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AS-Path Analysis

Testing Claims of "Tier 1" Status and Examining BGP Routing Anomalies

Version 1.2

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Background

Autonomous systems which claim “tier-1” status differentiate themselves from others by claiming that they do not receive transit from any other autonomous system.

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Background

Autonomous systems which do not receive transit may reach other ASes by selling transit to them or by peering with them.

Background

All AS-paths take one of two forms: One in which the “center” is an AS which provides transit to two down-stream ASes:

Dupont buys Sprint sells SBC sells Fry’s

Background

All AS-paths take one of two forms:
Or one in which the “center” is a peering session between two ASes, each of which provides transit to one down-stream AS:

PCH buys Verio peers Sprint sells SBC sells Fry’s

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Proposition

Since there can exist no more than one peering session in any AS-path,
No more than two ASNs can make a legitimate claim to “tier-1” status with respect to any valid AS-path.

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Seed-list to test

For an arbitrary starting-point to test our proposition, we took the intersection of the lists of most commonly-occurring transit ASes from a number of routers:

701	UUNet / MCI	1239	Sprint
3356	Level 3	2914	NTT / Verio
7018	AT&T	6461	MFN
209	Qwest	2828	XO Communications
3549	Global Crossing	6461	SAVVIS

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Adding a Candidate

Adding ATDN (AOL Transit Data Network) to our list yields no additional observed anomalies. Thus they're probably fairly "tier-1."

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Adding a Candidate

The arbitrary method by which we seeded our list does not find content providers, only transit providers.

ATDN is reputed to be “tier-1” so we can test our proposition by adding them, and checking to see whether this yields additional anomalies...

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Testing the Proposition

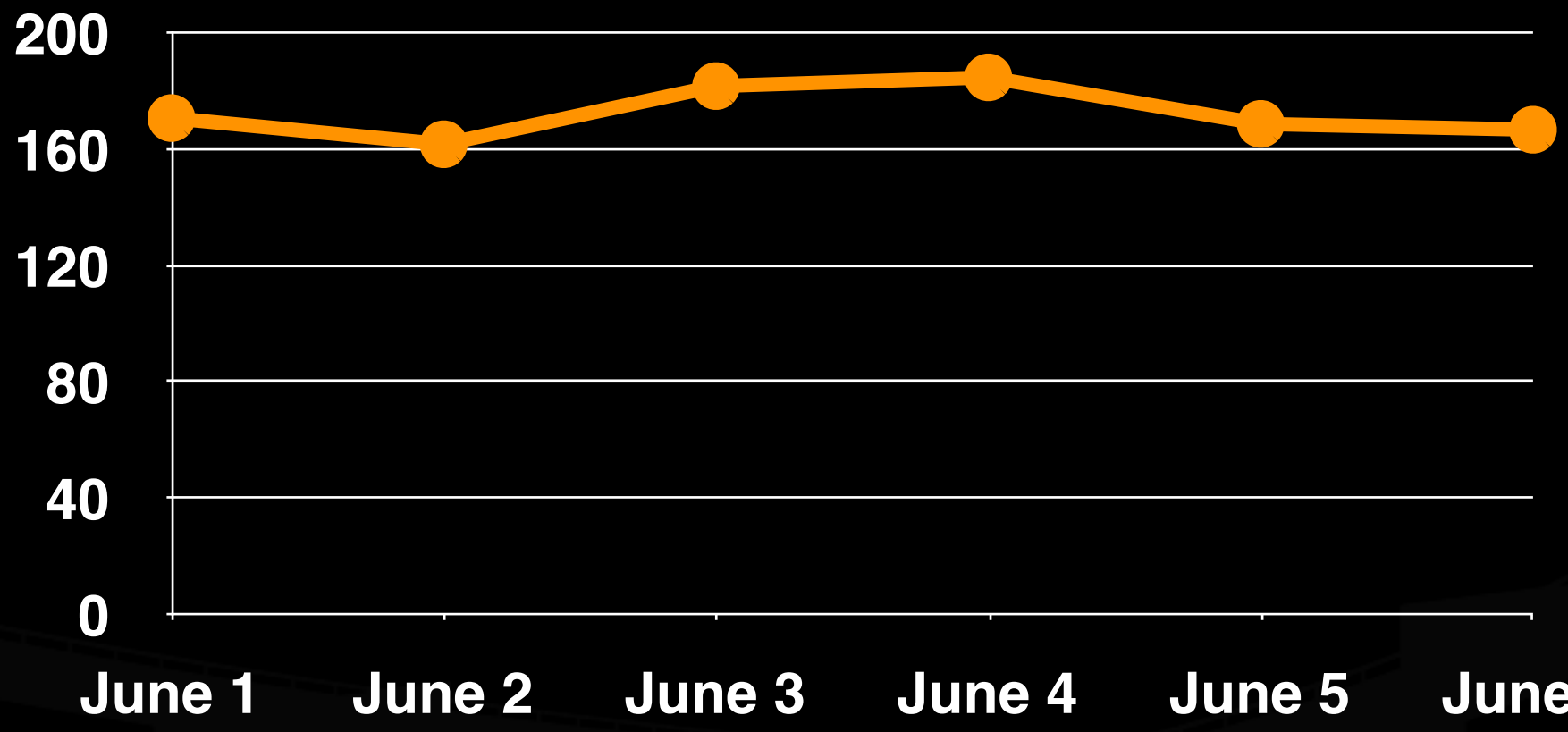
We find anomalous cases, in which three or more ASNs from our test list occur in the same AS-path:

65.215.36.0/24

3549	6221	3356	701	22907
Global Crossing	Cybersites	Level 3	UUNET	

Leaked Routes

(more than 2 Tier1 ASNs)



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More Anomalies

Inconsistent ASNs

Non-contiguous Repeats

Private ASNs

Unallocated ASNs

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Inconsistent Prefix Announcements

Examples

12.33.218.0/24

Announced by more than 1 ASNs:

22057, 23181

12.64.255.0/24

Announced by more than 1 ASNs:

4264, 17228, 17229, 17233

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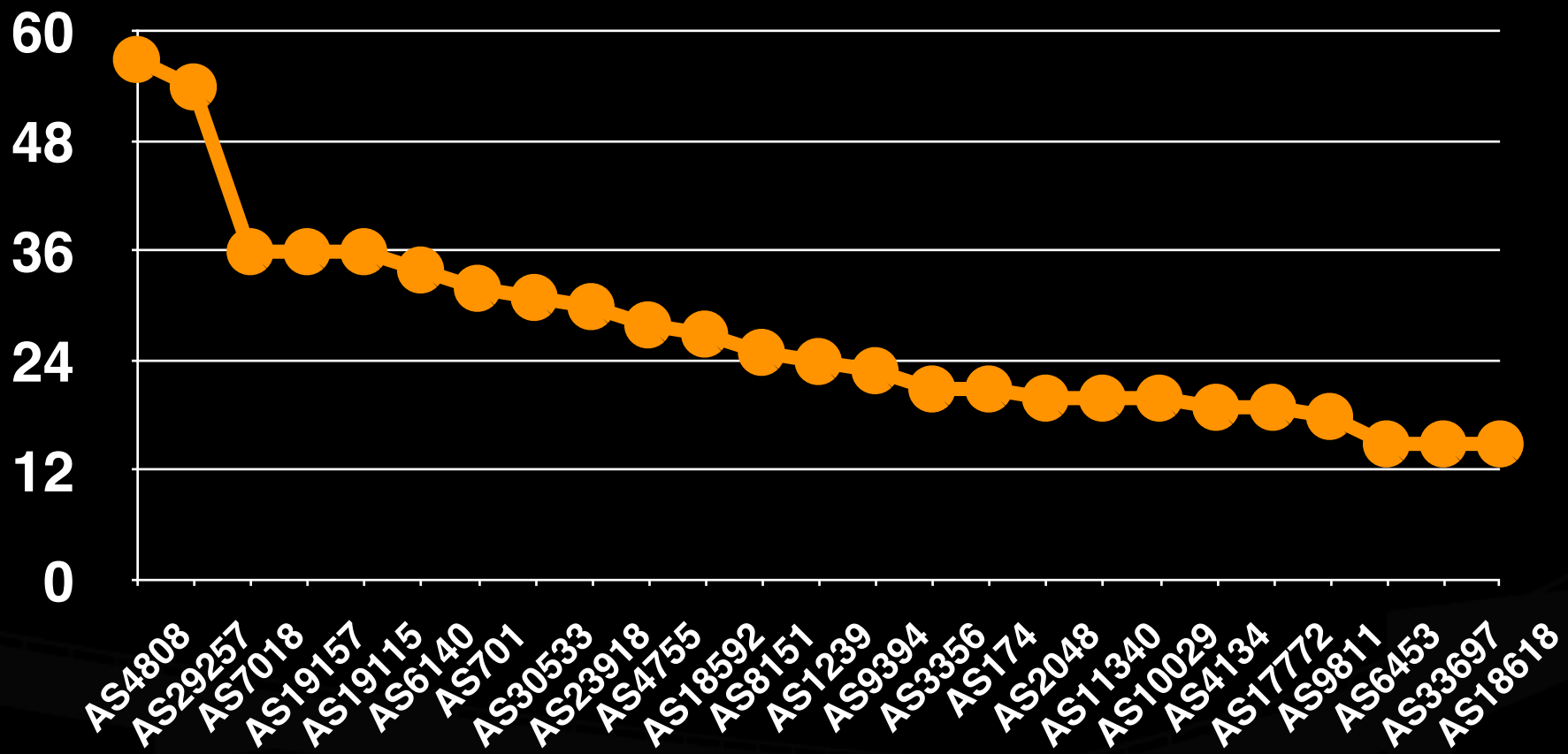
Inconsistent Prefix Announcements



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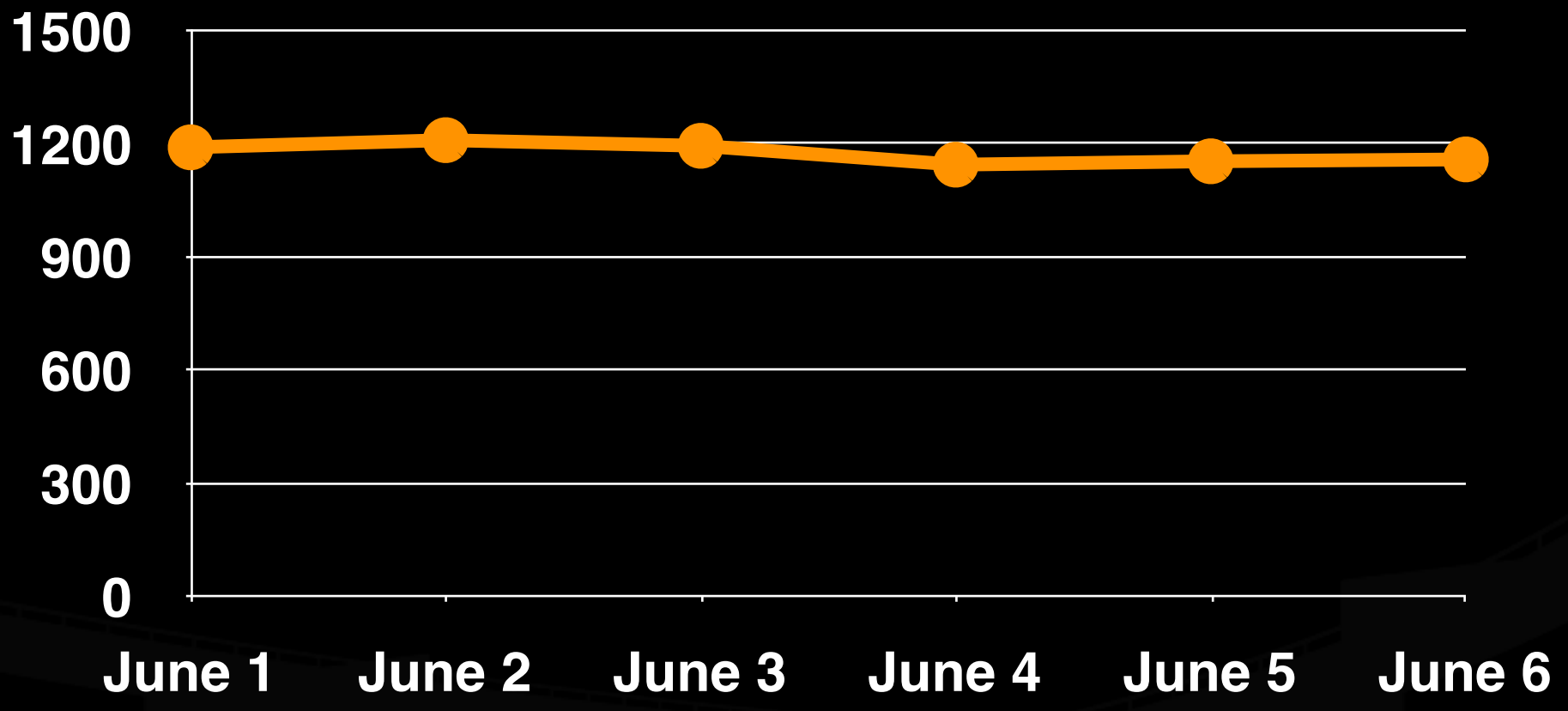
Inconsistent Prefix Announcements



Non-contiguous Repeats

Examples:

1299 7018 12163 12163 12162 12163 12163 12163 12163
7018 65000 65001 7018 1239 4648 2764 9837 9476
11608 13768 21548 21548 21548 21548 7018 21548 36231

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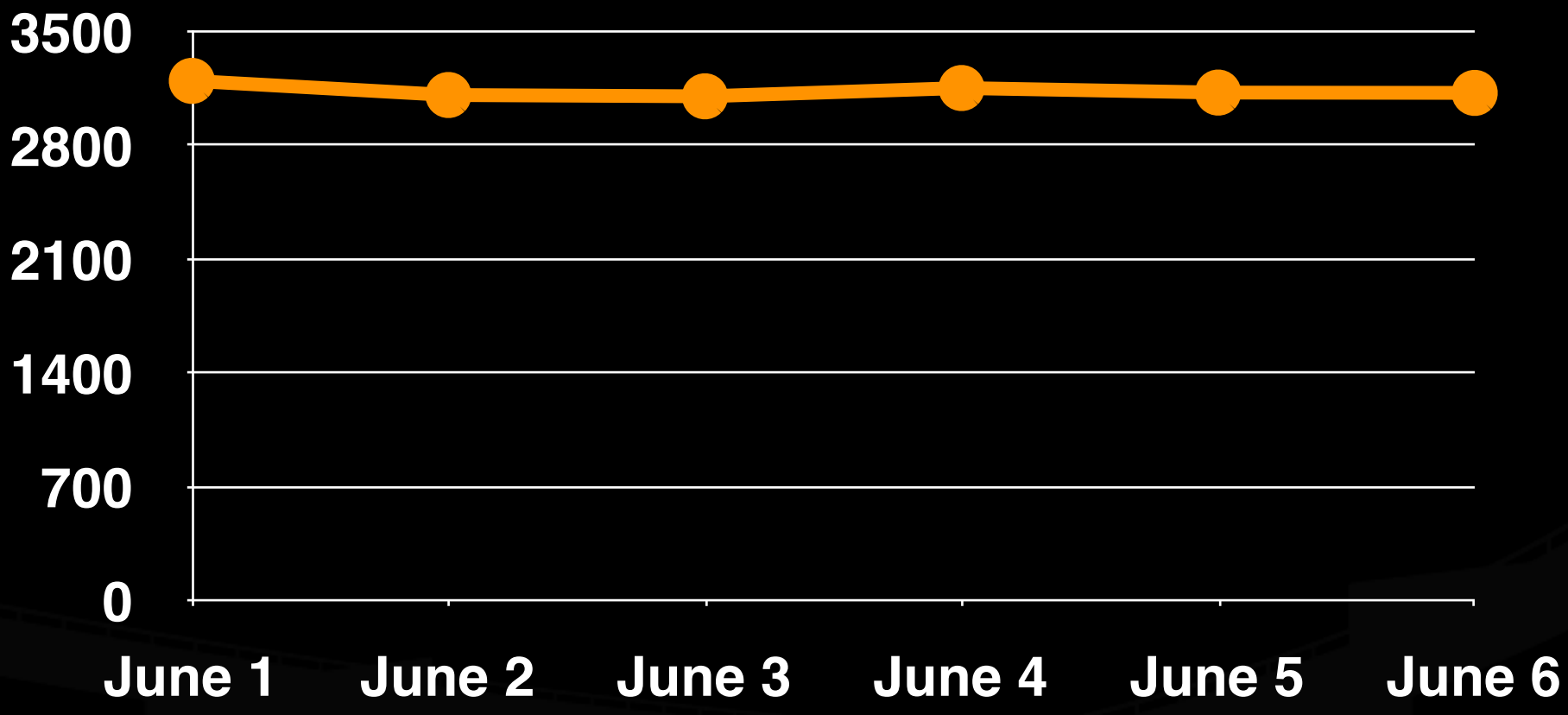
Non-contiguous Repeats



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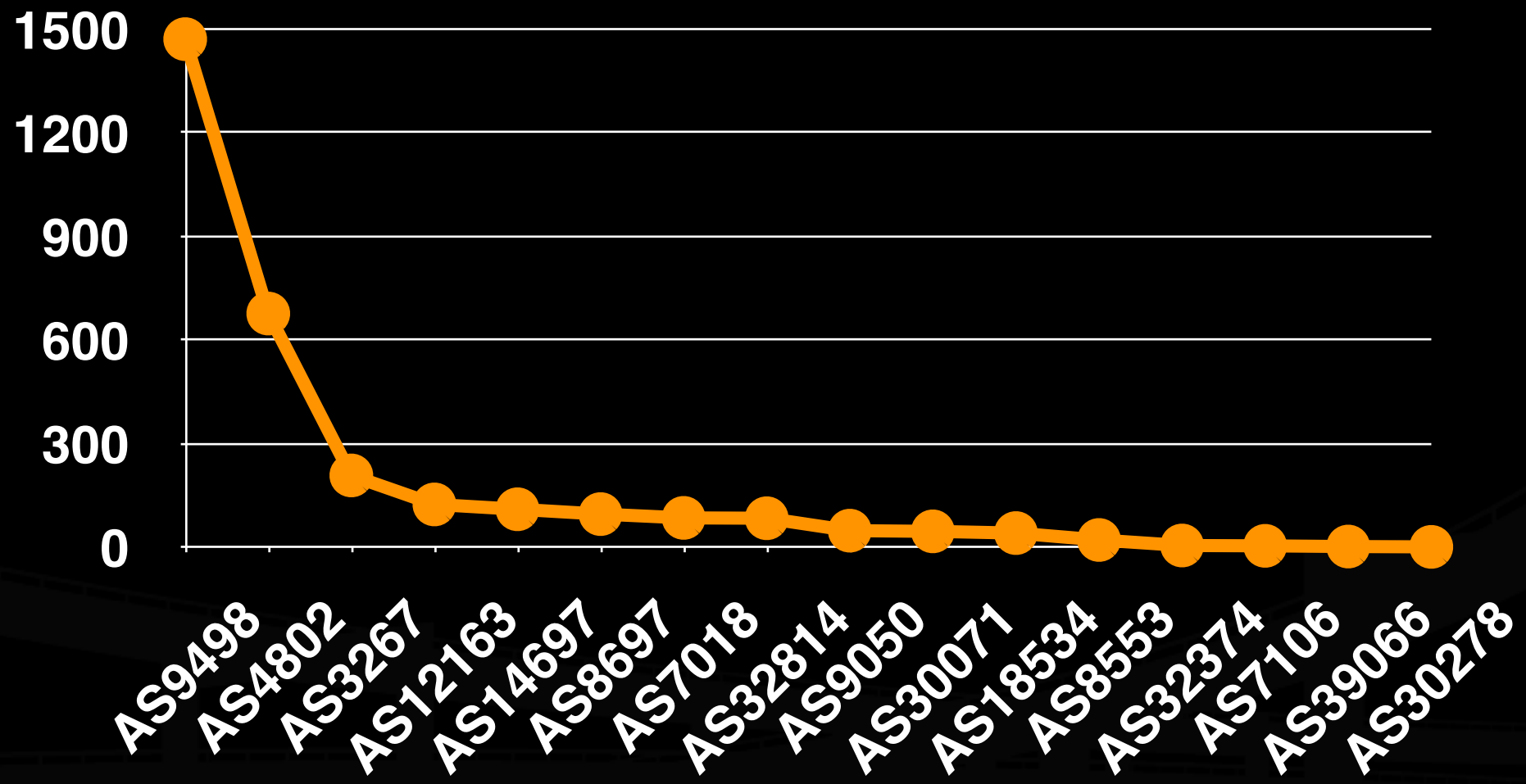
Non-contiguous Repeats



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Private AS Number Leak

7018 65000 65001 7018 1239 4648 2764 9837 9476
14608 19029 2516 65000 4134

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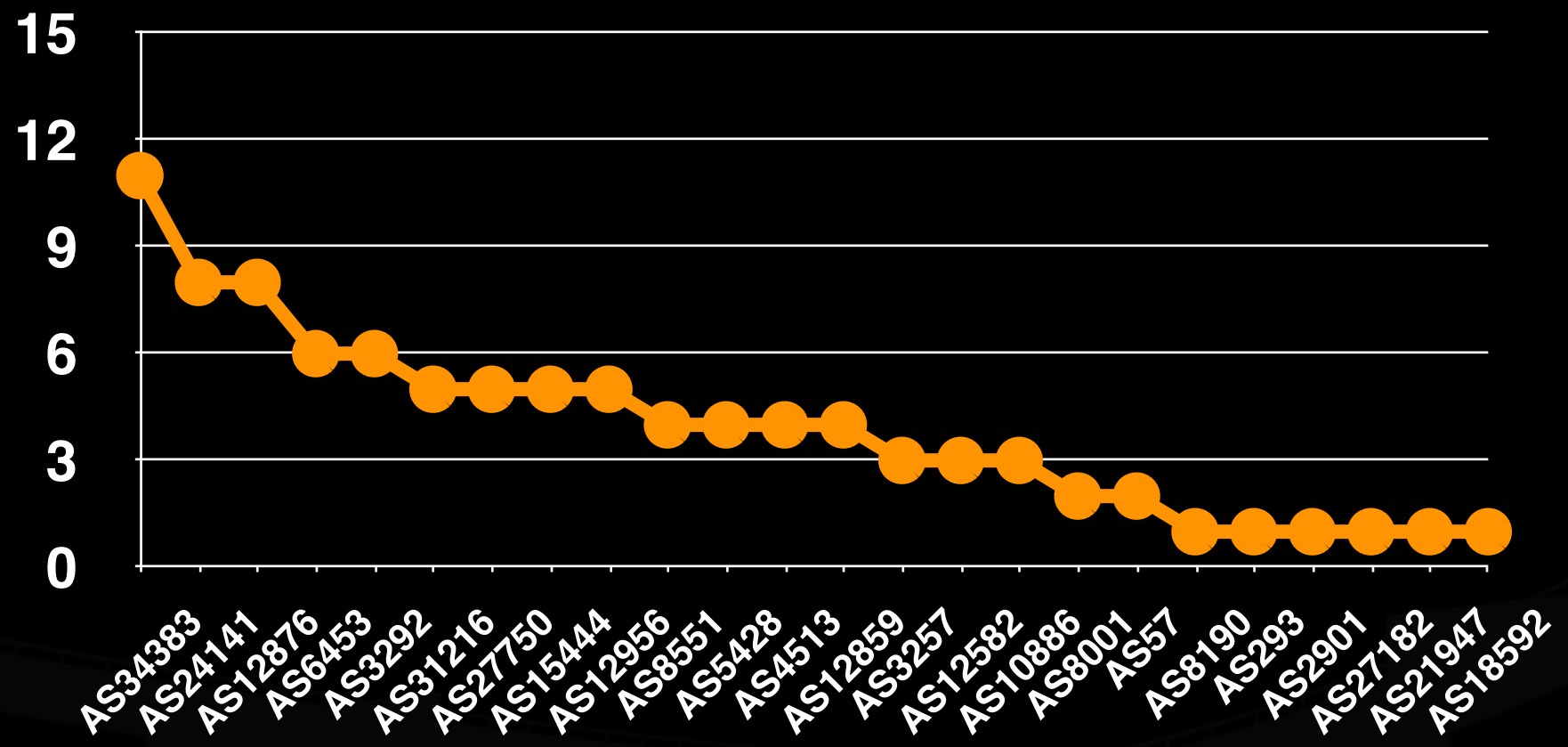
Private AS Number Leak



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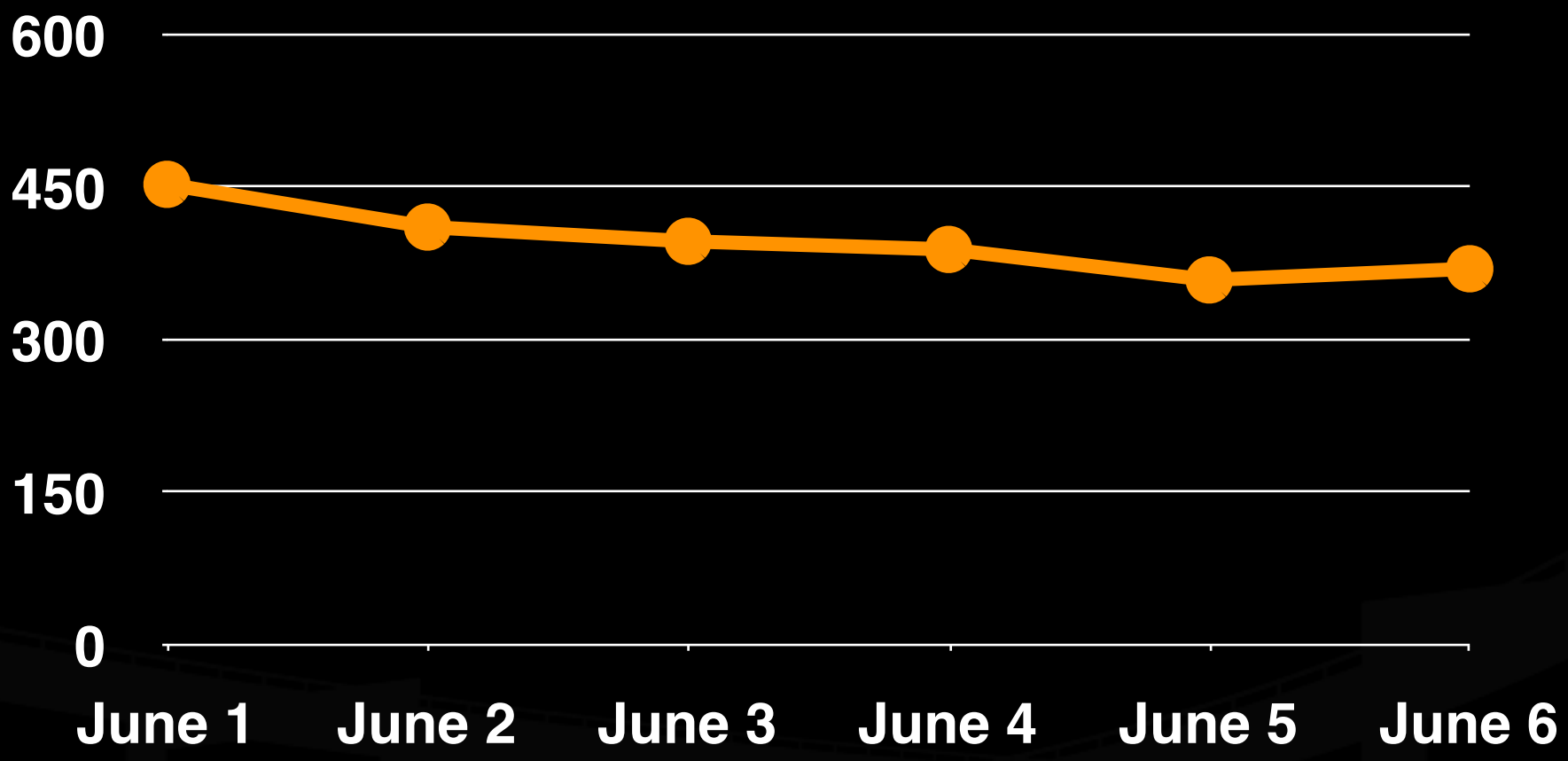
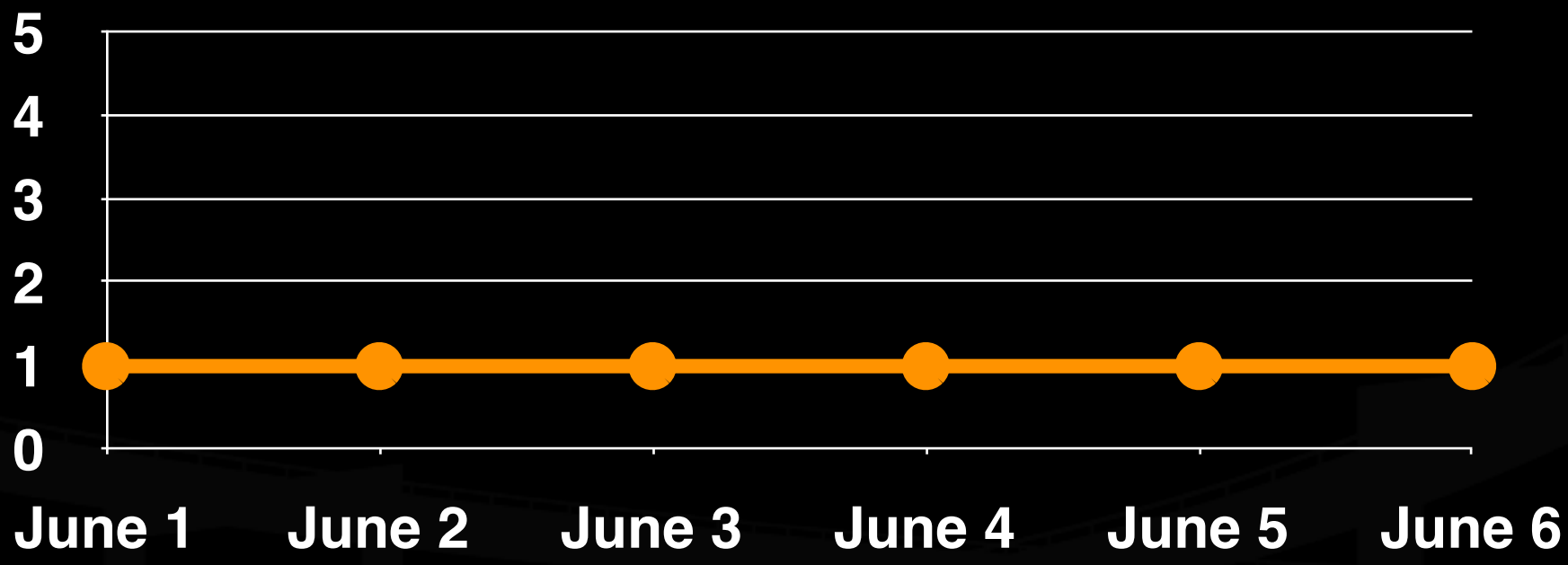
Private AS Number Leak



Using and Leaking Unallocated ASN

24587 is the only ASN leaking an unallocated ASN

81.17.39.128/27 3333 24587 64500



‘X’ relationships

Contrary to our assumption on ISP relationship, we see quite a few ‘X’ relationship

e.g

7660 / 2516 \ 7473 \ 9498 X 9730 X 9498 \ 17913

8001 / 7018 \ 9498 X 9730 X 9498 \ 17625

Where, AS9498 & AS9730 are two parts of same company

5650 / 7018 \ 12069 X 23269

5650 ? 22773 \ 23269 \ 12069

Where, it’s very likely that 23269 is leaking routes

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X Relationship

Where two ASNs announce each other routes

Use iterative parsing of the routing table data from multiple sources

Additional cross-checks

- Assume the top 10 ASNs as not buying from anyone
- Look at peer routes collected on PCH routers
- Regional full routes in 4 locations around the world from our own routers and by others.

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Deciphering X Relationships

Using Whois is sometimes useful

```
aut-num:    AS10310
as-name:    Yahoo-prod
descr:      Yahoo, Inc. production AS

aut-num:    AS26085
as-name:    Yahoo-SC5
descr:      Yahoo SC5 datacenter
```

sometimes it's not:

```
aut-num:        AS35324
import:         from AS35391 accept ANY
export:         to AS35391 announce ANY

aut-num:        AS35391
import:         from AS35324 accept ANY
export:         to AS35324 announce ANY
```

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Deciphering X Relationships

Some AS-PATH are difficult to explain

Best Guess here : ANC is leaking Routes, but how Tiscali comes between ANC and CNC is difficult to imagine - both topologically and geographically

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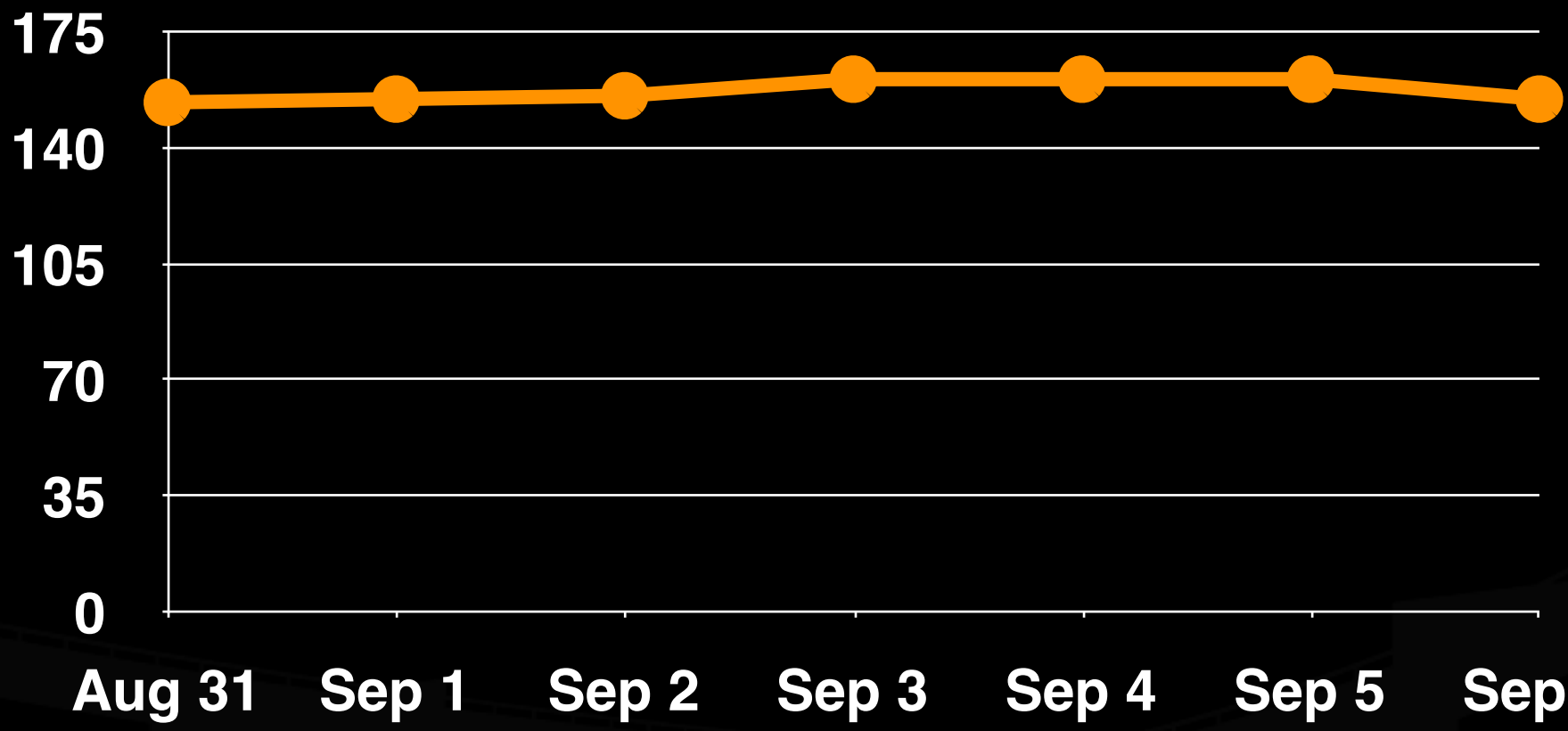
X - Relationship count



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Plan

Setup a e-mail mechanism to report possible route-leaks to ASNs

Setup a web front end so that operators can check against possible route leaks by peers and customers

More extensive cross check mechanism, against historical and archived data

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Thanks, and Questions?

Copies of this presentation can be found
in PDF and QuickTime formats at:

http:// www.pch.net / resources / papers / bgp-aspath-analysis

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