ALTO map calculation from network data

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Who is Benocs

- Spin-off from TU-Berlin and Telekom Innovation Laboratories
- Found 2013
- Located in Berlin/Germany
- Providing relevant network data across network boundaries
  - Optimizing CDN content delivery
- Perform network analysis

Motivation

- Networks subject to changes over time
  - Links appear and disappear
  - Routers added/removed
  - Metrics and Paths change
- Dynamic network conditions
  - Utilization and Delay
- Clients want up-to-date information
  → Continuous ALTO maps update required

Network Data Accumulation

- Routing Protocols
    - IGP (IS-IS, OSPF, IBGP)
    - EGP (BGP)
    → Links, Routers, Networks
- Flow Information
    - Netflow
    → Ingress/Egress Points
- Network Monitoring
    - SNMP
    → Utilization, Bandwidth, Latency

Compile Internal Network Map
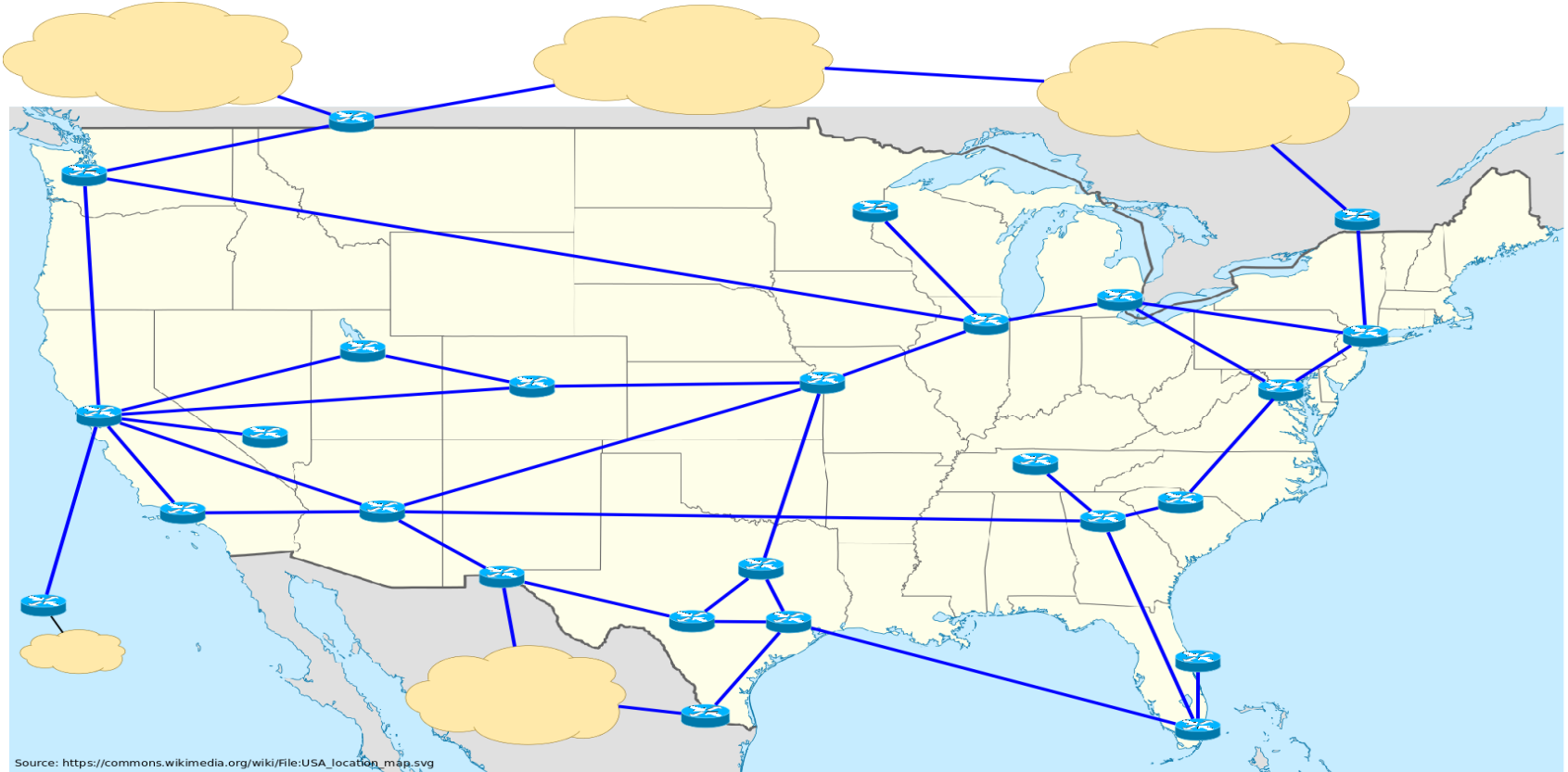
How to get to ALTO Maps

ALTO network maps:

- Set of functions to generate ALTO network map
    - Perform grouping of network elements to PIDs
    - → Manifold ways to group: E.g. by Routers, Location
- IP filters to exclude prefixes from ALTO network map

ALTO cost maps:

- Set of cost functions to calculate costs between PIDs
    - Includes tie breakers for multiple paths between PIDs
    - → E.g. Min/Max value

Network Map by Location
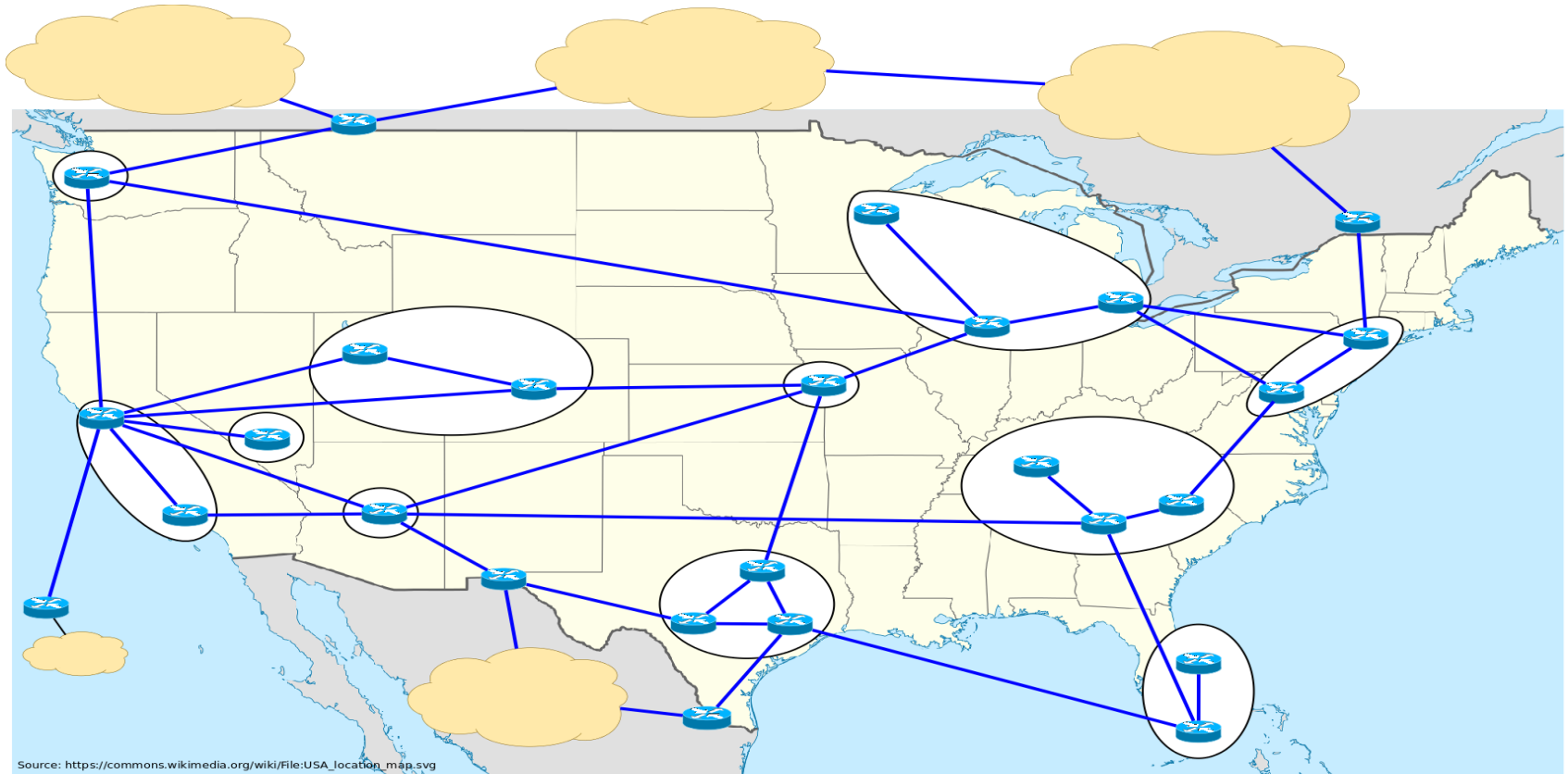
Real-Life Test of ALTO Maps Calculation

- Attached to large European ISP network

- 800 Router

- ~3200 links

- ~700.000 prefixes

  - ~170.000 internal prefixes

  - ~530.000 external prefixes

- We excluded infrastructure prefixes

  - ~67.000 internal prefixes remaining

  - ~530.000 external prefixes remaining

Example ALTO Maps

- Utilization based cost function
- PIDs per router:
  - Results:
    - 585 PIDs
    - Size of network map JSON object: ~10.7 MB (~1.9 KB compressed)
    - Size of cost map JSON object: ~7.1 MB (~770 KB compressed)

- PIDs per location:
  - 1 PID for each City
  - Results:
    - 99 PIDs
    - Size of the corresponding network map JSON object: ~10.7 MB (~1.9 MB compressed)
    - → Prefix text forms major part of JSON object
    - Size of cost map JSON object: ~84 KB (~12 KB compressed)
    - → Number of PIDs has major impact on cost map JSON object size

ALTO Map Dynamics

- Changes depend on chosen functions

- Examples:
    - ALTO network map based on IGP only (grouped by router and location)
        - Fairly stable, changes during night, stable during busy hours

    - ALTO cost map based on IGP properties (e.g. path weight)
        - Fairly stable, changes during night, stable during busy hours

    - ALTO cost map based on dynamic network properties (e.g. Utilization)
        - Average utilization of links over 15 minutes
        - Highly dynamic
        - Update every interval

Conclusion

- Optimize CDN Content Delivery
- Gather live network state and routing information to compile map
- Derive ALTO network and cost maps from compiled map
  - Grouping functions to generate PIDs for ALTO Network Map
  - Cost functions to compute costs between PIDs