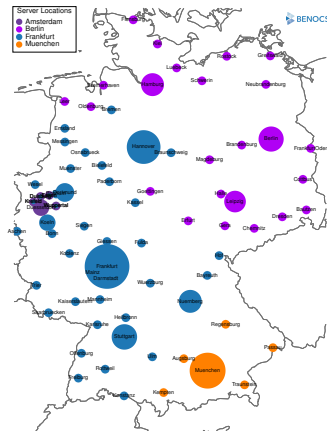**But what if we could talk to the CDN ?**

Example: Mapping Reality

Example: Mapping Reality vs. optimal
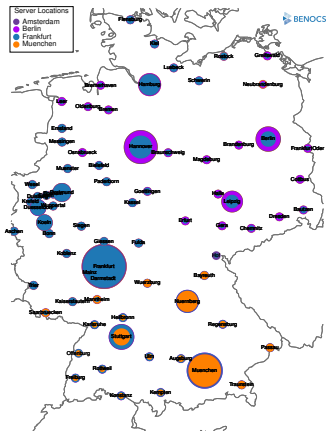
Example: Mapping Reality vs. optimal
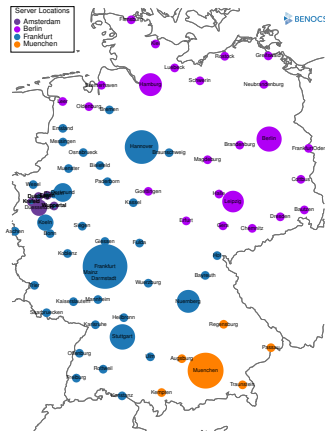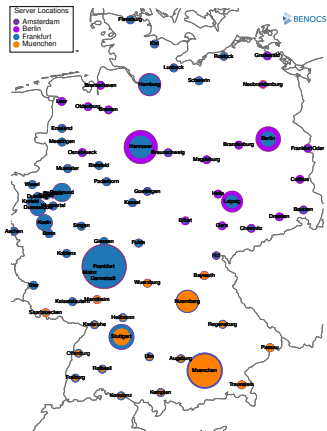
Proposed Solution:

We achieve this mapping change by communicating summarized network preferences based on ISP-Grade network knowledge to the CDN

Gathering Data

Network-Aligned content delivery through collaborative optimization
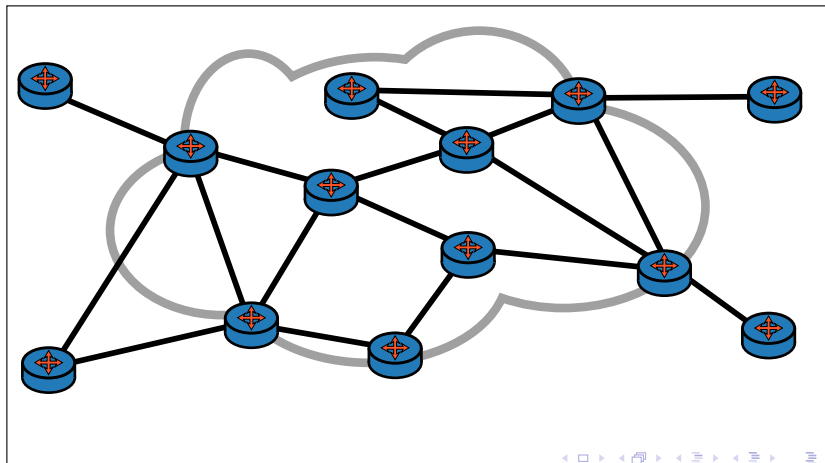
Gathering Data

ISIS, OSPFv2/v3, MPLS LDP
Currently tracking $\sim$3,000 nodes in 13 areas

IGP
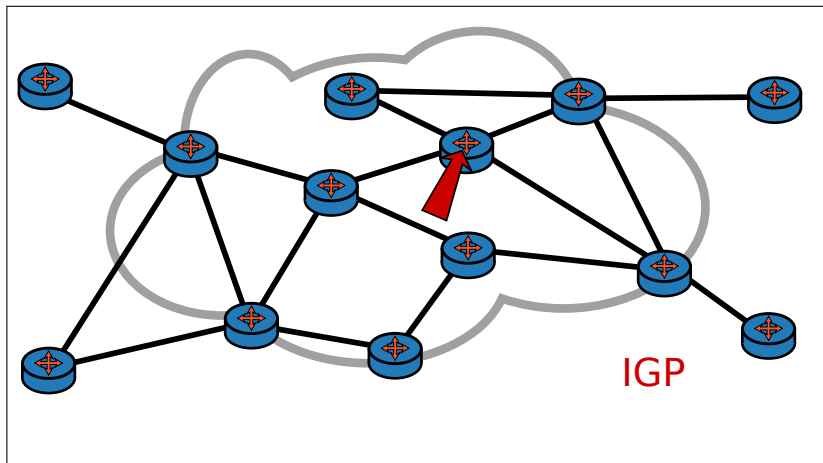
Gathering Data

BGP RR-client of all Border routers
Currently maintaining $\sim$300 BGP connection with $\sim$260 Million routes
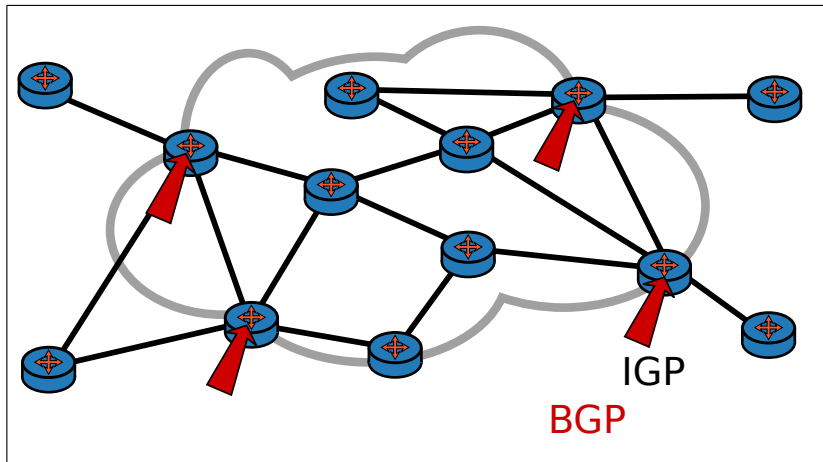
Gathering Data

Netflow from all Border routers
tracking 2500 exporters @ $\sim \frac{800 Mbit}{sec}$ **@peak (50 Billion records/day)**

IGP

BGP Netflow
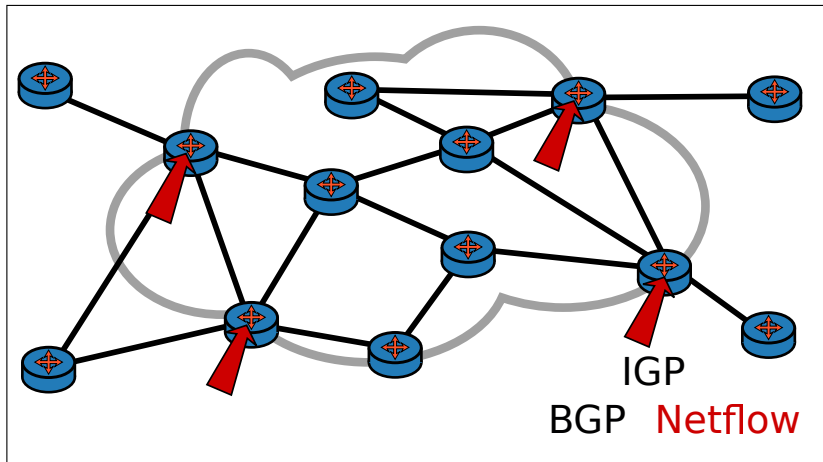
Gathering Data

**SNMP counters from all interfaces in the network
tracking ∼17,000 interface @ 5 Minutes**

SNMP IGP

BGP Netflow
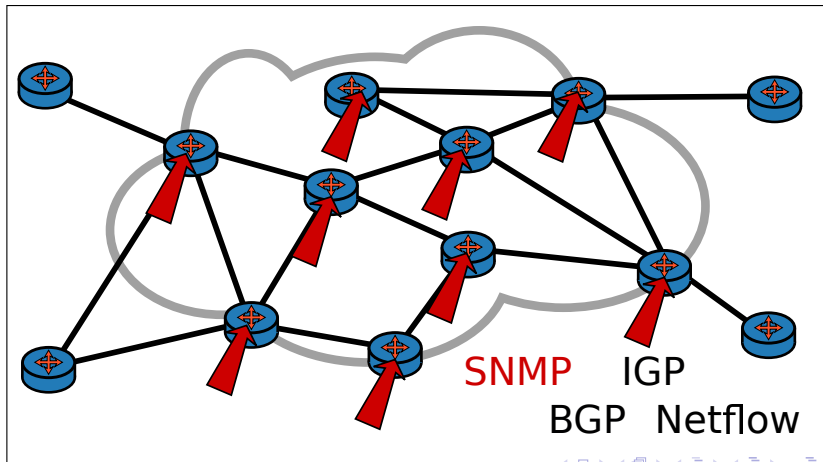
Gathering Data

IP Ingress Points
Cost Models

Link Classification
BMP

Router Config
...

Processing Pipeline

IGP

BGP

Netflow

SNMP

Other

max 60s
reaction time

Analytics

Mapping

BGP ✓ automatic Updates
Does not support hierarchy

ALTO ✓ Pull + Push via HTTP(s)

JSON ✓ Updates via file in JSON
EMAIL Push / SCP Push/Pull

XML ✓ Updates via file in XML
EMAIL Push / SCP Push/Pull
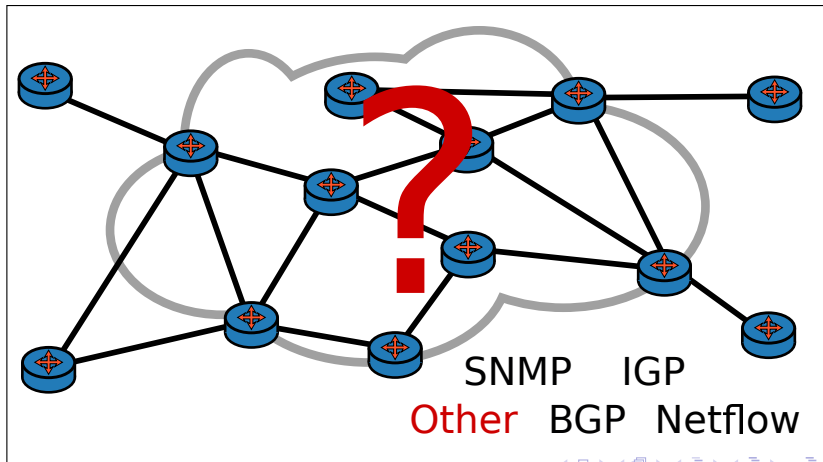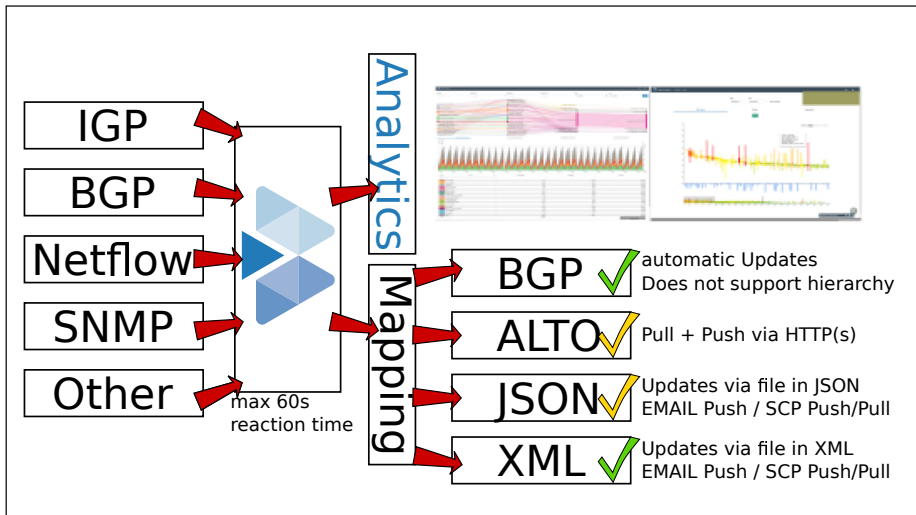
Mapping Information

Running online

1. Network Topology T as Abstract Graph
2. Annotate T with all available information from all Sources
3. Assign all Subnets S in T
4. function $f(S, T) \rightarrow R$ maps subnets to regions in T
   - $f(S, T)$ can be customized to use any data available in T from any source
   - $f(S, T)$ is independent of the CDN to be optimized, i.e. global
5. for each CDN (C) to be optimized
   1. find (in)direct Ingress Nodes I for C in T
   2. use $c(T, C, I, S) \rightarrow w_{TCIS}$ to calculate weight for delivery to S from C
      - $c(T, C, I, S)$ can be customized on C, I, S and all information in T
      - $c(...)$ can be adapted/changed during run time
      - $c(...)$ should be stable to avoid oscilation
   3. Build preference table based on w_{TCIS} as a directed 2 dimensional Mapping
      - if desired, this can also build hierarchical structures
   4. generate diff-set if previous results are available
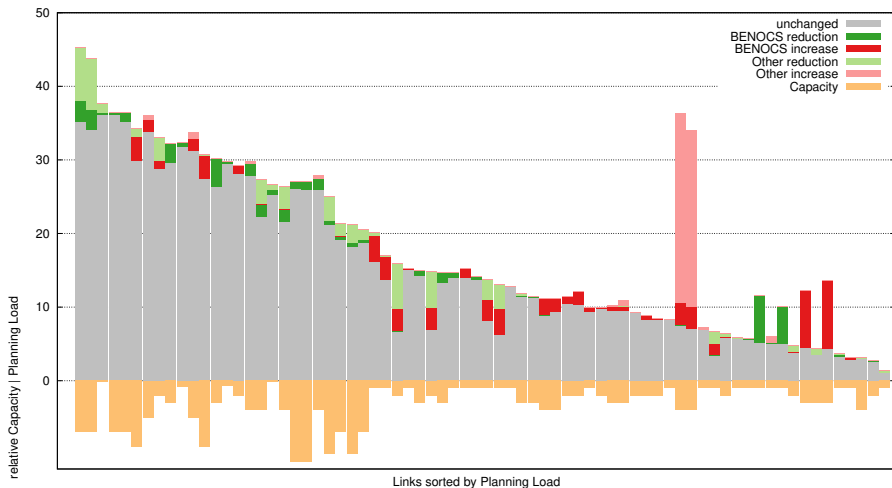   5. push set/full information via interface to C

Networks #1 - Network Allignment (TE)
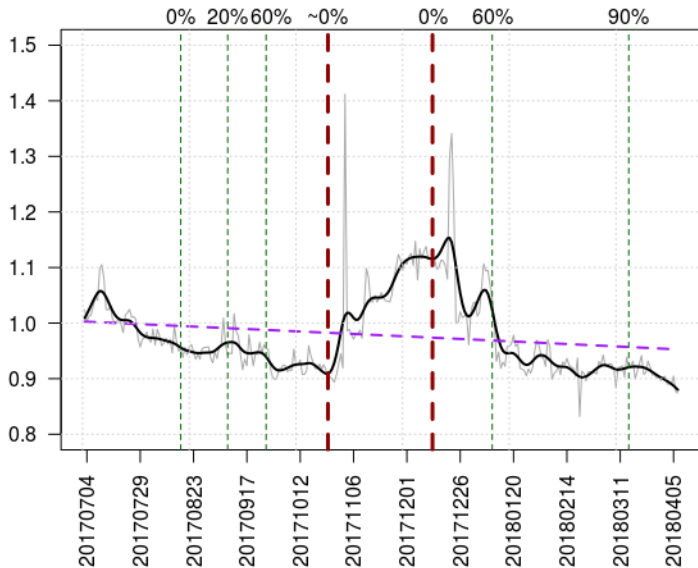
Networks #2 - Upgrade Planning

Summary

Collaboration

- Align traffic of CDN to topology
- easy, on demand interface
- up to date network information
- CDN keeps control

Benefits

- improved network alignment
- reliable, distributed delivery planning
- reduced network load
- improved network planning reliability
- reduced RTT in content delivery

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Closing remarks

This is already running live !

AS3320 (Deutsche Telekom) is offering to engage in the collaborative program **at no cost other than to staff the project** because the network benefits are interesting already.

Contacts

- For how the solution works technically: Ingmar Poese (**ipoese@benocs.com**)
- For joining DT's "Net Reflekt" program, CDNs please contact: Oliver Holschke (**oliver.holschke@telekom.de**)