Implications of the topological traffic properties of Internet traffic on traffic engineering

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Agenda

- The Interdomain Internet
- Topological traffic distribution
- Topological traffic dynamics
- Implications on traffic engineering
- Conclusions
The Interdomain Internet Today

- About 16,500 Autonomous Systems
- Hierarchical structure:
  - Dense core: 20 large transit ISPs (worldwide)
  - Outer core: smaller transit ISPs (regional)
  - Edge: stubs
- 86% stubs ASes / 14% transit ASes
Topological traffic distribution

Traffic captured by largest destination ASes:

Cumulative distribution of total traffic for ASes

- BELNET
- Yucam
- PSC
Topological traffic distribution

Traffic aggregation seen by a typical stub as:

Cumulative traffic percentage for edges (PSC)

- AS hop distance = 1
- AS hop distance = 2
- AS hop distance = 3

Percentage of total traffic vs. Number of edges
Topological traffic distribution

The interdomain Internet is shallow:
Topological traffic distribution

- A limited percentage of the interdomain topology sends/receives most of the traffic.
- Most of the traffic exchanged with ASes located within a few AS hops.
- Lack of traffic aggregation beyond peers.
- Topological traffic distribution is a consequence of hierarchical structure of the interdomain topology.
Motivation:

- Topological traffic distribution suggests that:
  - caring about a very limited fraction of the interdomain topology is enough for traffic control purposes
  - “small” timescales see the same topological distribution as large timescales

- Is that true?
Topological traffic dynamics

Stability of interdomain paths:

AS path stability for traffic over 1 month

% of AS path having traffic

Traffic percentage

AS path lifetime [days]

Traffic
AS paths
Topological traffic dynamics

Number of largest hourly traffic destinations:

Number of hourly AS paths for traffic percentage

- 100%
- 99%
- 90%
- 50%

Time [days]
Topological traffic dynamics

How stable are the largest traffic destinations?

Presence of AS paths capturing 90 percent of the traffic

Percentage of AS paths

AS paths percentage

Percentage of the total traffic

Traffic percentage
Implications on traffic engineering

“A few interdomain sources generate most of the traffic” is misleading:

- still a large number of interdomain sources (100's) on a hourly timescale
- non-negligible fraction of interdomain traffic for “unstable” sources
- predicting the important traffic sources for next hour is an issue
Conclusions

• Interdomain paths seen by most of the traffic are stable.

• Part of the interdomain traffic sources/destinations are “stable”, part are “unstable”, and remaining in-between.

• Traffic control may need to influence a larger fraction of interdomain topology than previously thought due to this variability.