

# Middle East Meltdown

## A Global BGP Perspective

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# Overview

- Several cables in the Mediterranean and the Persian Gulf were damaged around 30 January 2008
  - 3 cables severed
    - SEA-ME-WE 4 (30 January: 04:30 UTC)
    - Flag (30 January: 08:00 UTC)
    - Flag-Falcon (2 February: 05:59 UTC)
  - At least one other had power problems
- Impacted regions include ...
  - Middle East / North Africa (65% outaged networks w/o Israel)
  - Persian Gulf (45% outaged networks)
  - Indian Subcontinent (32% outaged networks)
- 6856 networks from 23 countries suffered outages

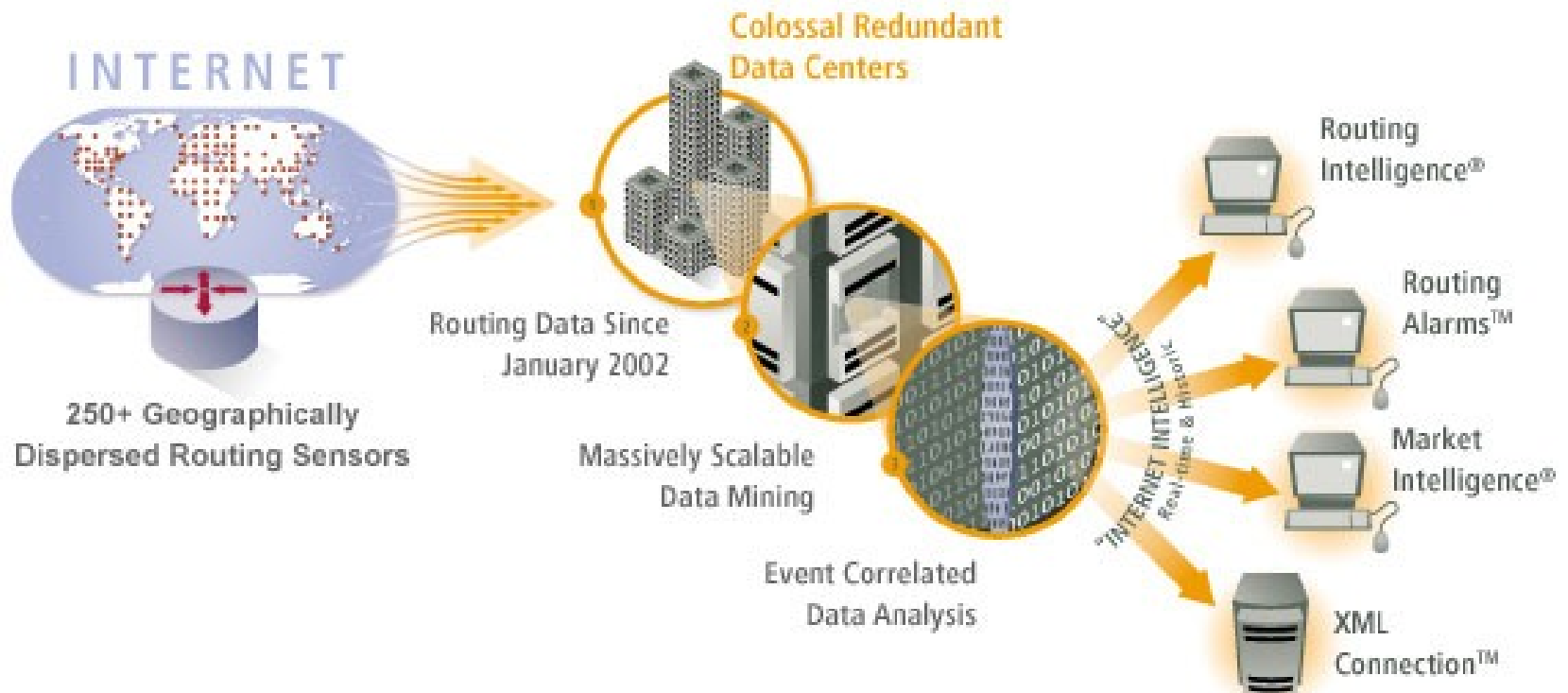
# Impacted Countries



Darker colors represent countries that had outages for more than 50% of their prefixes

# Renesisys Data Collection Infrastructure

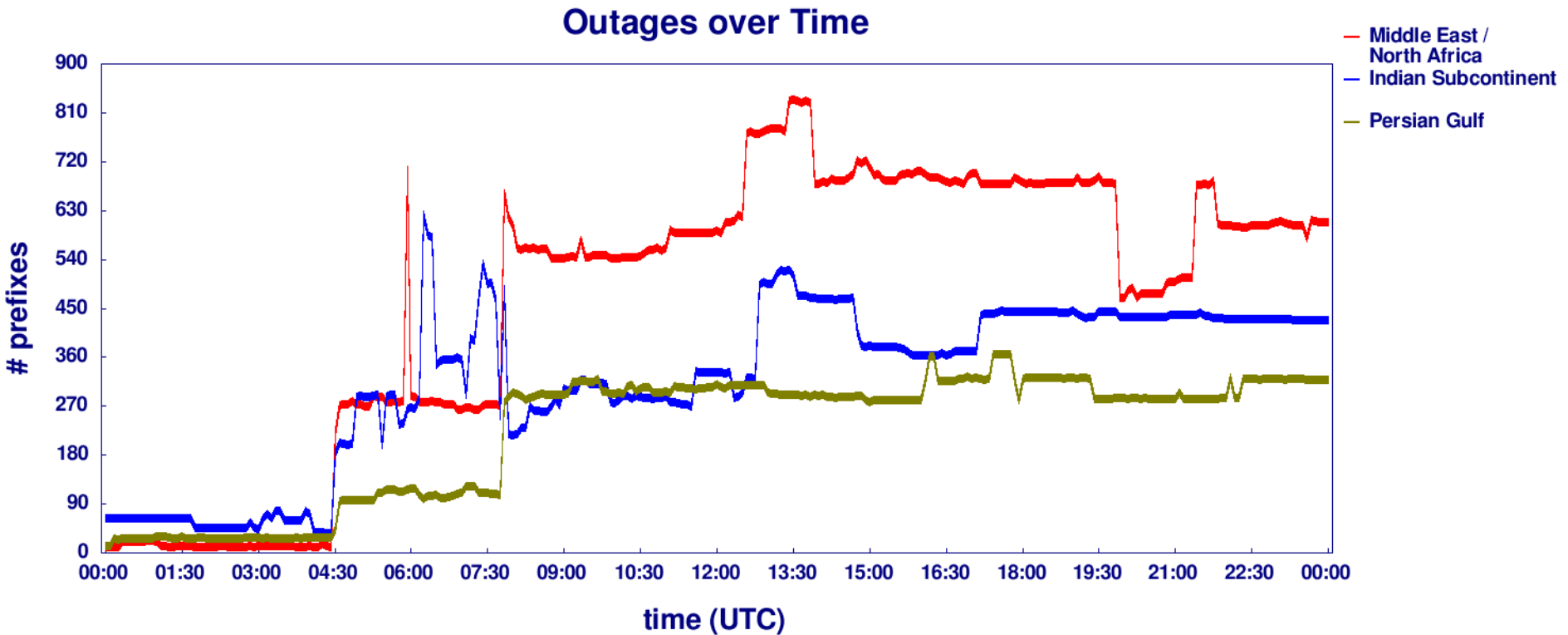
- 250+ full-table peering sessions from 170+ different ASNs
- Initial period for analysis: 30 January to 6 February 2008
- Ignored countries with < 5 networks (e.g., Oman, Yemen)



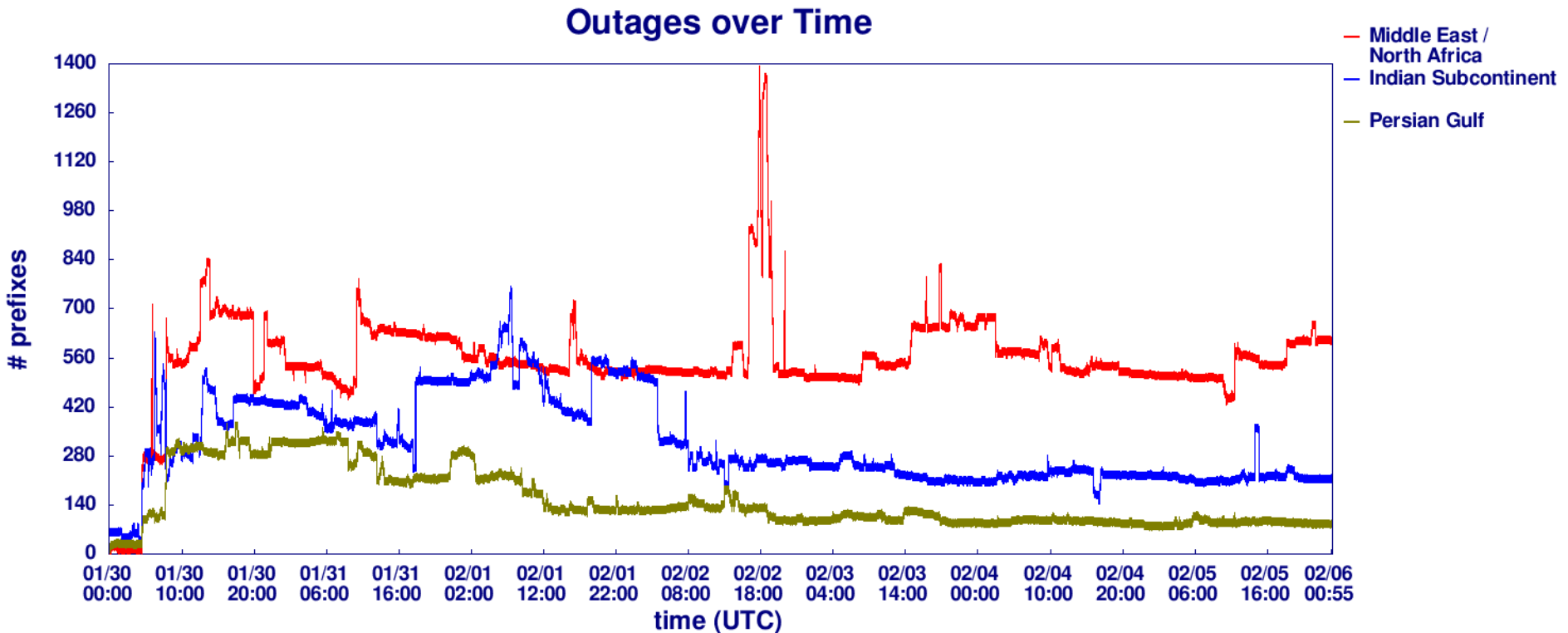
# Definitions: Outage, unreachable, unstable

- A **network outage** occurs when routes to the network are withdrawn by a large number of BGP routers worldwide.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.

# Outages — 30 January

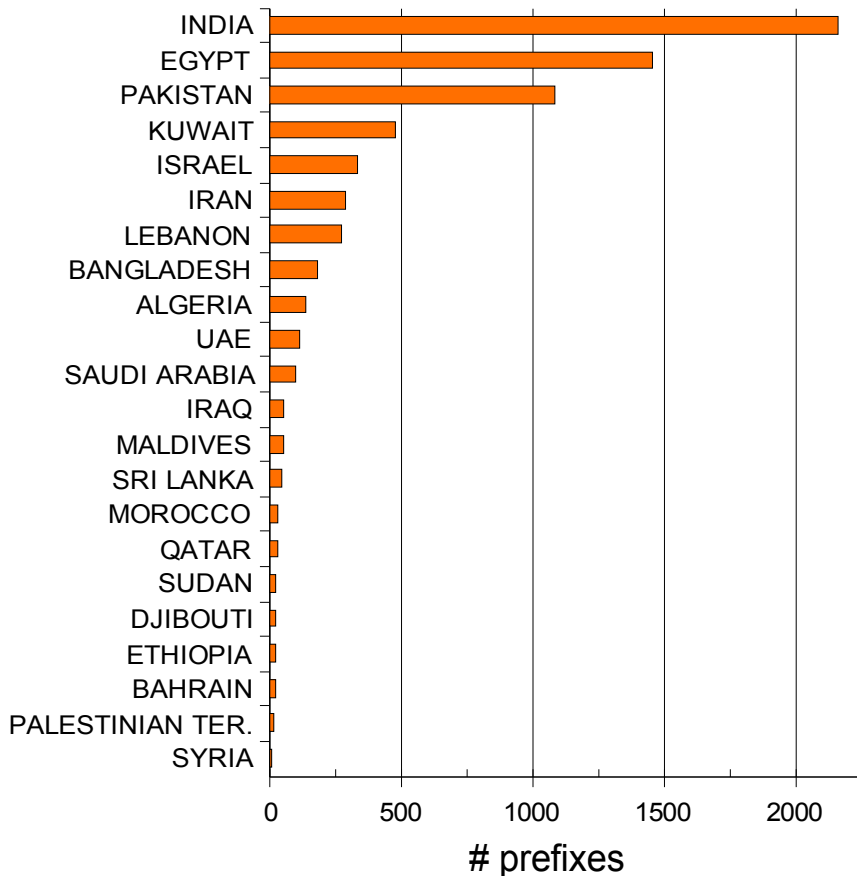


# Outages — 30 January through 6 February

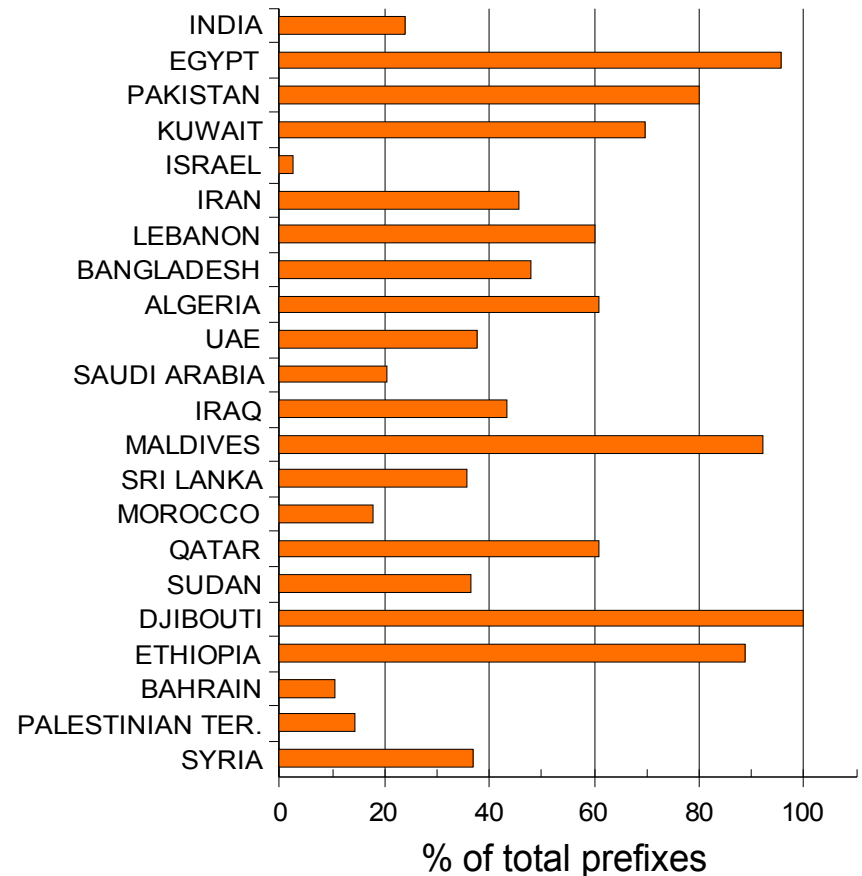


# Outages per Country

## Outages per country (# pfxs)



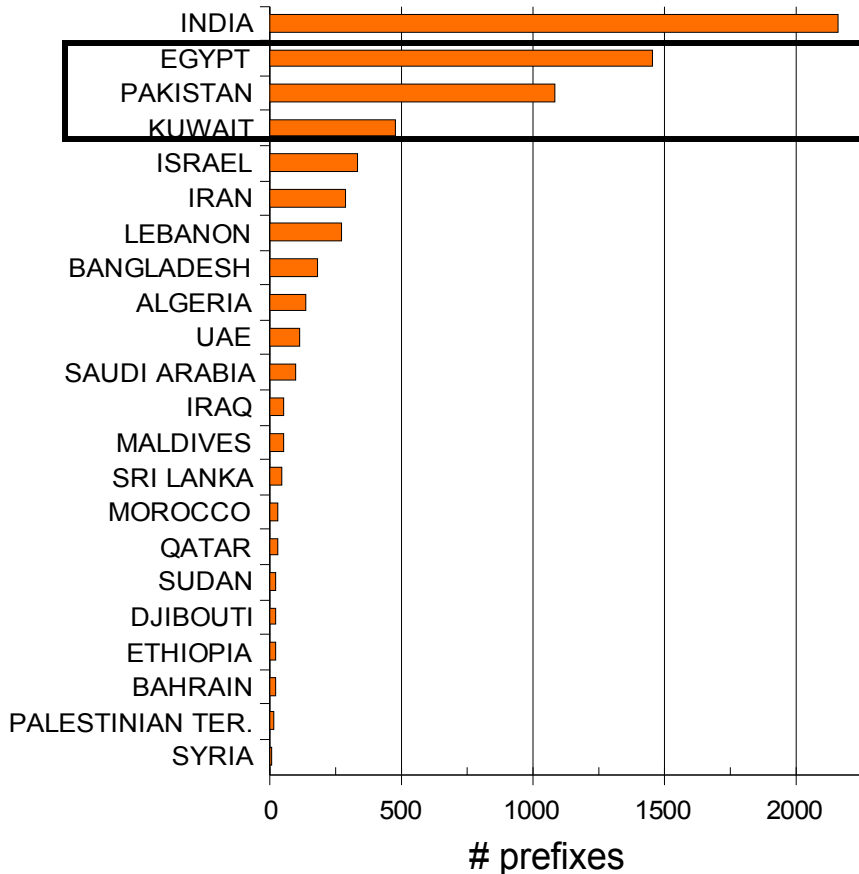
## Outages per Country (%)



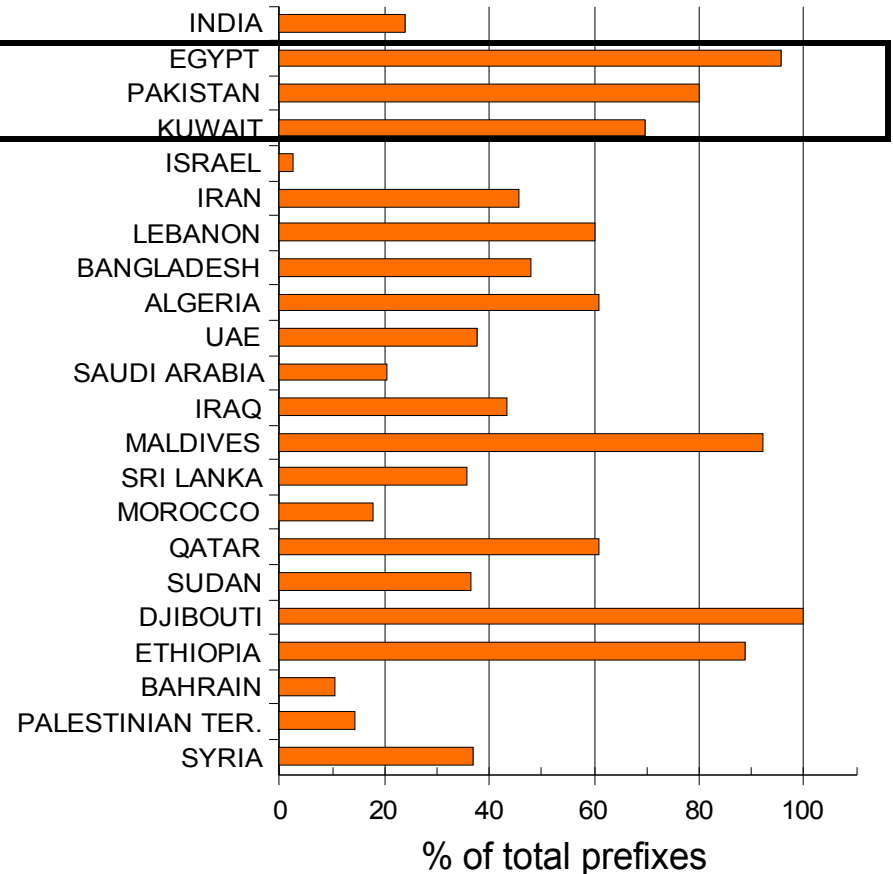


# We examine 3 countries: one per region

## Outages per country (# pfxs)

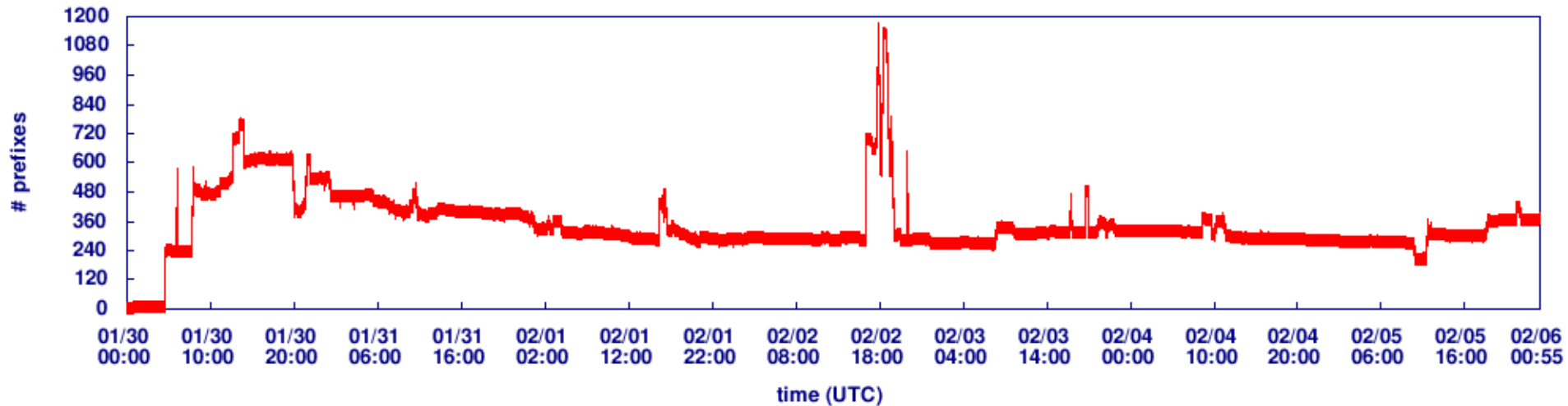


## Outages per Country (%)



# Egypt

## Outages

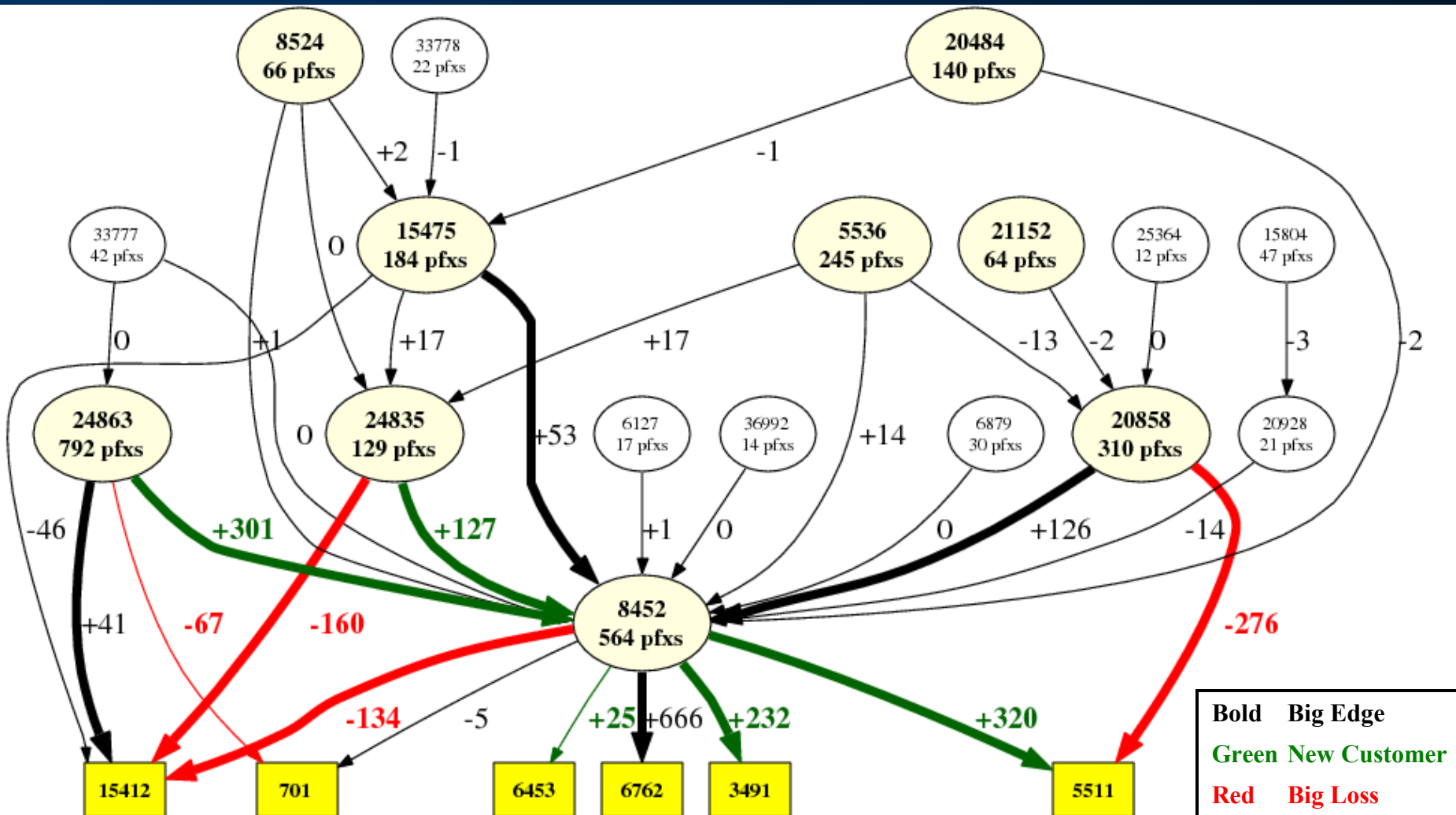


- 95% of prefixes suffered some outage
  - 1456 out of 1502
- Events:
  - 30 Jan around 04:30 UTC and 08:00 UTC (cable breaks)
  - 2 Feb from 16:25 UTC to 19:45 UTC (?)

# Egypt — Major Changes

- Telecom Egypt (8452) gets new providers:
  - PCCW (3491)
  - France Telecom (5511)
  - VSNL/Teleglobe (6453)
- Telecom Egypt gets routes from other Egyptian ISPs:
  - LINKdotNET (24863)
  - RAYA Telecom (24835)
  - EgyNet (20858)
  - Nile Online (15475)
- Flag (15412) was significantly impacted

# Egypt — Simplified Provider Map

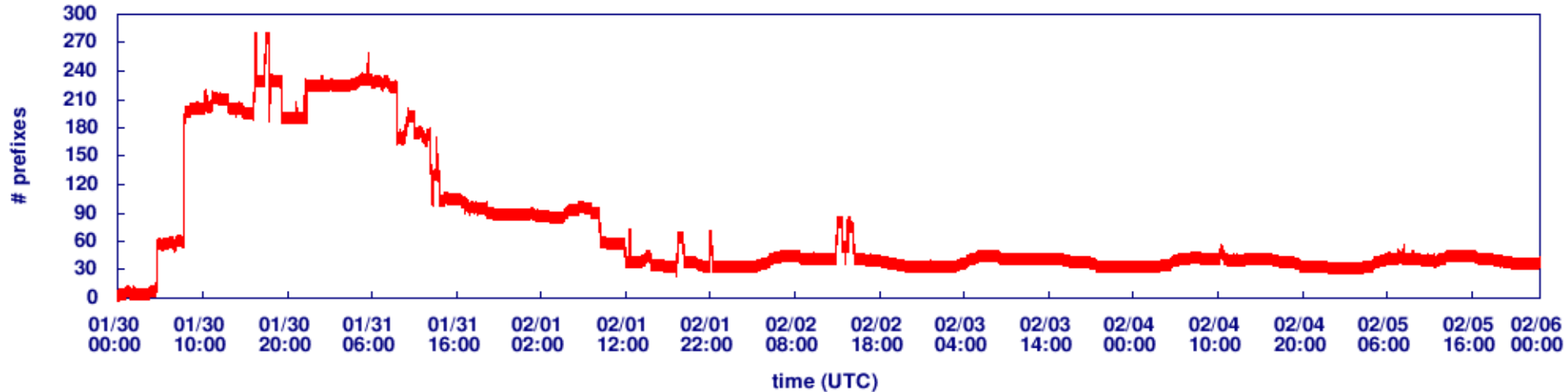


701	Verizon	6453	VSNL	15412	Flag Telecom	20928	Noor Advanced Technologies	33777	Egypt Network SAE
3491	PCCW	6762	Telecom Italia	15475	Nile Online	21152	Soficom	33778	Mantrac Group
5511	France Telecom	6879	EUnet Egypt	15804	The Way Out	24835	RAYA Telecom - Egypt	36992	ETISALAT MISR
5536	Internet Egypt Network	8452	TEDATA	20484	Yalla Online	24863	LINKdotNET		
6127	IDSC	8524	AUCEGYPT	20858	EgyNet	25364	Egypt Cyber Center Network		

**Egress**

# Kuwait

## Outages

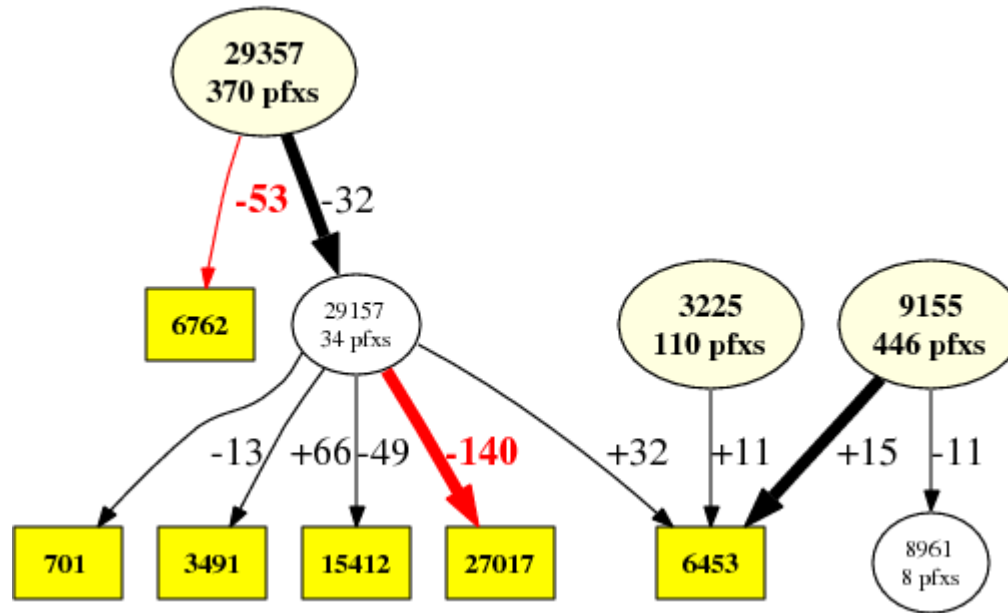


- 70% of prefixes suffered some outage
  - 474 out of 680
- Events:
  - 30 Jan at 04:38 UTC and 07:54 UTC (cable breaks)
  - 31 Jan at 09:00 UTC and 13:00 UTC (partial recovery)
  - 1 Feb – recovery complete for all prefixes that eventually returned.

# Kuwait — Major Changes

- VSNL/Teleglobe gains routes from regional ISPs:
  - Gulfnet Kuwait (3225)
  - QualityNet (9155)
  - Kuwait Internet Exchange (29157)
- PCCW (3491) also gains from Kuwait IX (29157):
- Two ISPs lost big customers:
  - Telecom Italia (6762) loses Wataniya Telecom (29537)
  - Global VoiceCom (27017) loses Kuwait IX (29157)

# Kuwait — Simplified Provider Map



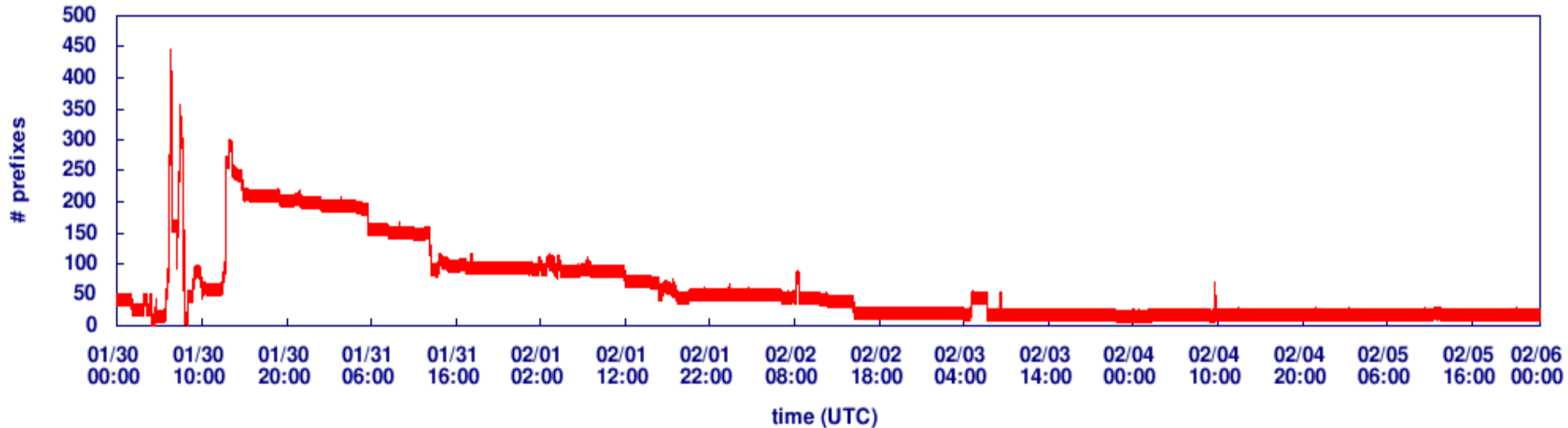
**Bold** Big Edge  
**Green** New Customer  
**Red** Big Loss

**Egress**

701	Verizon	6762	Telecom Italia	27017	Global Voicecom
3225	Gulfnet	8961	Emirates	29157	Kuwait IX
3491	PCCW	9155	QualityNet	29357	Wataniya
6453	Teleglobe	15412	Flag		

# Pakistan

## Outages



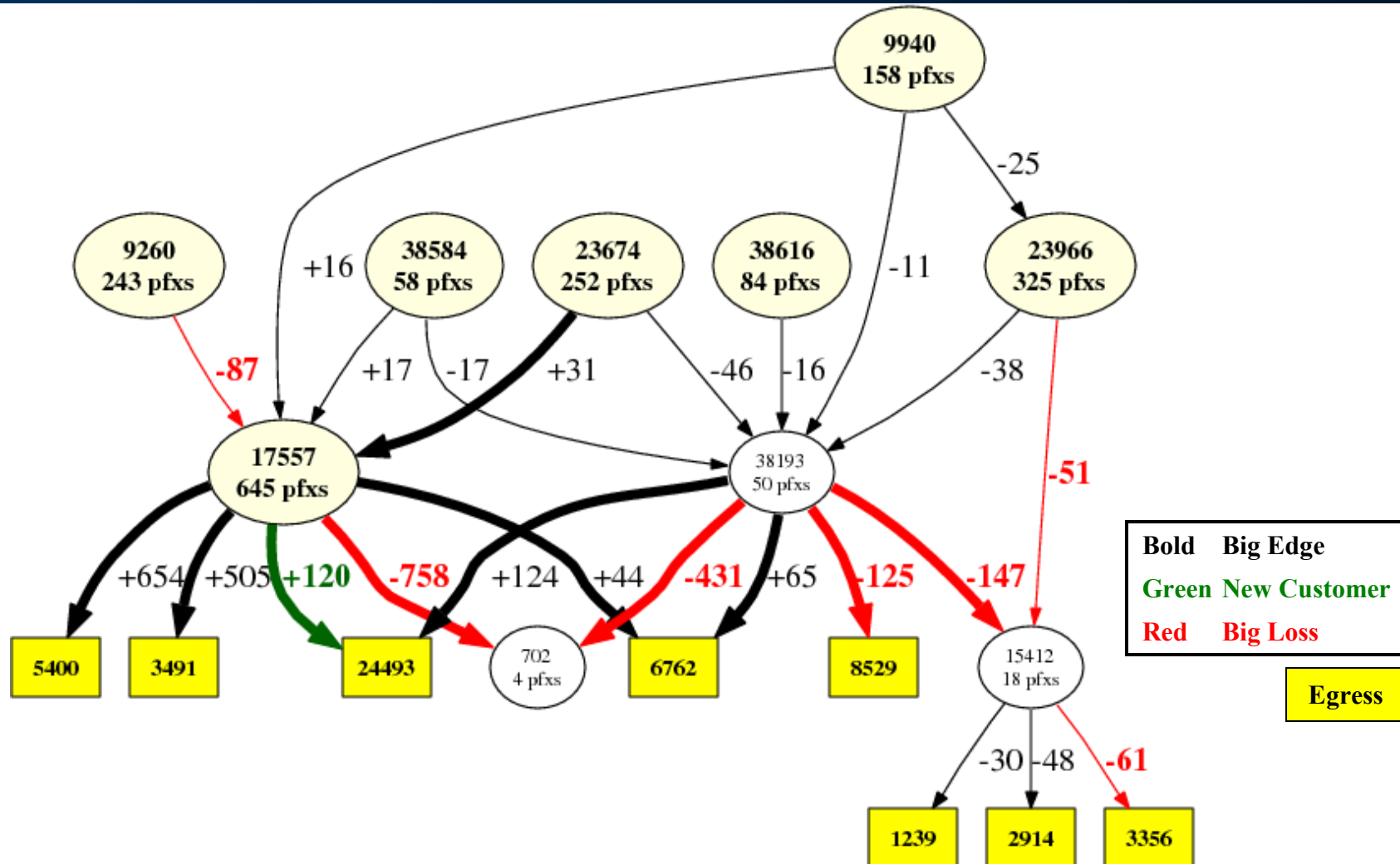
- 80% of prefixes suffered some outage
  - 1079 out of 1351
- Events:
  - 30 Jan at 04:31 UTC (big spike), 06:30 (recovery)
  - 30 Jan at 12:53 UTC (2<sup>nd</sup> spike that stayed)
  - 30 Jan from 13:38 UTC to Feb 2 (gradual recovery)



# Pakistan — Major Changes

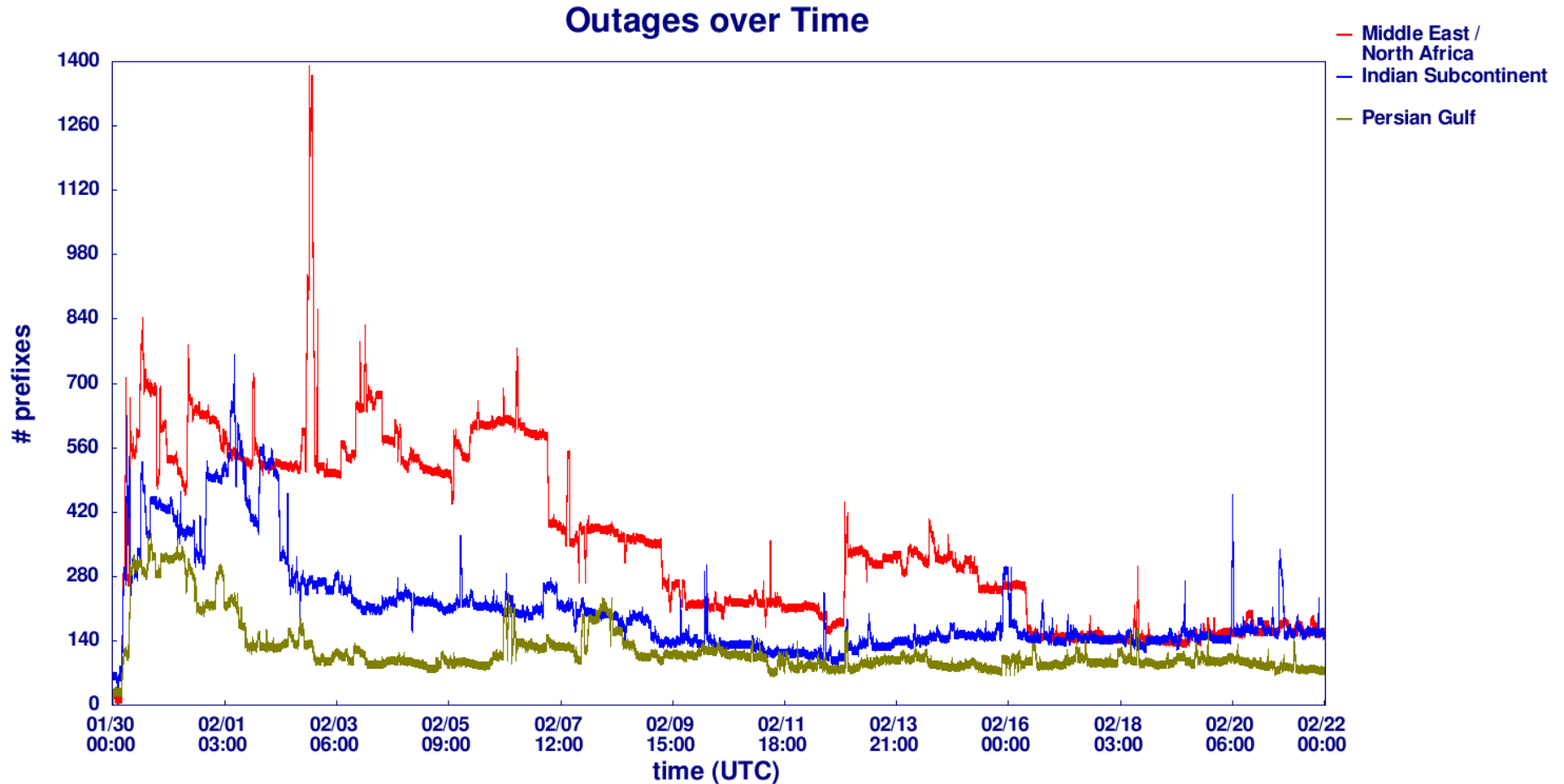
- Verizon (702) lost the most:
  - Lost Pakistan Telecom (17557)
  - Lost Transworld (38193)
  - Where was 703? Downside of not having an global AS?
- Flag (15412) lost routes
  - Lost routes to Dancom Online Services (23966)
  - Lost routes to Transworld (38193)
- Pakistan Telecom (17557) reshuffles their transit:
  - Picks up STIXLITE (24493 – Singapore) as new provider
  - Adds routes to existing providers
    - BT (5400)
    - Telecom Italia (6762)
    - PCCW (3491)

# Pakistan — Simplified Provider Map



702	Verizon	5400	BT	15412	Flag	38193	Transworld
1239	Sprint	6762	Telecom Italia	17557	Pakistan Telecom	38584	CubeXS
2914	NTT	8529	Oman Telecom	23674	Micronet	38616	Worldcall
3356	Level 3	9260	MultiNet	23966	Dancom		
3491	PCCW	9940	Cybersoft	24493	Stixlite		

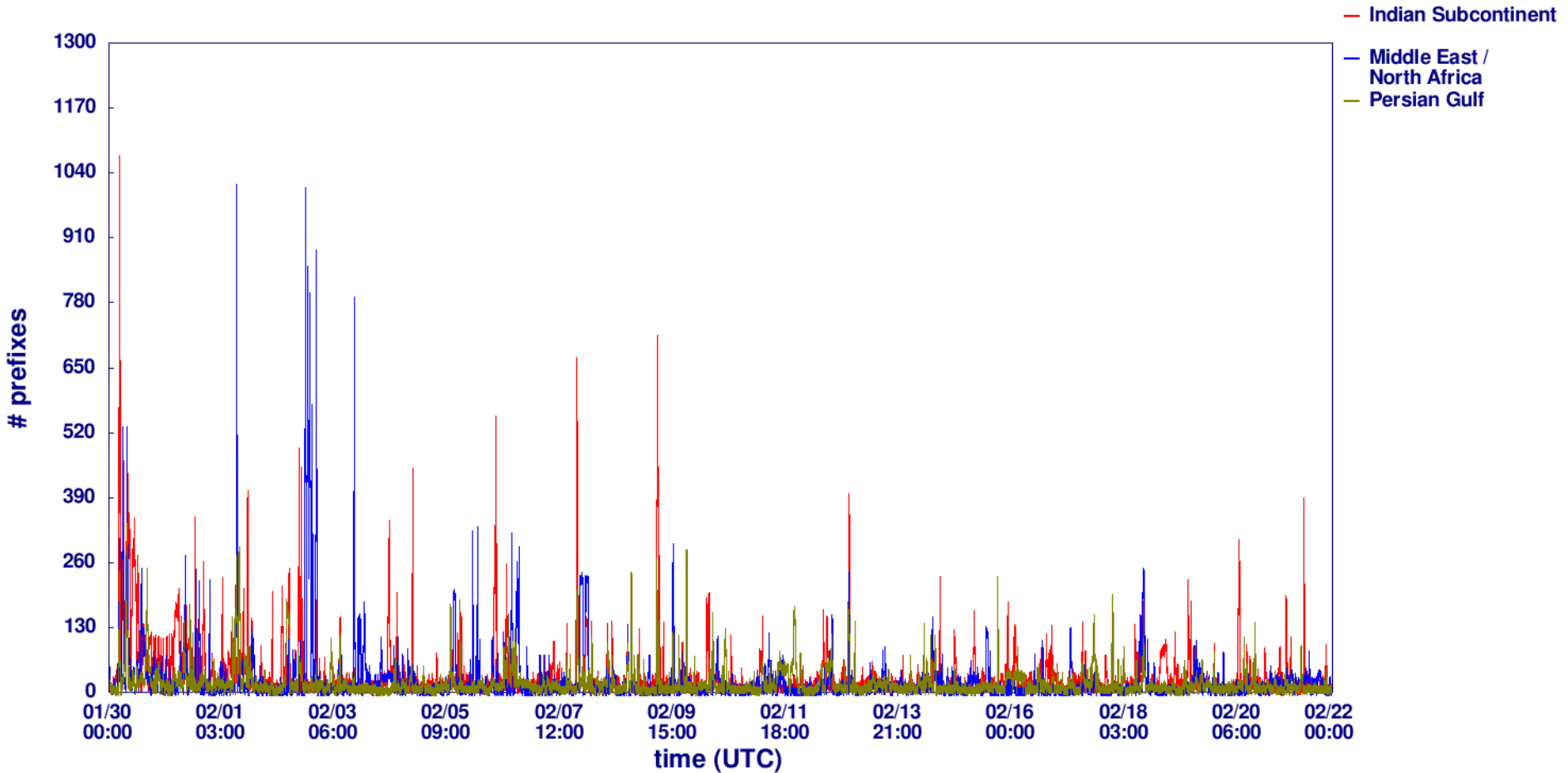
# What is happening now?



# Are networks still out?

- All cables have now been repaired
  - Prefixes can be engineered out of existence
    - Two /23s might now be announced as a single /22
  - “Outaged” networks may now be reachable
- What about stability?
  - Dead prefixes are completely stable
  - Reachable prefixes can still be impacted.
  - Capacity reduced + long latencies
    - => BGP session resets => BGP instability

# Unstable networks



# Conclusions from the data

- Providers with capacity in *both* directions won, e.g., ...
  - PCCW
  - VSNL/Teleglobe
- Local incumbents quickly gained new transit, e.g., ...
  - Telecom Egypt
  - Pakistan Telecom
- Smaller providers sought help from the incumbents

# Lessons learned (again)

- You get what you pay for
  - Natural trade-off: cost, performance/latency vs. reliability
- Entropy happens
  - Cables break in the Atlantic all the time, nobody notices
- Geography plays an important role
  - Cables break in the Taiwan Straits or Suez Canal, entire geographic regions lose connectivity
- Internet intelligence is essential for disaster planning and recovery
  - For local ISPs to select new providers
  - For a global ISP to acquire new customers

# Now what?

- Cable cuts illustrate fragility of today's Internet
- Asia and Middle East are particularly vulnerable
- Solutions revolve around ...
  - Educated Internet consumers
  - New business relationships
  - Local peering (IXs)
    - At least individual countries/regions can retain connectivity
  - New cable systems
  - Physical redundancy
    - Different submarine cables with different paths
    - Land-based systems where possible
    - Satellite backup links?



# Thank You

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