

Aftershocks from the Taiwan Earthquakes: Shaking up Internet transit in Asia

NANOG42: San Jose, California 2008

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Overview

- Large earthquakes hit Luzon Strait, south of Taiwan on 26 December 2006
- Seven of nine cables passing through the straight were severed
- We reviewed the event from a routing perspective in Bali, Apricot 2007
- Today, we look at business fall out (which is NOT necessarily quake induced, since we don't know the motivations)

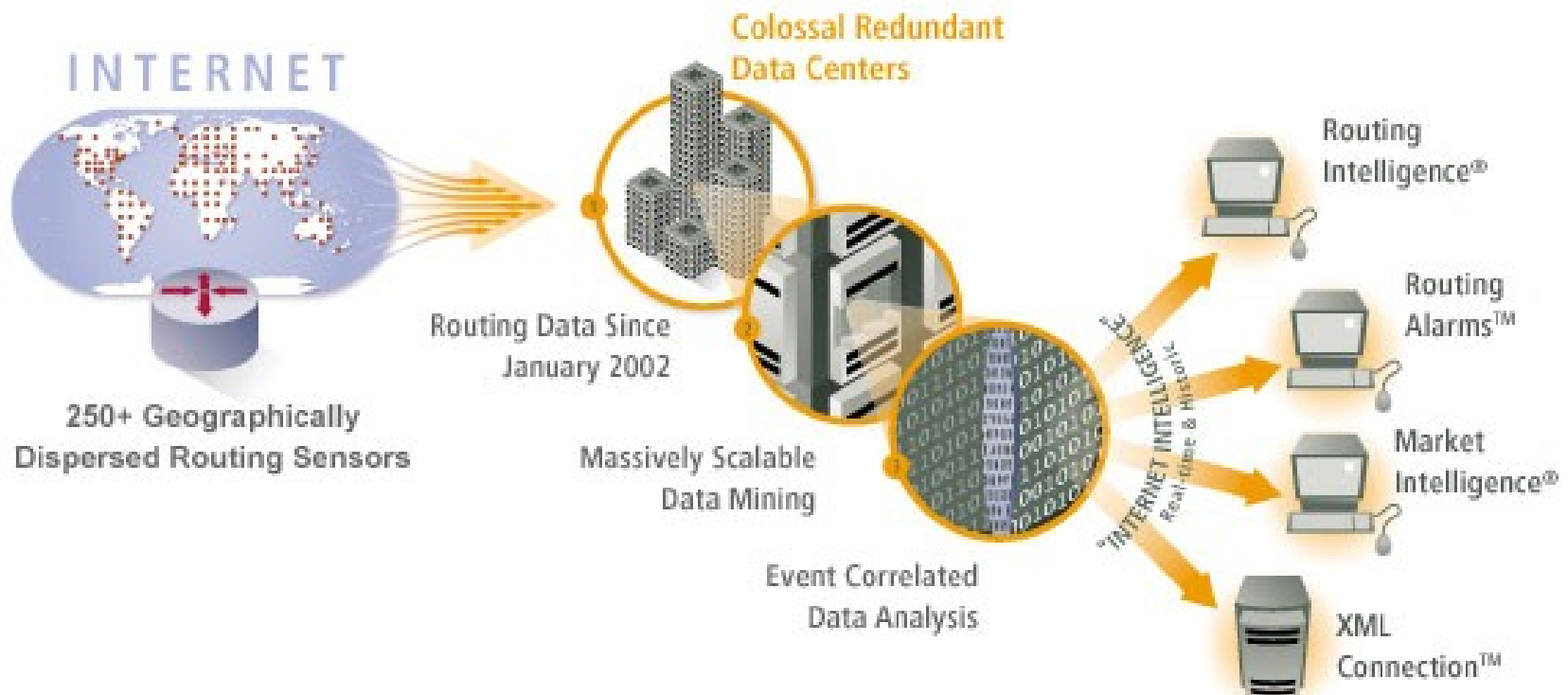
Submarine cables in East Asia



- Two of nine cables **not** impacted:
 - Asia Netcom's EAC
 - Guam-Philippines
- All cables reported repaired as of **14 February 2007** (source: Office of the Telecommunications Authority of Hong Kong)

Renesisys Data Collection Infrastructure

- 250+ full-table peering sessions from 170+ different ASNs (Adjacent or one AS hop from over 65% of all Internet transit providers)
- Here, we focus only on prefixes geo-locating to specific Asian countries



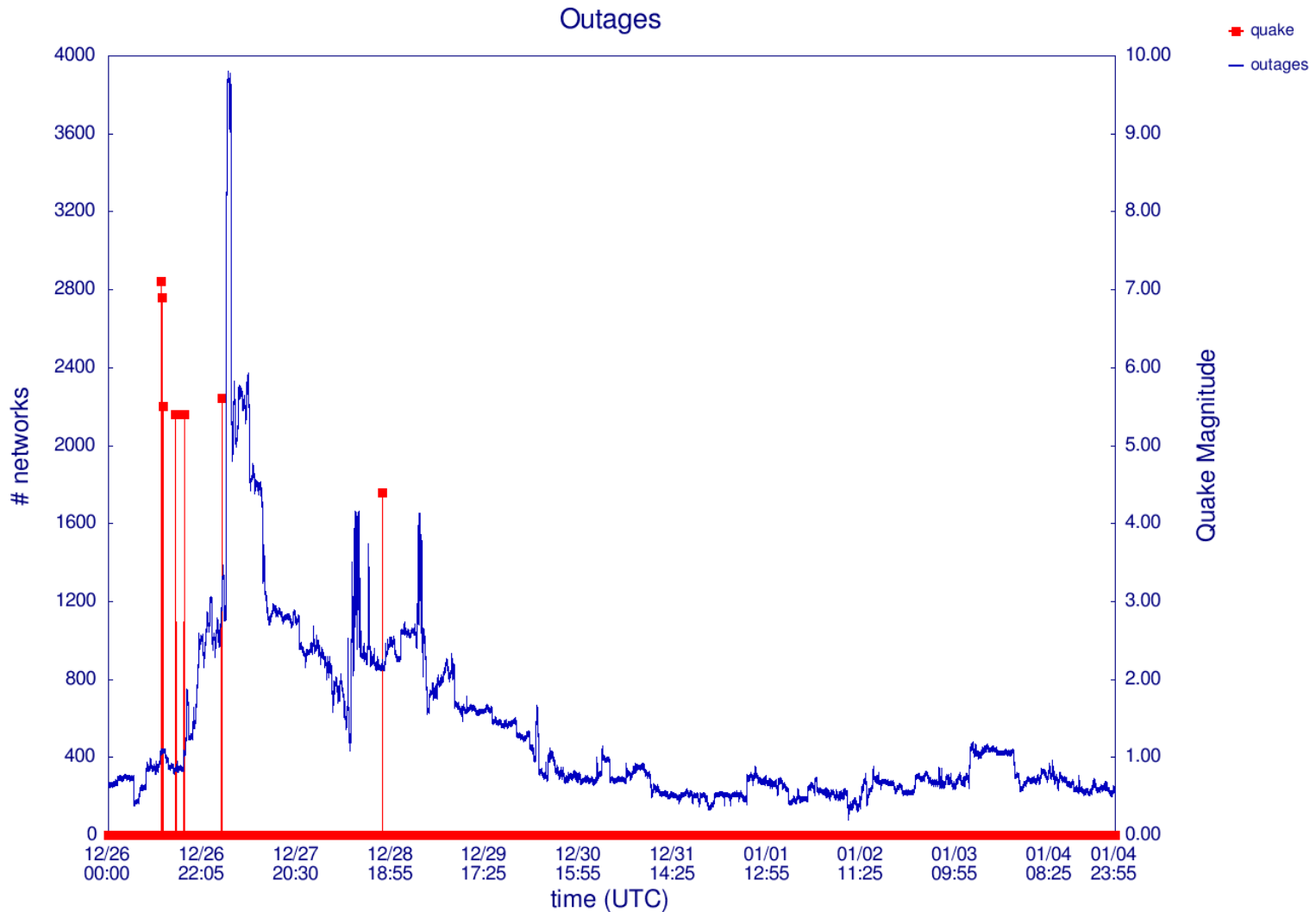
Definitions: Outage, unreachable, unstable

- A **network outage** occurs when routes to the network are withdrawn by a large number of BGP routers worldwide.
- In this case if no less specific route is available, the network is **unreachable** and effectively disconnected from all or parts of the Internet.
- **Unstable networks** are not completely disconnected, but show frequent changes in network routing paths or alternating announcements and withdrawals (**route flapping**) – serious packet losses.

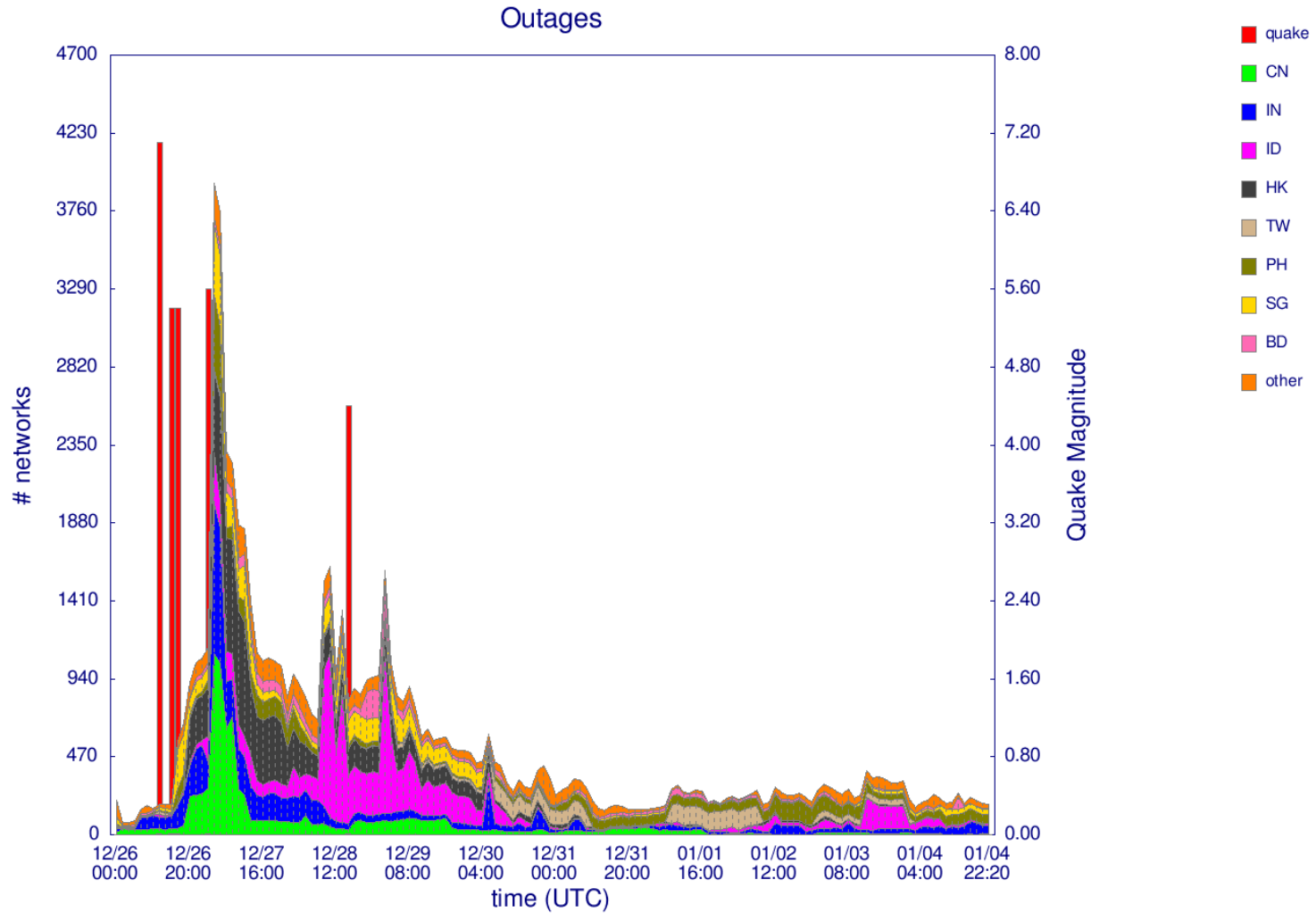
The Pattern of the Taiwan Quakes

- Ramping up outages and spikes in instabilities
- Gradual increase in number of outages after major quake in 26 December 2006
- Big spike in outages/unstables associated with smaller quake on 27 December 2006
- Recovery typically noisy
- Pattern was probably affected by the number of different cable systems involved – this is not really one event but at least seven.

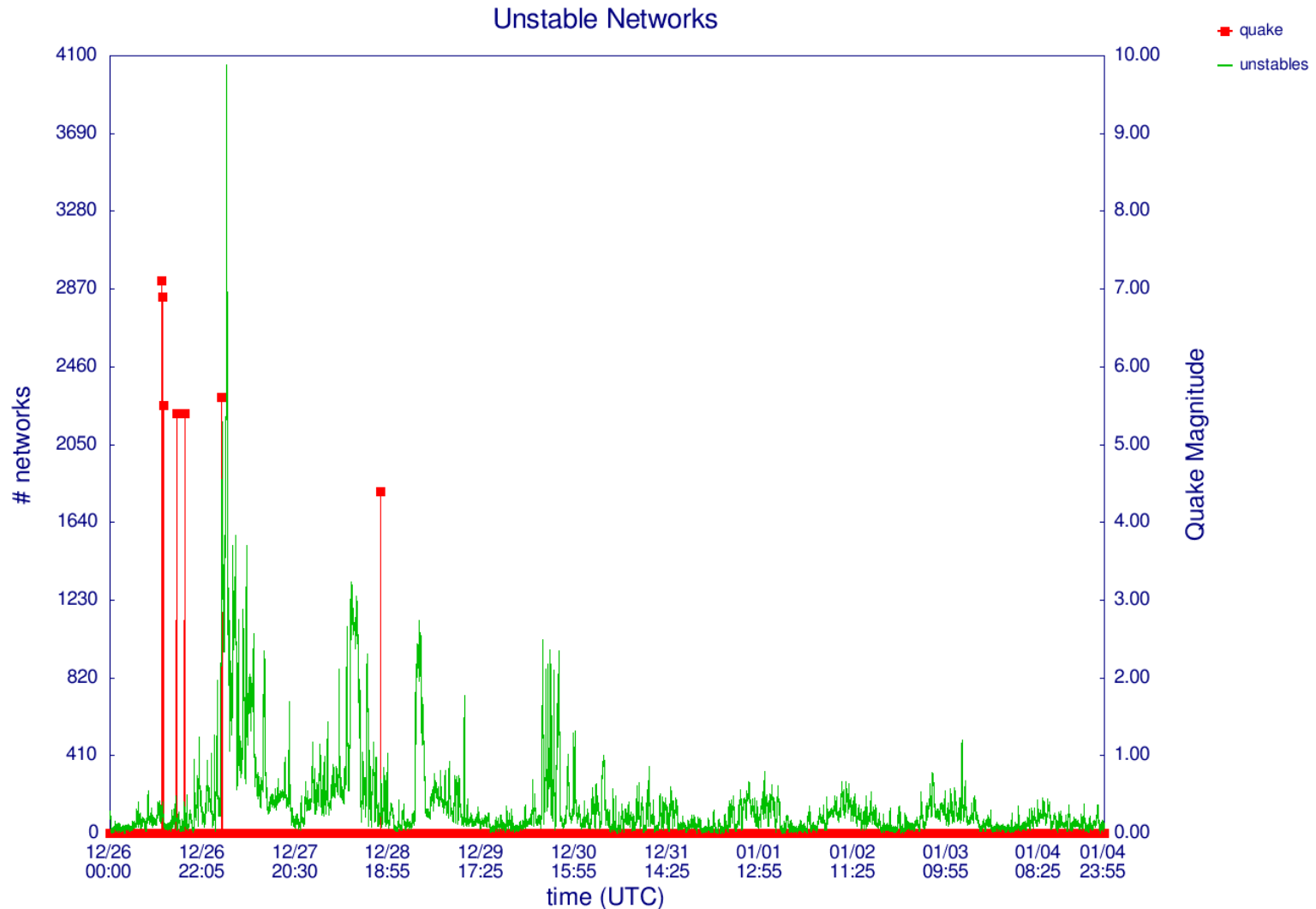
Outages & Quakes – 10 Days



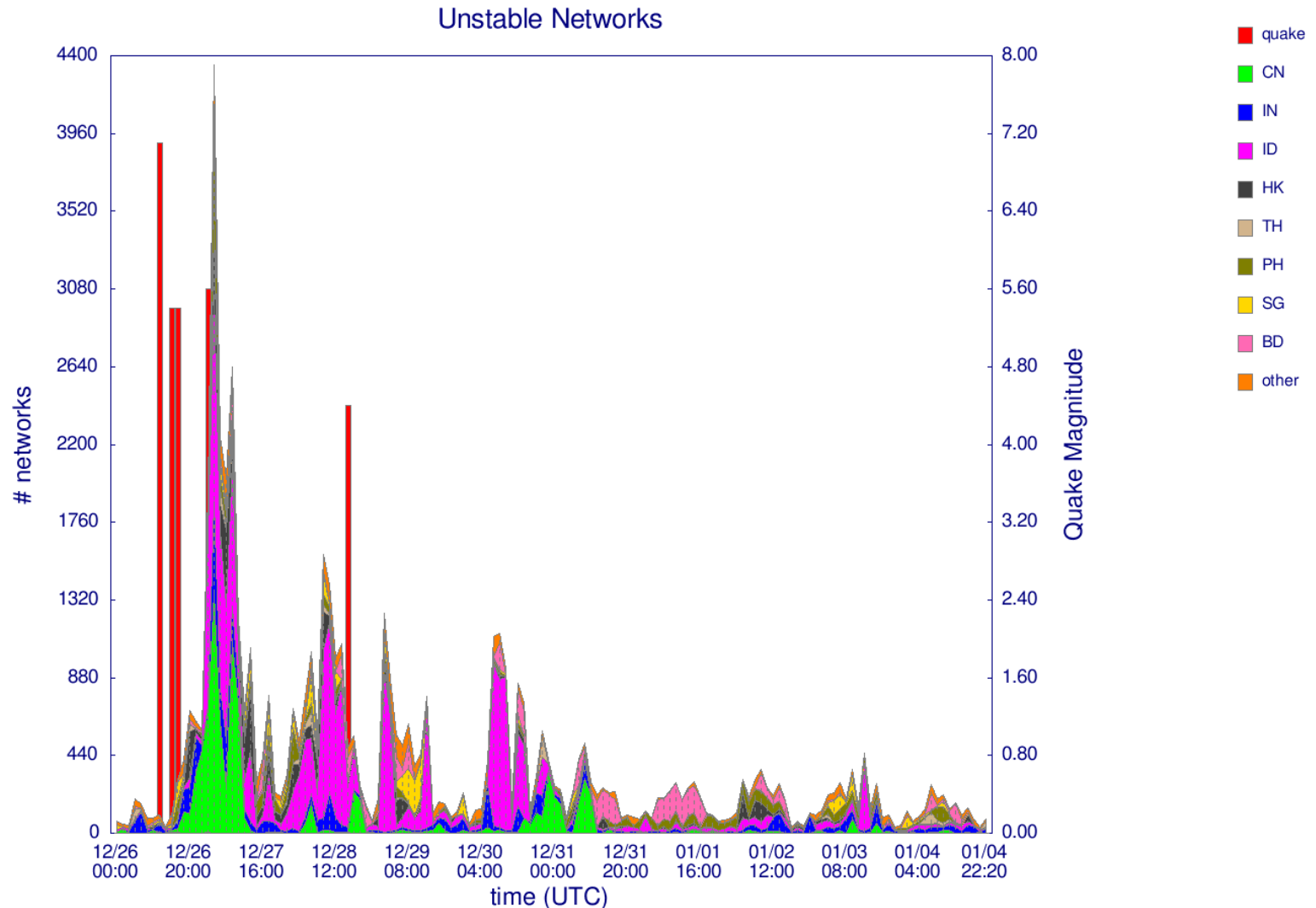
Outages by Country – 10 Days



Unstables & Quakes – 10 Days



Unstables by Country – 10 Days

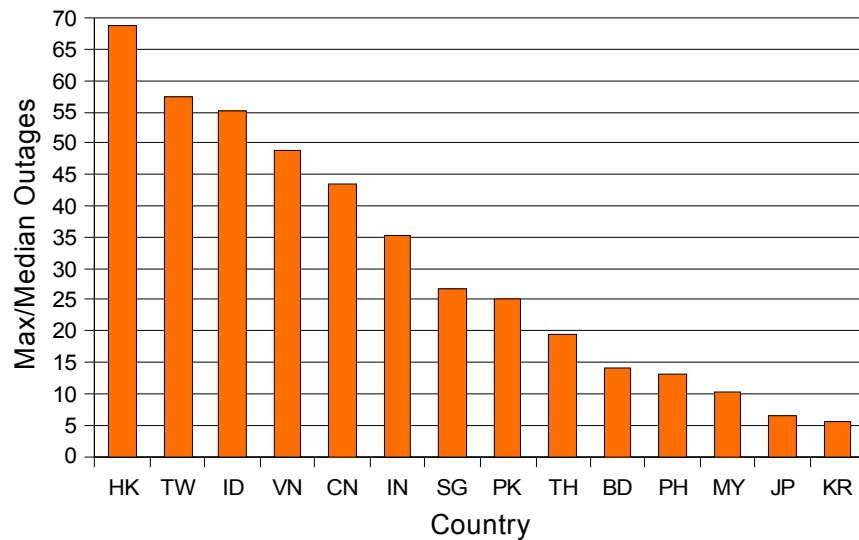


Impact by Country

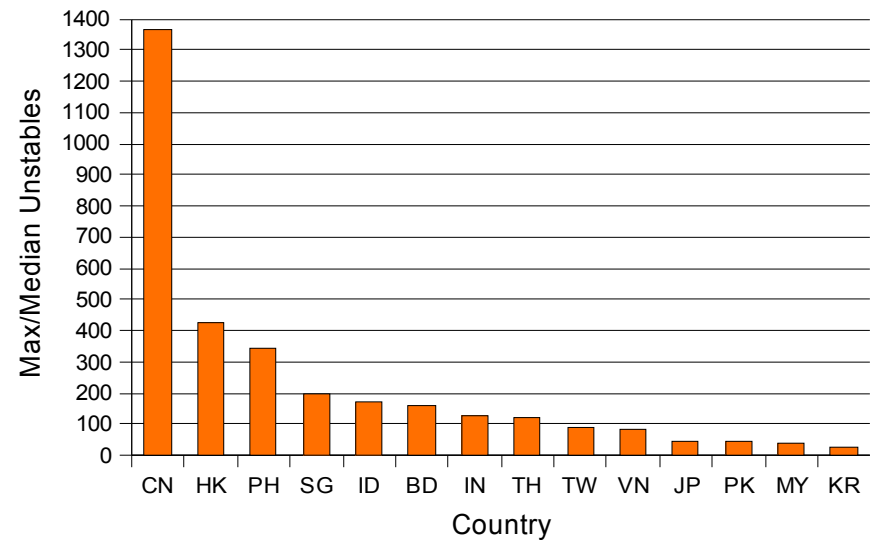
- Used maximum to median ratio of outages and unstable networks
- Worst Impacted:
 - China, Hong Kong
- Least Impacted:
 - Korea, Japan

Impact by Country (cont'd)

Max/Median Outages by Country



Max/Median Unstables by Country



Impact on providers to the region

- Renesys computes daily rankings
 - Rankings are provided by market (retail, wholesale, backbone) and by geography
 - Provider rankings are based on total score of *relevant transited* prefixes
 - Business relationships for adjacent ASes are computed (peers, provider->customer, customer->provider, etc)
 - From such relationships, we compute the transited prefixes for an AS
 - Each prefix is geo-located
 - Each prefix is assigned a score based on size and assignment date
 - Aggregation carried out to prevent double counting
 - Scores for a provider's transited prefixes are then summed by region, market, etc.

What does this measure exactly?

- Rankings are a *very rough* measure of
 - The size of a market or geography
 - A provider's share of a market
- Rankings are **NOT** necessarily a measure of ...
 - Actual traffic (which is what everyone wants to know)
 - Profitability
 - Network quality
 - Transit location (e.g., Chinese prefixes might be transited from US)
 - Customer satisfaction
 - Or anything else that cannot be determined from objective global routing and geo-location data

What information can be derived from rankings?

- Provider size in geographic market and market segment (retail, wholesale, backbone)
- Provider physical presence in a geography, i.e., what is their retail ranking?
 - Sprint is ranked #1 of all backbone providers in China
 - Sprint has one of the lowest ranks in the retail market in China
- Trends: losing or gaining market share?

New Ranking: SE Asia + Indian Subcontinent + China (22 countries)



Image Credit: Cartographic Research Lab, University of Alabama

What changed in this region since the quake?

- What are the per country growth rates?
- How do the per-country markets compare in size?
- Which providers gained/lost market share and why?

Top-10 Regional Country Rankings on 23 December 2007

Rank	Yr. Rank Change	Size Rel. to China	Yr. % Growth	Country
1	0	1.00	37	China
2	0	0.22	22	Taiwan
3	+1	0.14	60	India
4	-1	0.11	16	Hong Kong
5	0	0.07	48	Malaysia
6	+4	0.06	221	Vietnam
7	-1	0.06	17	Thailand
8	-1	0.04	15	Philippines
9	-1	0.04	40	Singapore
10	-1	0.04	77	Indonesia

Top-20 Regional Provider Rankings on 23 December 2007

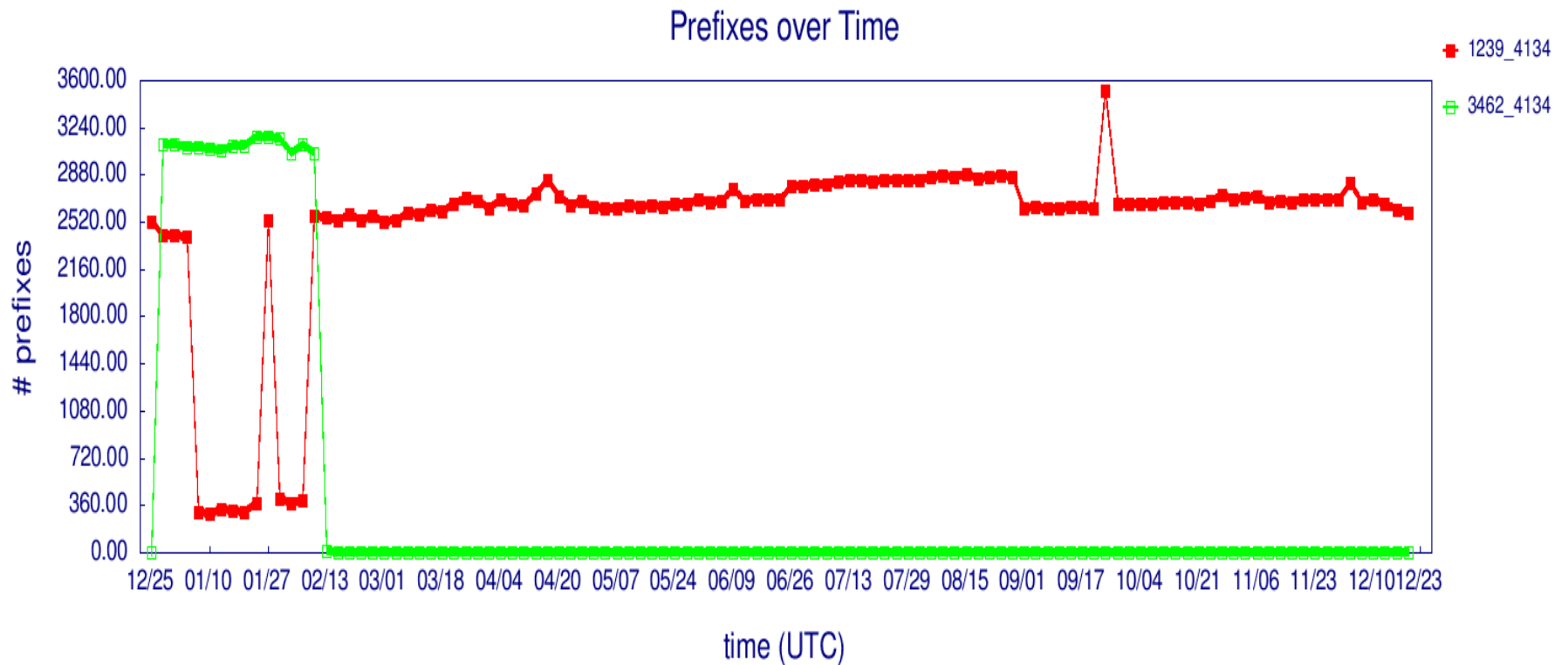
Rank	Yr. Rank Change	Provider	ASN
1	0	Sprint	1239
2	0	Savvis	3561
3	+2	Verizon	701
4	+3	NTT	2914
5	-1	AT&T	7018
6	-3	China Telecom	4134
7	+4	Level 3	3356
8	+1	VSNL/Teleglobe	6453
9	+4	Global Crossing	3549
10	+4	Singapore Telecom	7473

Rank	Yr. Rank Change	Provider	ASN
11	+1	Deutsche Telekom	3320
12	-6	CNC Group	4837
13	+2	Flag	15412
14	+10	PCCW	3491
15	-5	China Netcom	9929
16	+15	Telecom Italia	6762
17	+627	Cable & Wireless	1273
18	-1	Hutchison	9304
19	+516	Tiscali	3257
20	-1	Asia Netcom	10026

We review the highlighted lines in what follows.

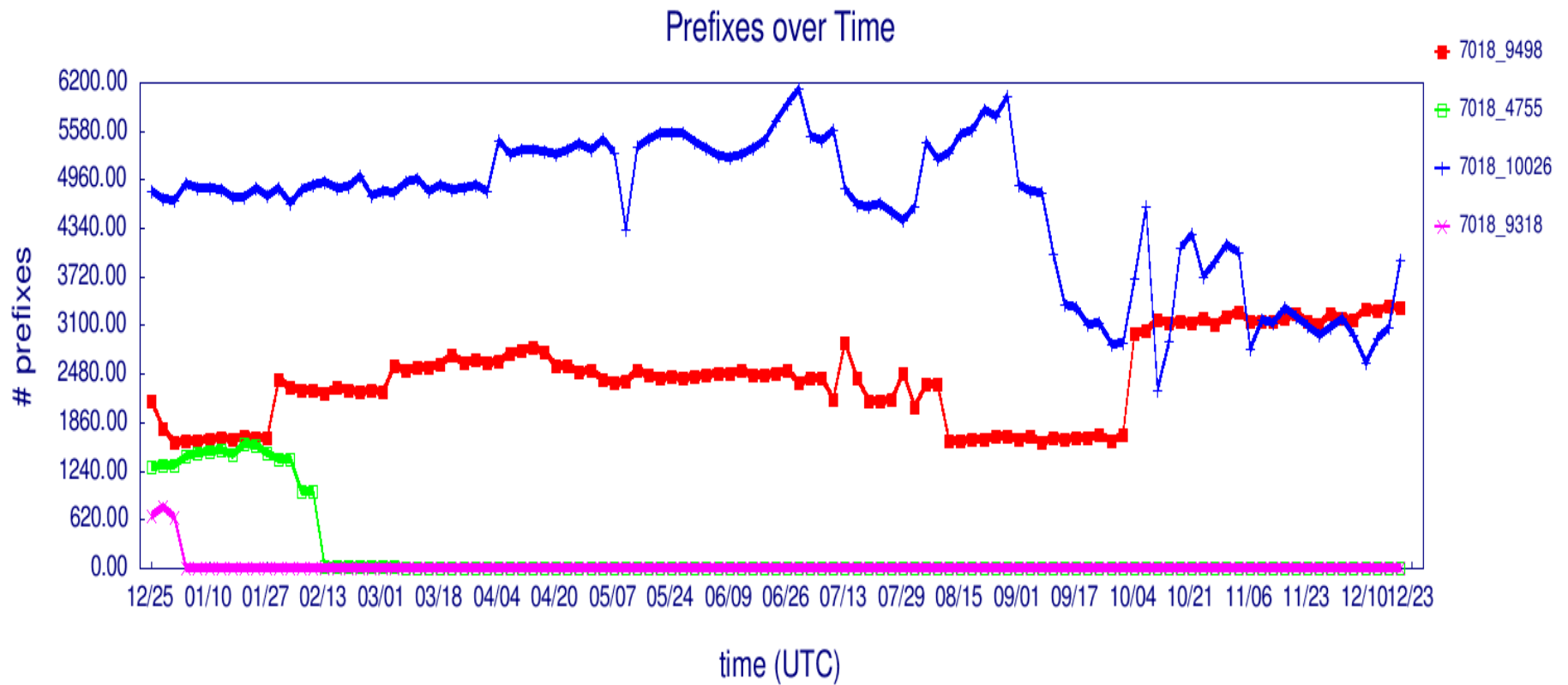
China Telecom stays with Sprint

China Telecom: 4134; Sprint: 1239; Chunghwa: 3462



AT&T loses VSNL, Hanaro, loses routes from Asia Netcom, gains routes from Bharti

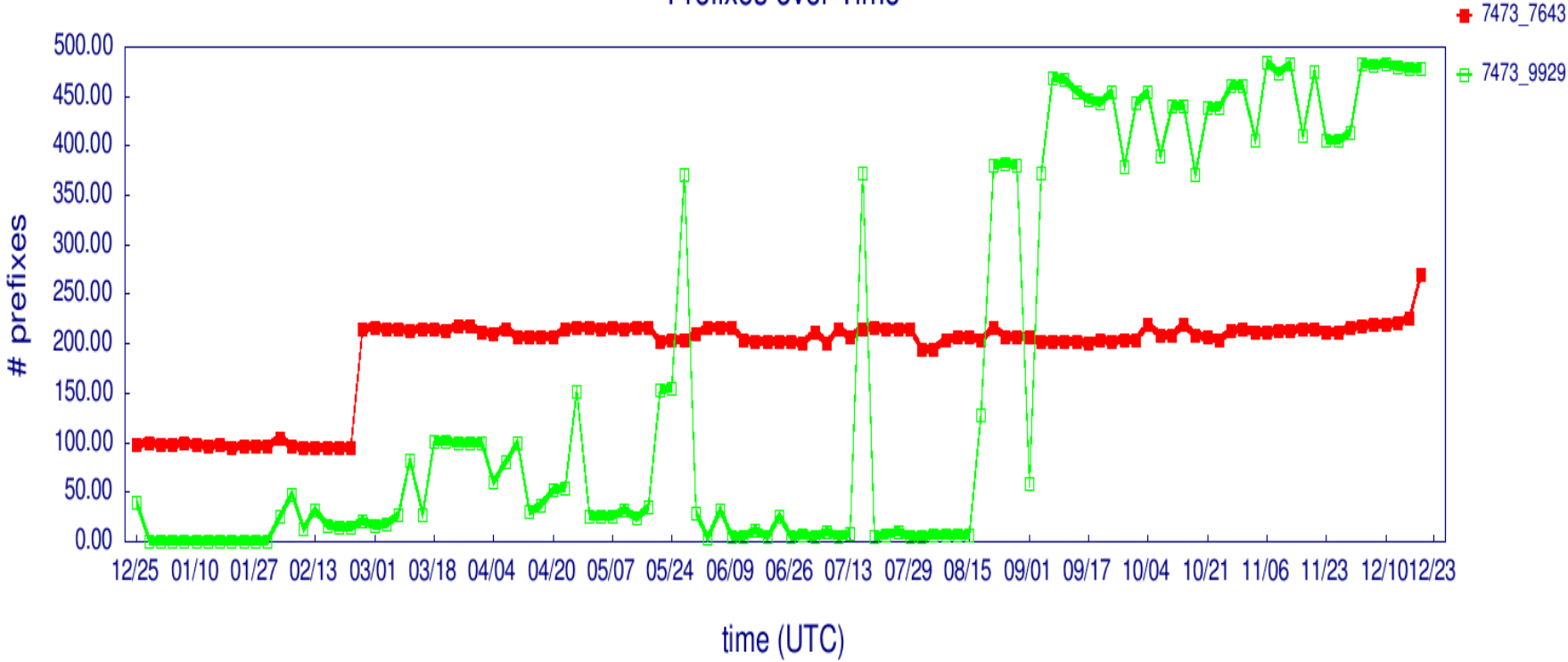
AT&T: 7018; VSNL: 4755; Hanaro: 9318; Asia Netcom: 10026; Bharti: 9498



SingTel gains from China Netcom & Vietnam

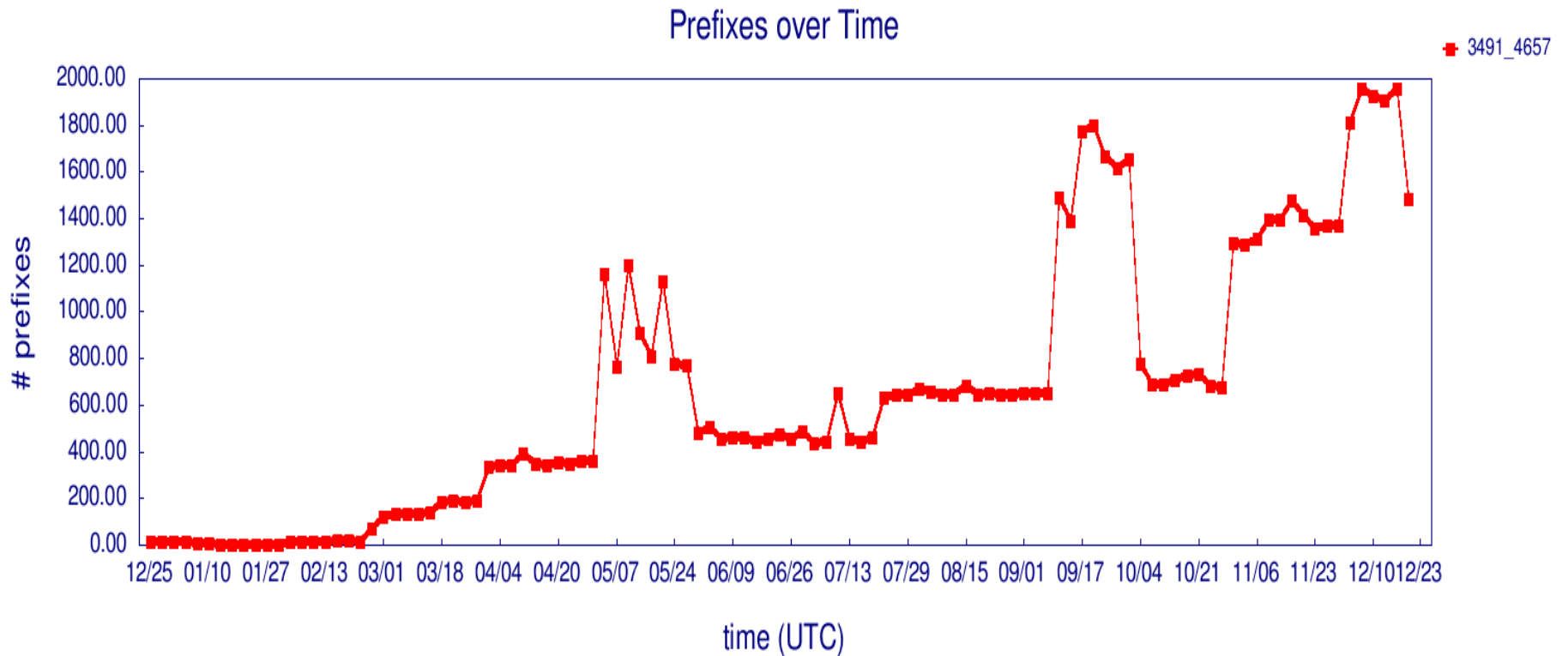
SingTel: 7473; China Netcom: 9929; Vietnam Posts and Telecom: 7643

Prefixes over Time



PCCW wins Starhub (Singapore)

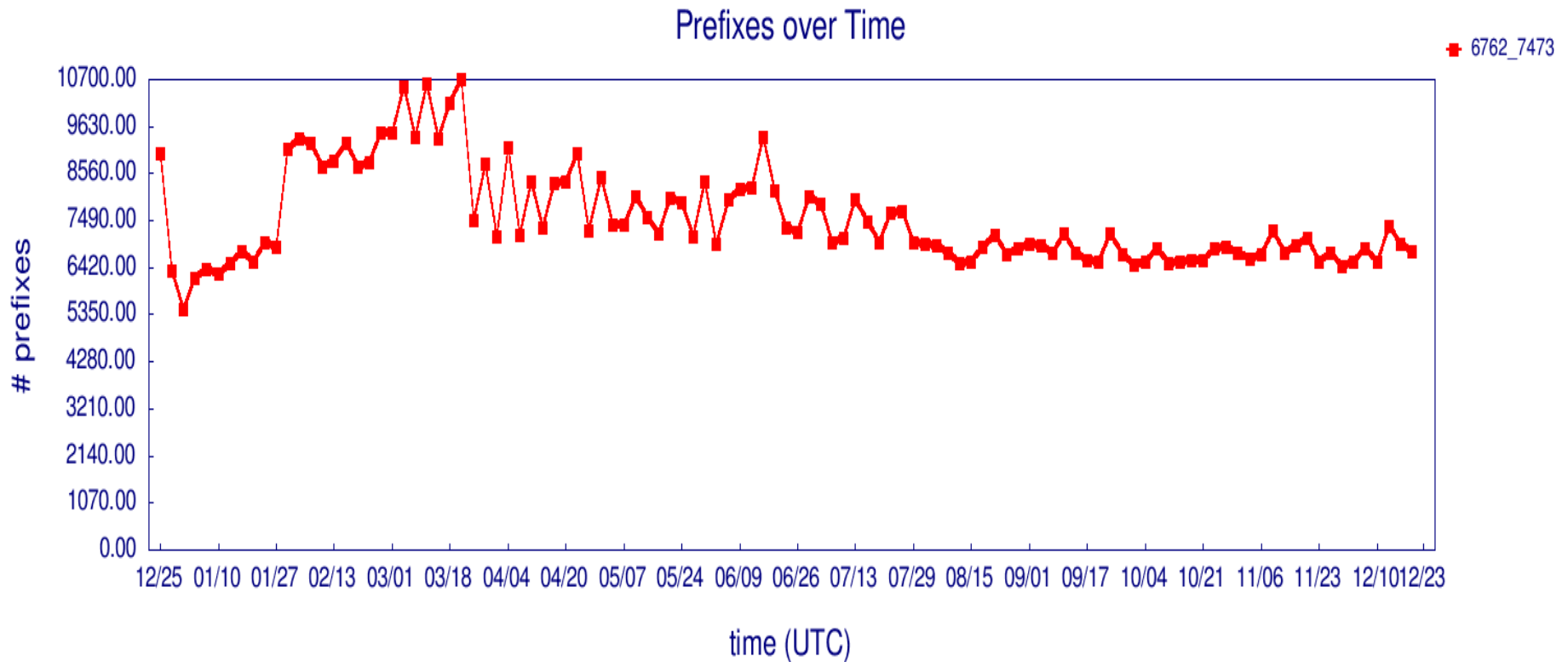
PCCW: 3491; Starhub: 4657



Telecom Italia gains traffic from SingTel

Hmm. Doesn't show on this graph ...

Telecom Italia: 6762; SingTel: 7473



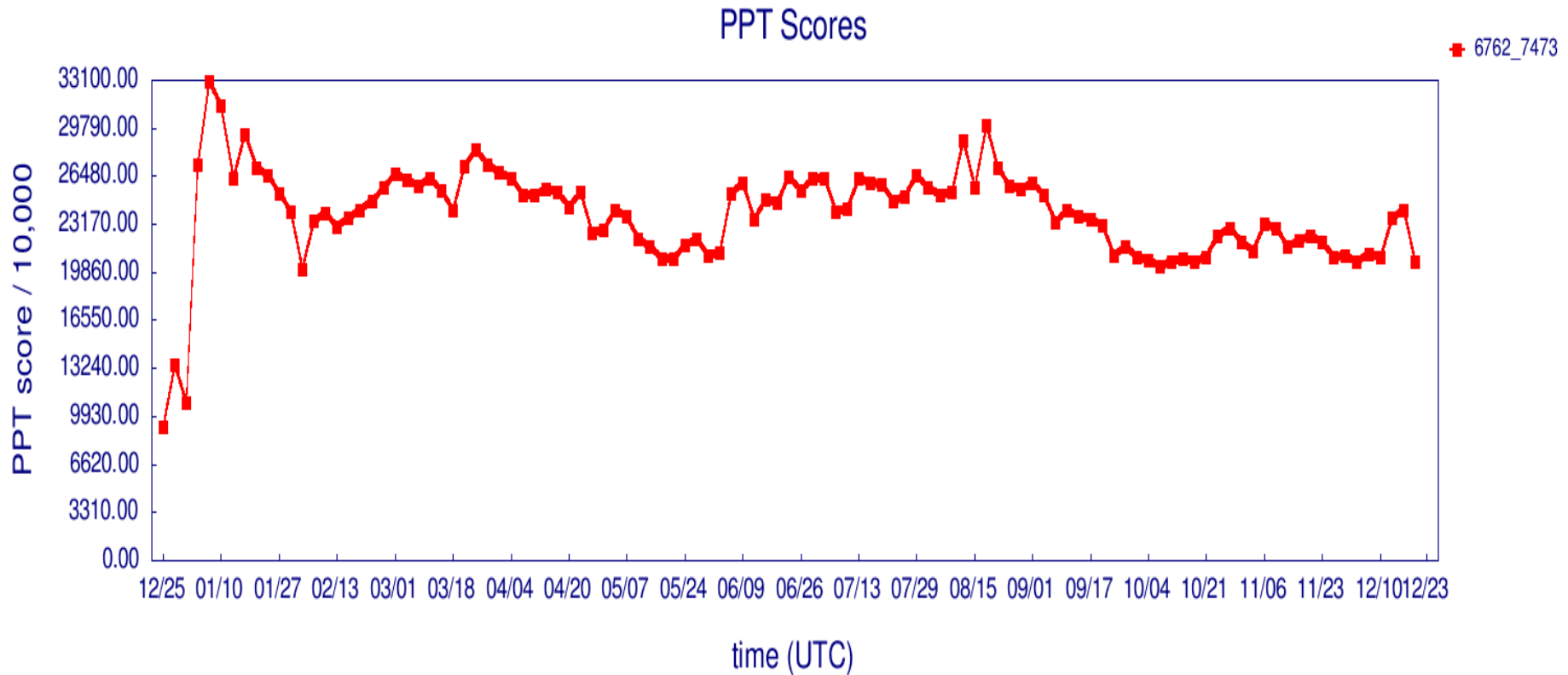
Need a different metric: PPT

- Counting prefixes seen on each edge does *not* show everything.
- Need to account for global selection of prefixes over time.
- New edge score: PPT (Prefix, Peer, Time)
 - For each prefix, for each Renesys peer, sum the amount of time the peer saw the prefix routed on the edge during a time interval
 - Caveats:
 - All prefixes have the same weight
 - Cannot distinguish **between** an edge with a lot of prefixes seen by only few peers, **and** an edge with few prefixes seen by a lot of peers

Telecom Italia gains traffic from SingTel

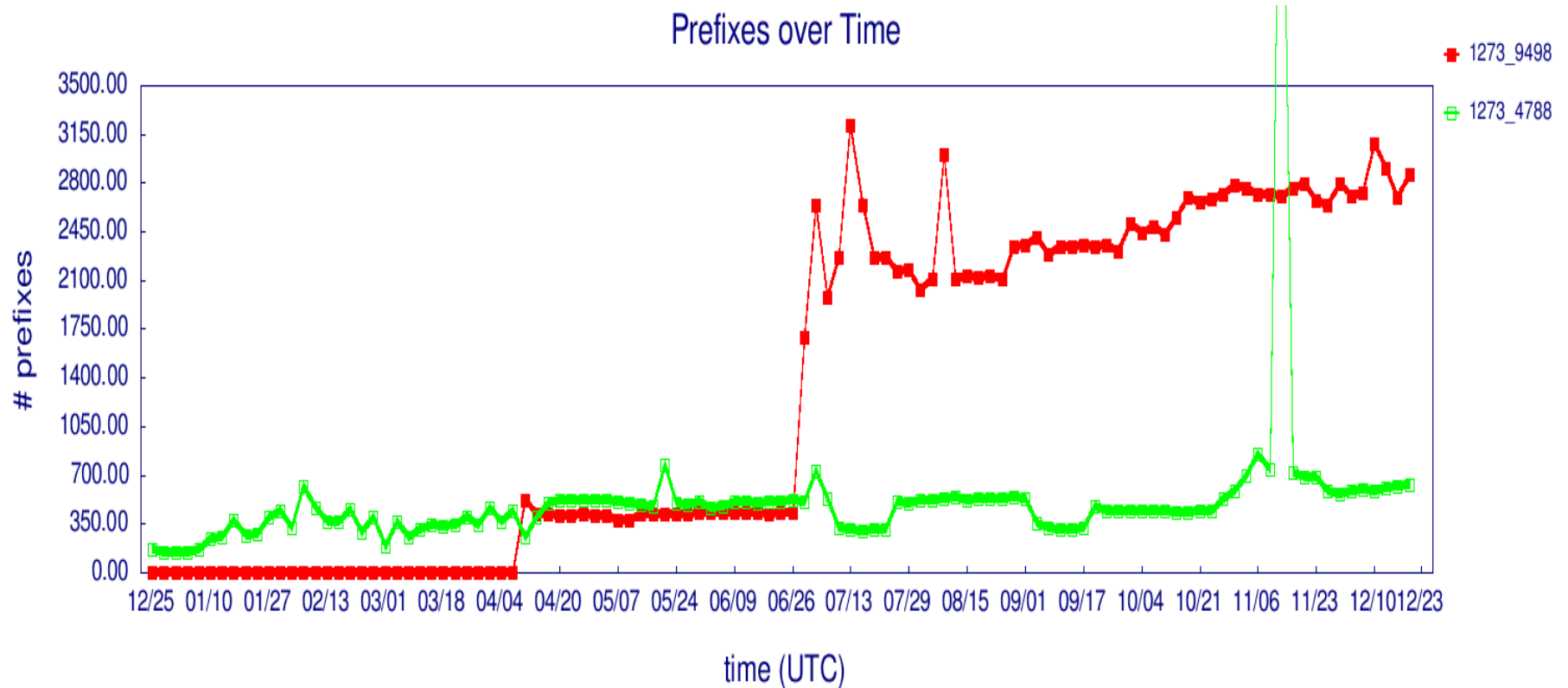
PPT shows the gains ...

Telecom Italia: 6762; SingTel: 7473



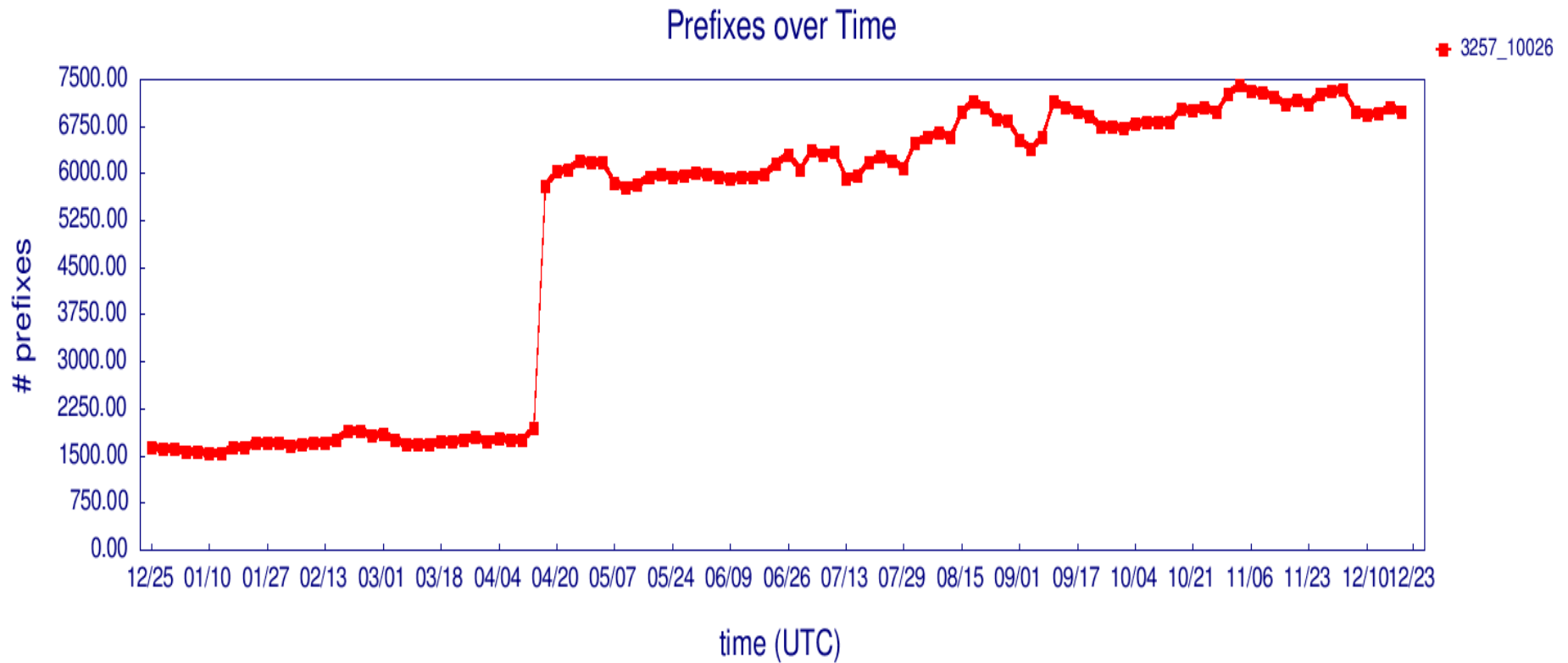
C&W gains big in India, some in Malaysia

Cable & Wireless: 1273; Bharti: 9498; TM Net: 4788



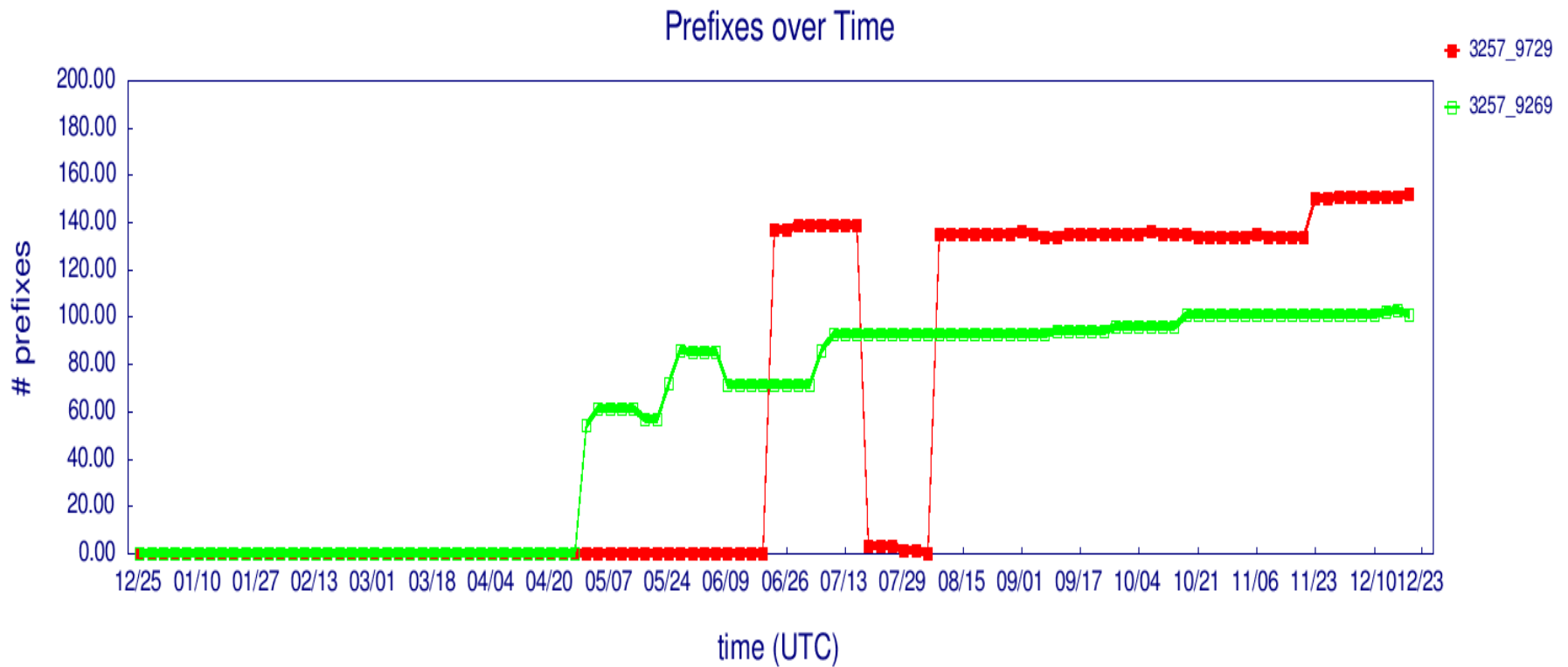
Tiscali gains from Asia Netcom ...

Tiscali: 3257; Asia Netcom: 10026



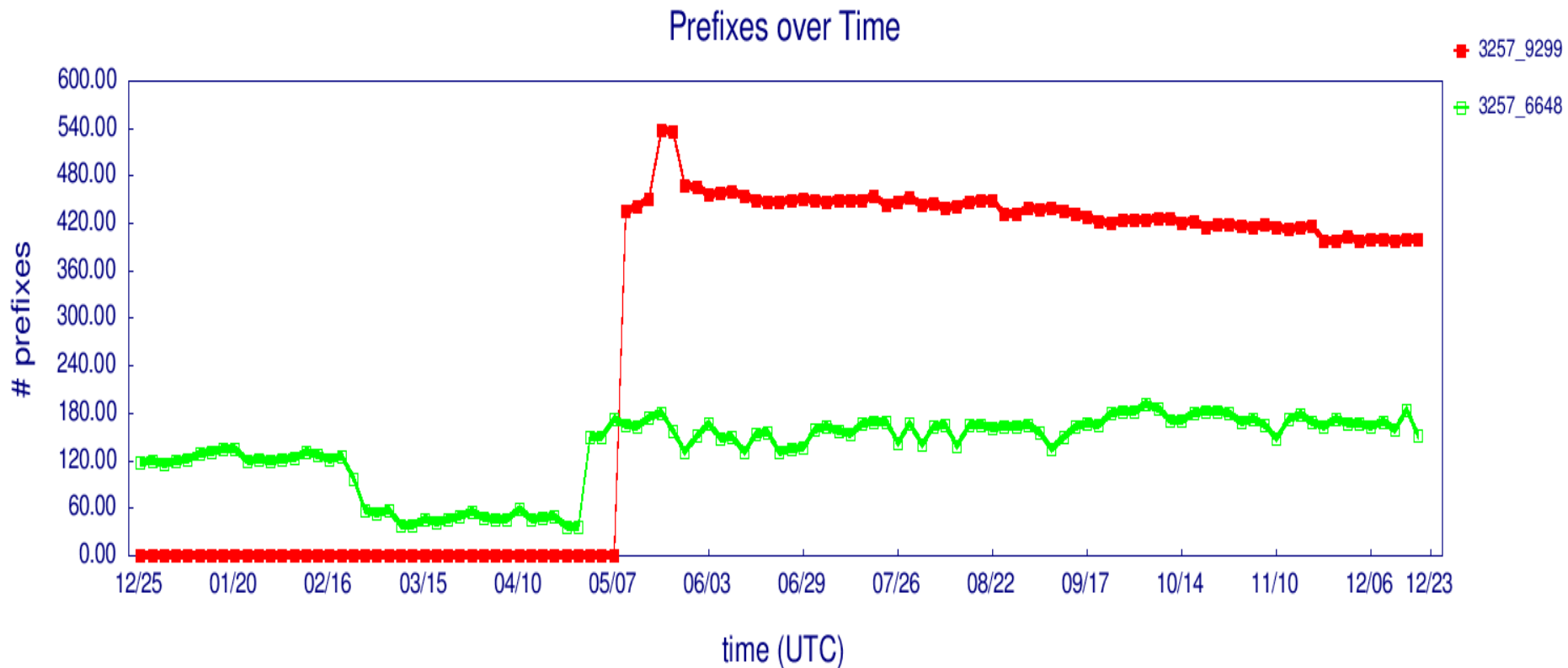
and Tiscali wins providers in Hong Kong ...

Tiscali: 3257; City Telecom: 9269; iAdvantage: 9729



and Tiscali wins providers in Philippines ...

Tiscali: 3257; Bayan Telecom: 6648; Philippine Long Distance Telephone Company: 9299



What happened to the Chinese providers?

Rank	Yr. Rank Change	Provider	ASN
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3	+2	Verizon	701
4	+3	NTT	2914
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Chinese providers dropped in rank because they did not grow *as fast* as some of the other top providers.

Others gained in rank as a result

Conclusions

- Quake and recent Middle East cable cuts illustrate fragility of today's Internet
 - “Local” events can have broad impact
 - Physical failures can be difficult to remedy
 - More capacity is need both east and west
- Asia and Middle East are particularly vulnerable
- Impact is still being felt
 - New business relationships
 - New cable systems
 - Renewed interest in redundancy
 - Renewed interest in land based cables (Russia)

Thank You

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