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Anatomy of a Large European IXP

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Abstract

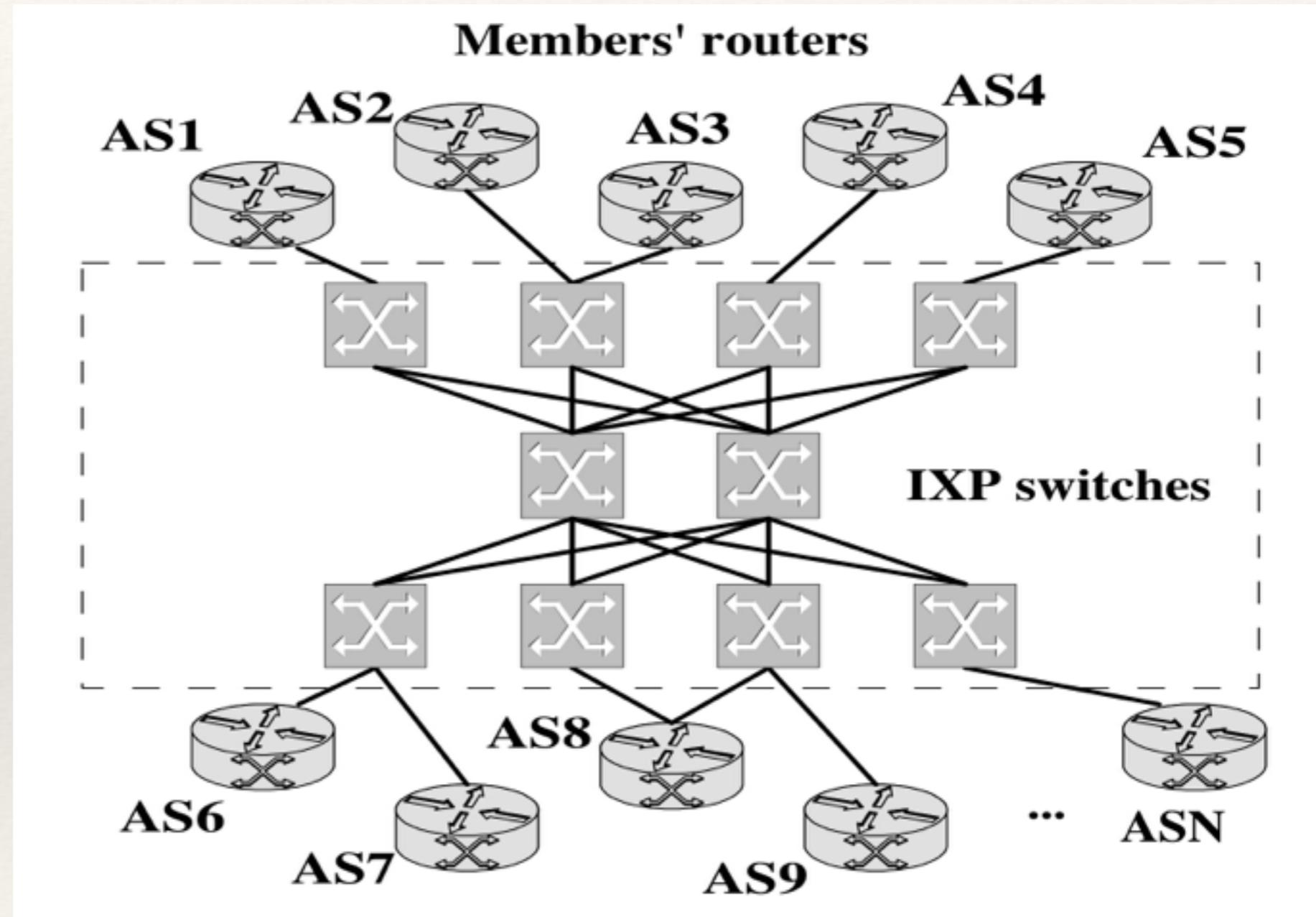
- ❖ Target: peering links at single IXP >> peer-peer type in entire Internet.
- ❖ Examine: IXP's eco-system and diversity of networks.

IXP

- ❖ A physical network infrastructure operated by single entity with the purpose to facilitate the exchange of the Internet traffic between Autonomous Systems

IXP Overview

- ❖ Private; Public
- ❖ large == good
- ❖ layer 2 switching



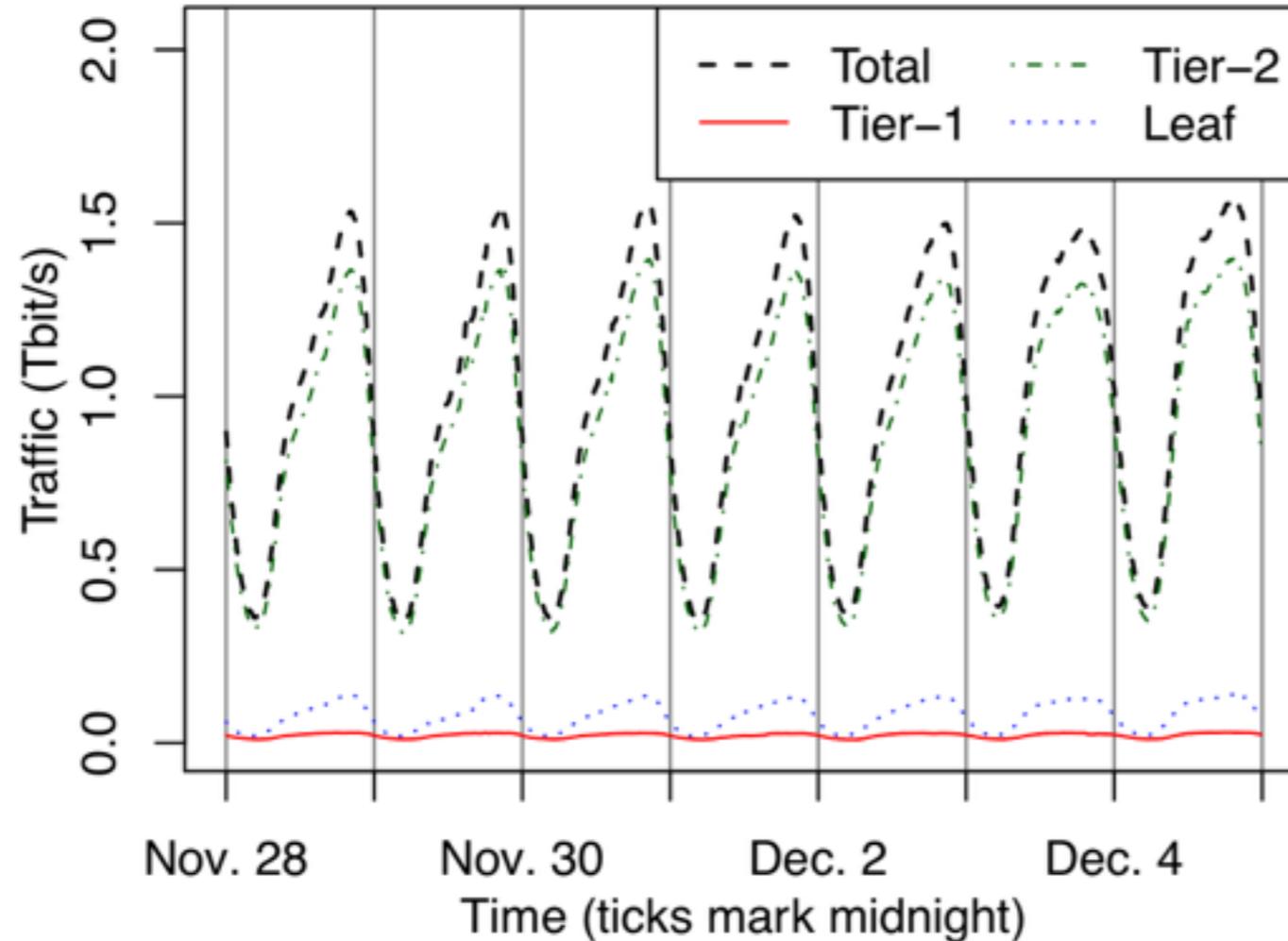
IP packet forwarded in ASes

- ❖ Traffic Increased!
- ❖ ASes is in tier-2.

Table 1: Overview of IXPs sFlow dataset.

	Apr 25	Aug 22	Oct 10	Nov 28
	May 1	Aug 28	Oct 16	Dec 4
Identified member ASes	358	375	383	396
Router IPs	426	445	455	474
MAC addresses	428	448	458	474
Tier-1	13	13	13	13
Tier-2	281	292	297	306
Leaf	64	70	73	77
Countries of member ASes	43	44	45	47
Continents of member ASes	3	3	3	3
Average packet rate (Mpps)	142	150	166	174
Average bandwidth (Gbps)	838	863	954	992
Daily avg volume (PB)	9.0	9.3	10.3	10.7

Traffic Statistics



- ❖ Tier-2 were responsible for most traffic.
- ❖ HTTP accounted around 50%, then video, file sharing.

IXP centric view of

connection

RV: route view
 RIPE: regional internet registries
 NP: non-public
 LG: looking glass

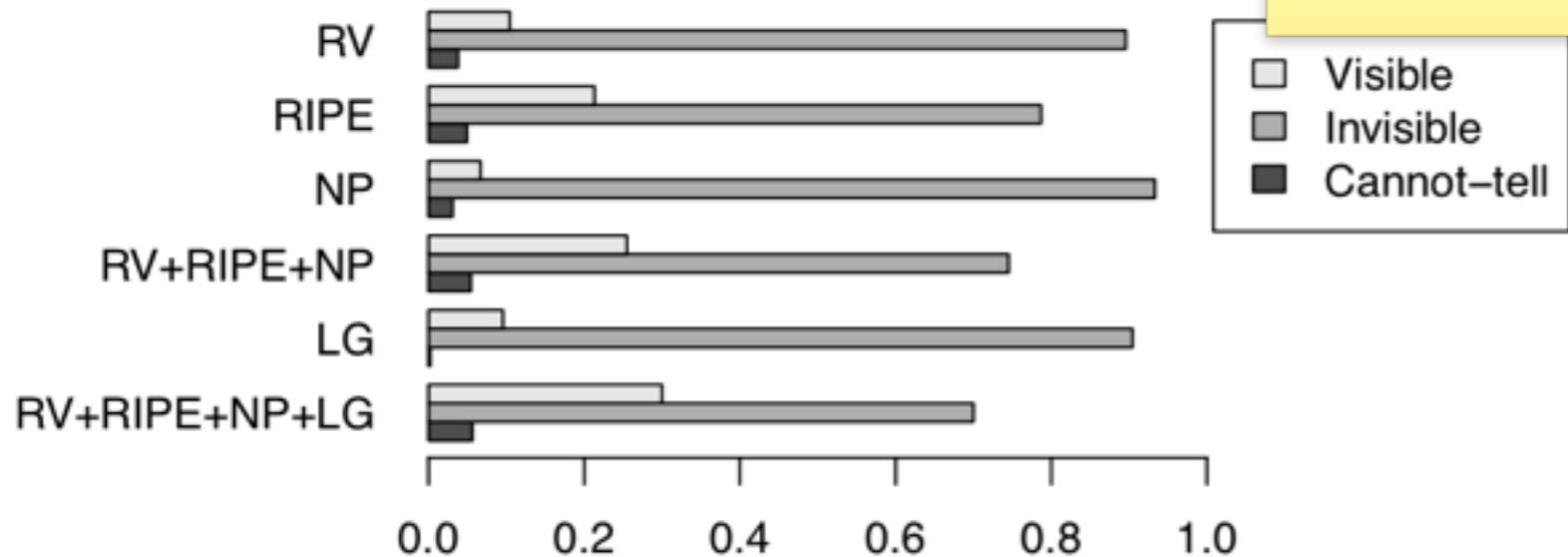


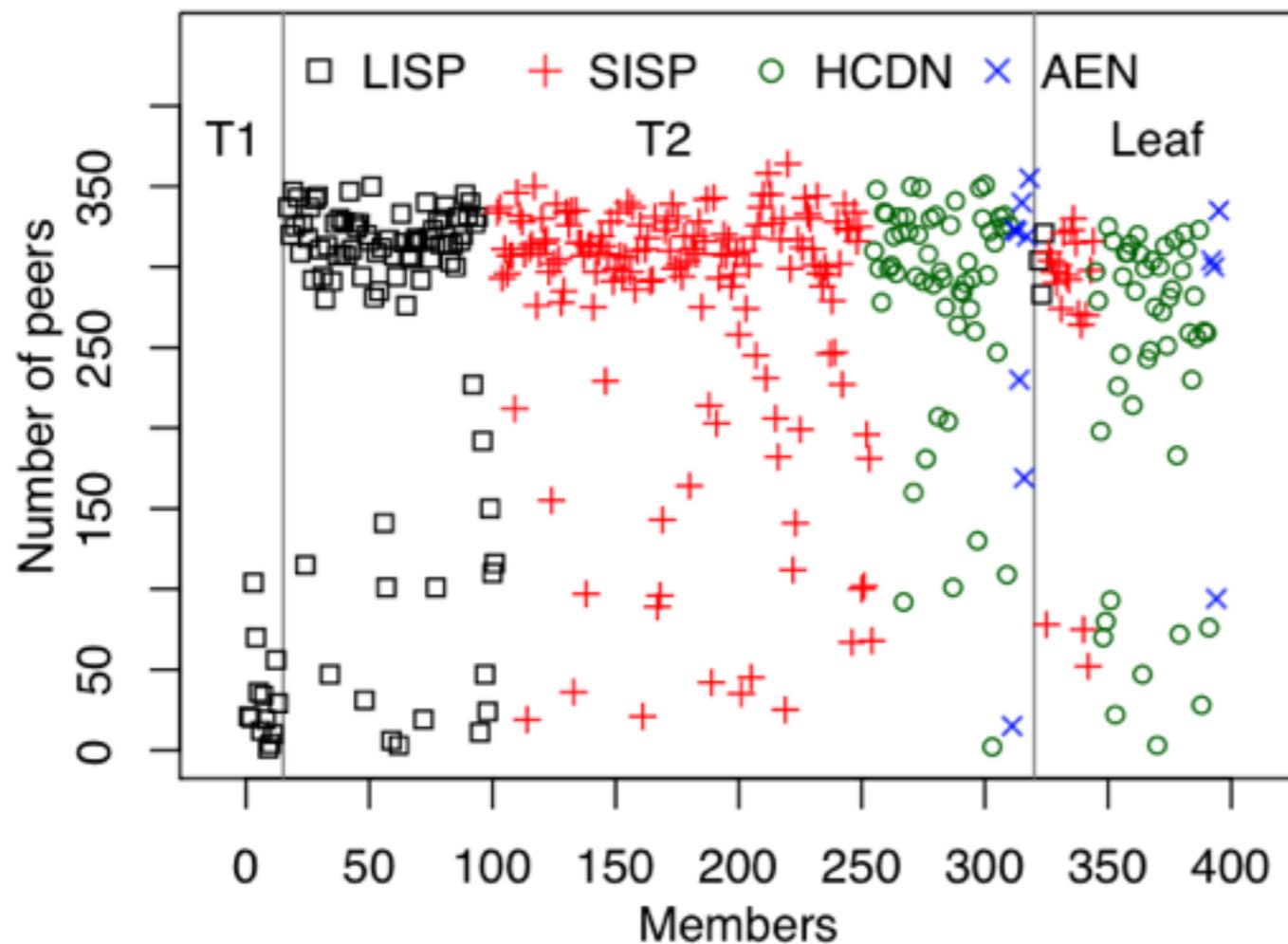
Figure 2: Peering links and visibility in control/data plane (normalized by number of detected P-P links).

- ❖ Visible P-P links seen from IXP-external data
- ❖ unique visible P-P link
- ❖ 70% P-P link is invisible

Table 2: Overview of routing and looking glass datasets for November. The numbers show P-P links.

Dataset	Unique LGs / ASN	Visible links	only in this dataset
RV	78	5,336	1,084
RIPE	319	10,913	5,460
NP	723	3,419	684
RV+RIPE+NP	997	13,051	10,472
LG	821 / 148	4,892	2,313
RV+RIPE+NP+LG	1,070	15,364	15,364

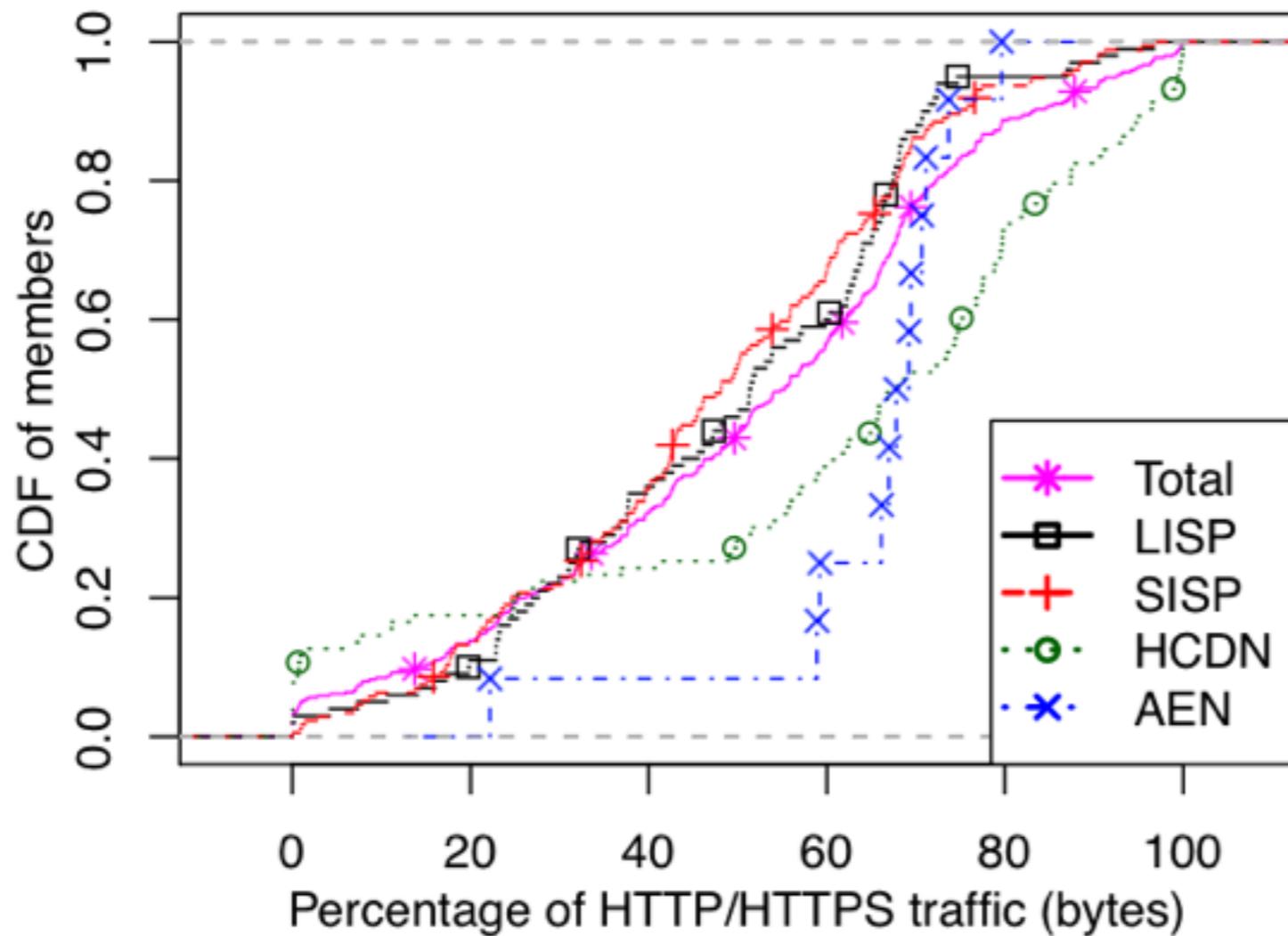
Member diversity – number of peers



(b) Scatter-plot of num. of peers per member.

- ❖ Most members have a large number of peers

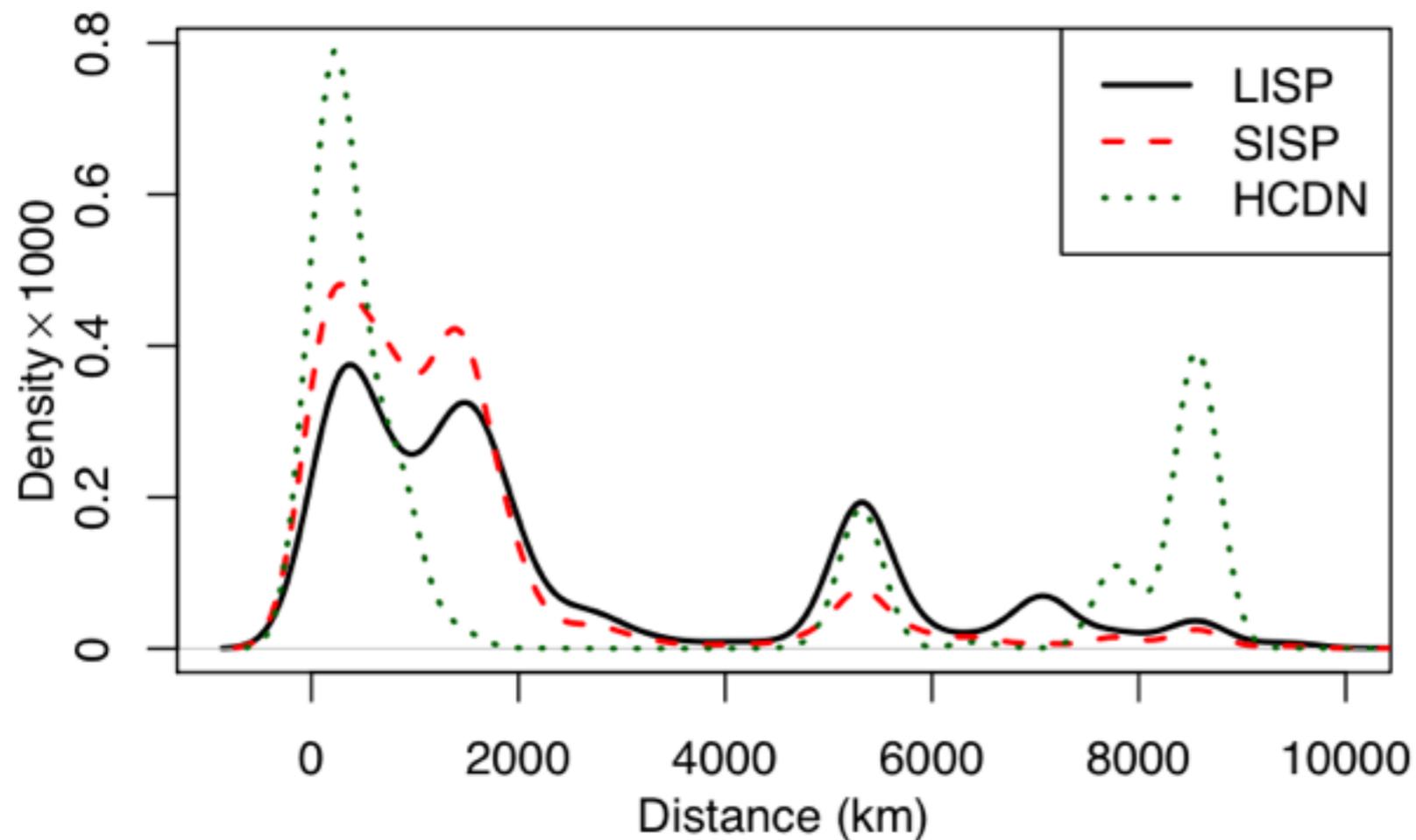
Fraction of web traffic



(c) Fractions of web-traffic across members.

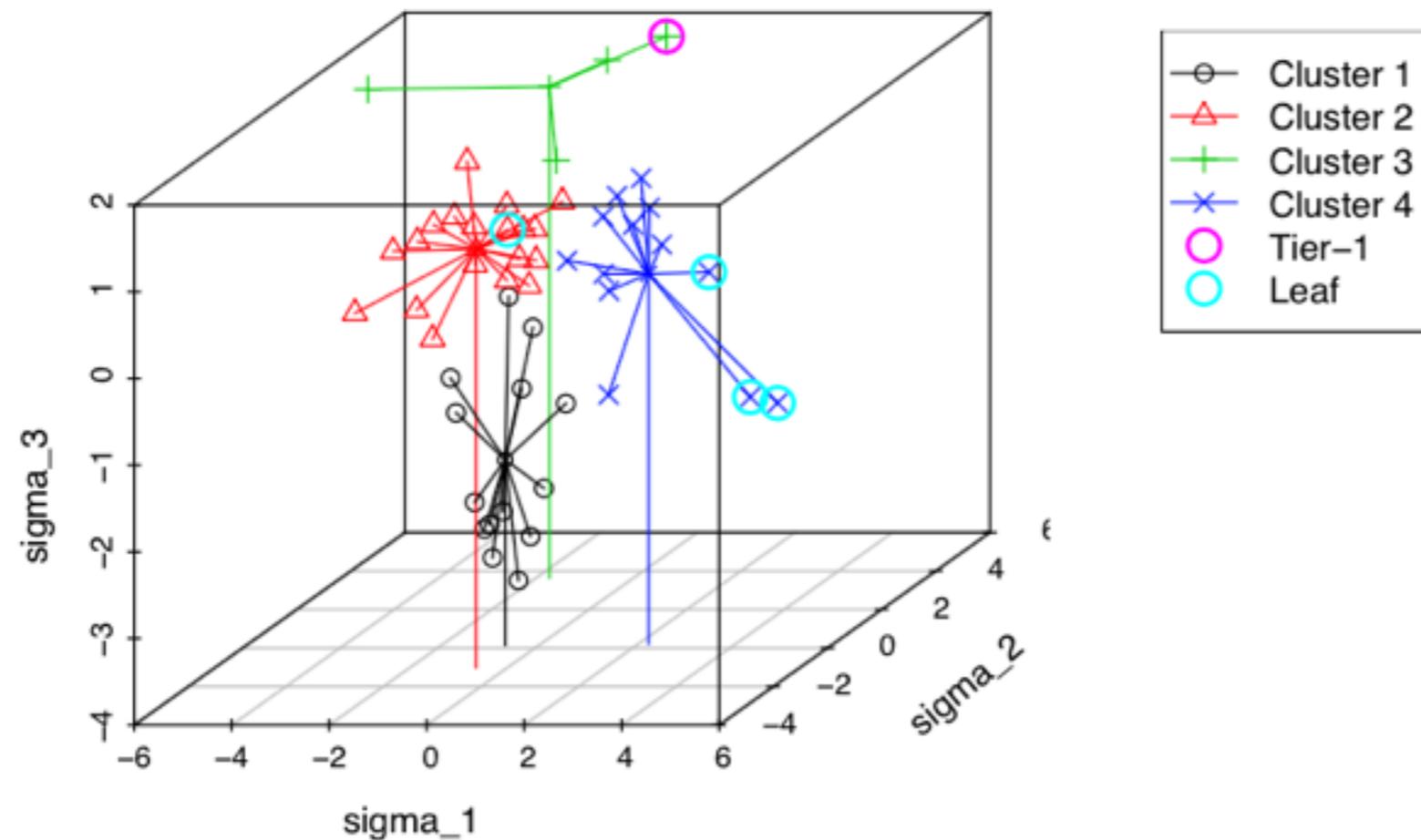
- ❖ Individual ASes differs significant.
- ❖ Almost a uniform distribution
- ❖ similar overall application mix

Geographic distances of IP end point to IXP



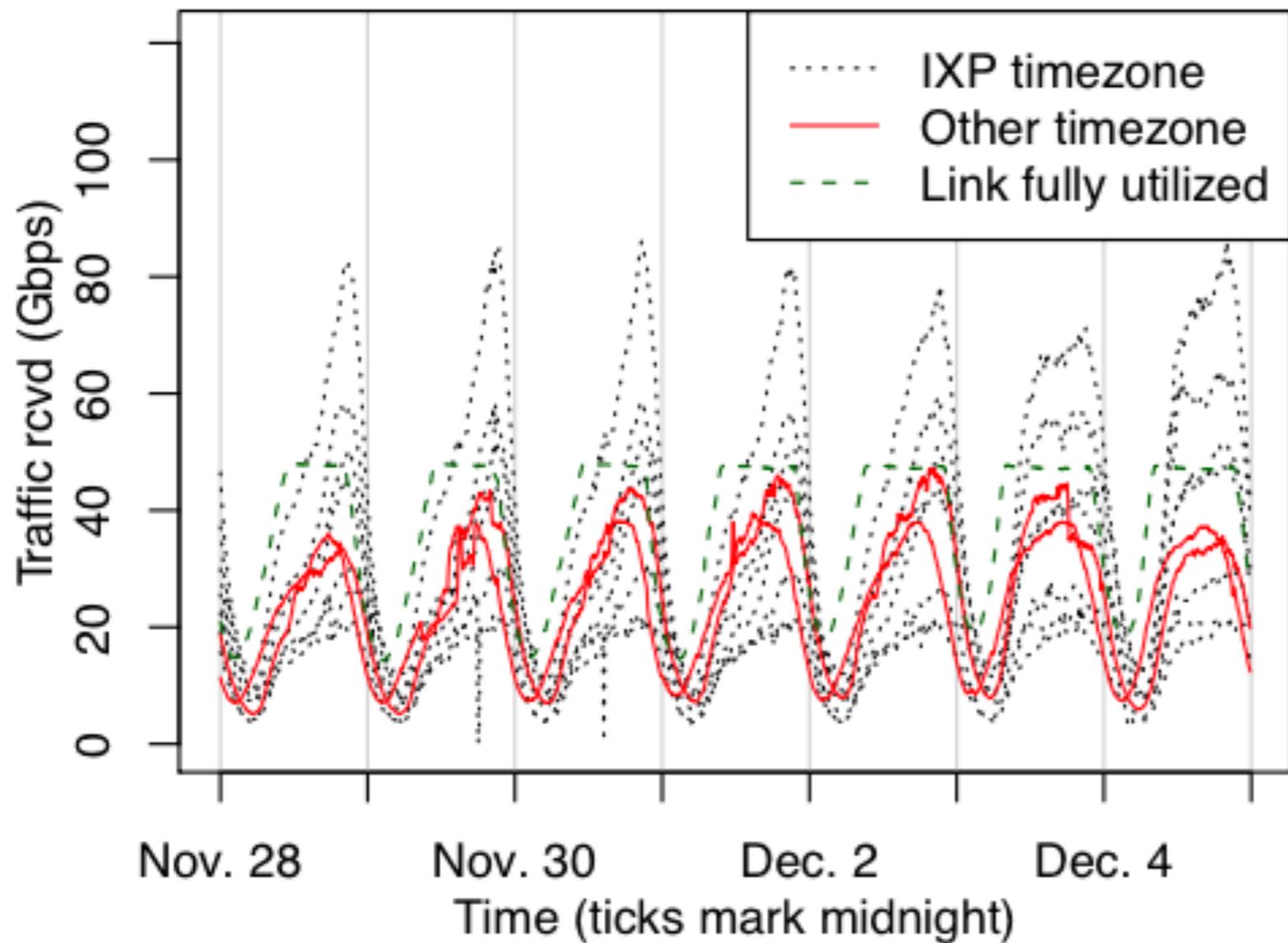
- ❖ IP source address to IXP
- ❖ HCDN has largest fraction. (Miss match/serve for remote address).

3D projection based on top member ASes by byte sent



- ❖ conventional tier classification is little help for understanding the Internet ecosystem locally

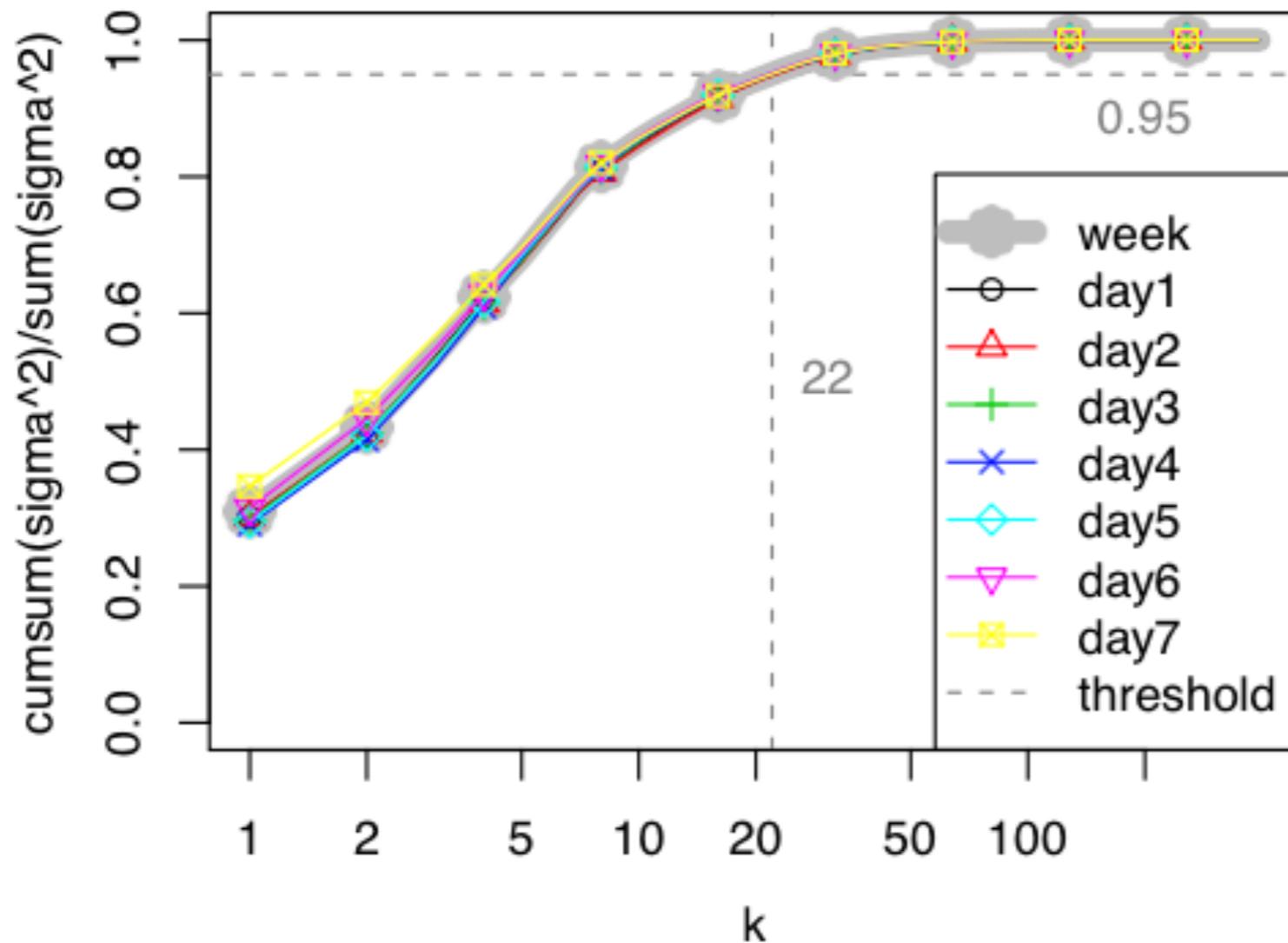
Daily pattern—top 10 tier-2 member



(a) Daily pattern of top-10 tier-2 members.

- ❖ Pronounced time of day effects
- ❖ Top 10 tier-2 responsible for 33% of traffic
- ❖ some ASes fully utilize their capacity

Structural properties of traffic matrix



(b) Traffic matrix energy.

- ❖ Using SVD to understand traffic matrix rank Energy in first k singular values
- ❖ 22 values suffice for 95% of the energy
- ❖ even smaller k for application specific matrix

Some observations

- ❖ Even tier 1 are members of IXP and do public peering links
- ❖ IXP is well wide used and most links has traffic
- ❖ IXP is more and more like a ASes

Conclusion

- ❖ reveal diverse IXP eco-system members, business types, connectivity, traffic
- ❖ Large IXP supports rich peering fabric
- ❖ Implication for studies of AS-level Internet