Recent Cable Breaks
A Middle East & Persian Gulf Perspective

MENOG 3 Kuwait
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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)
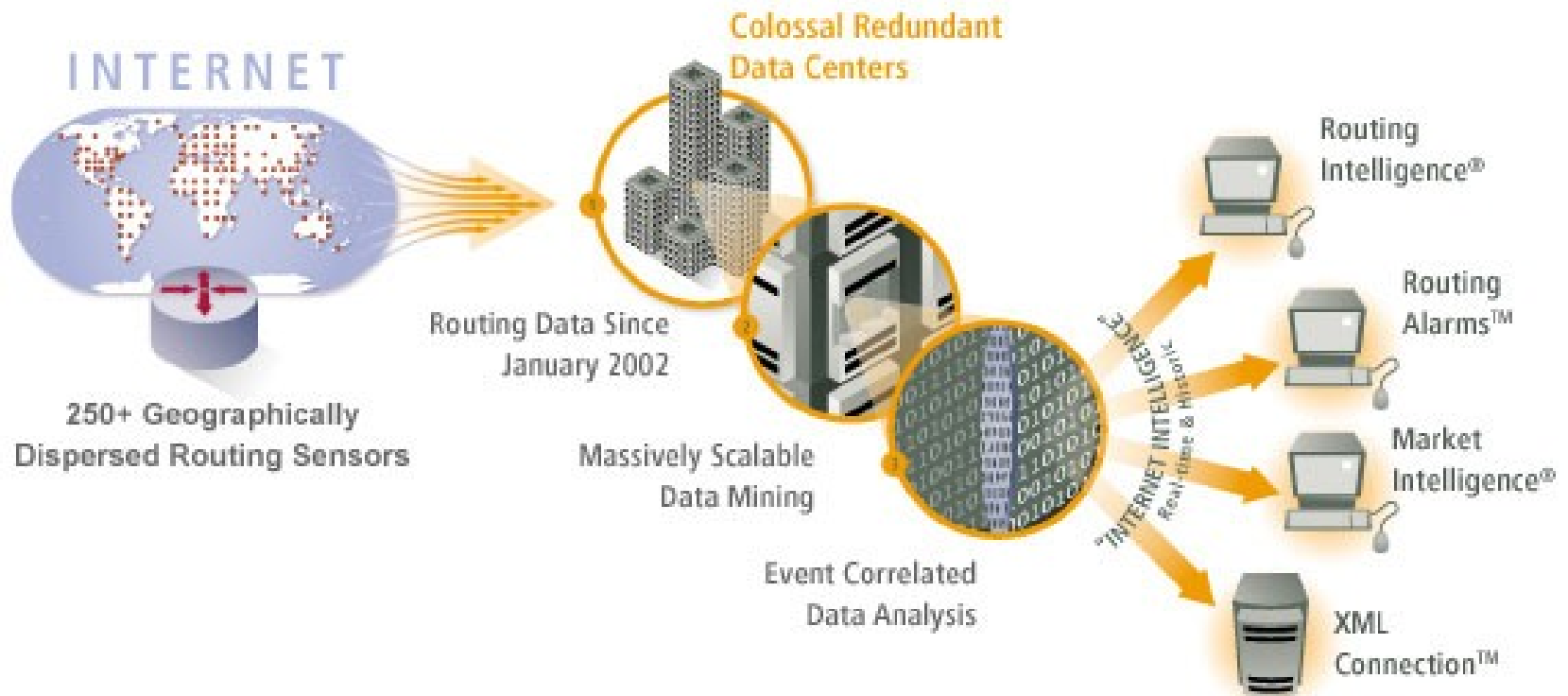
- 6856 networks from 23 countries suffered outages

Impacted Countries

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

Renesys Data Collection Infrastructure

- 270+ full-table peering sessions from 180+ different ASNs
- Initial analysis: 30 January to 6 February 2008 (1st week)
- Final analysis: End of March (2 months later)
- Ignored countries with < 5 networks (e.g., Oman, Yemen)

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Event Correlated Data Analysis

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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- A **network outage** occurs when routes to the network are withdrawn by a large number of BGP routers worldwide.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.
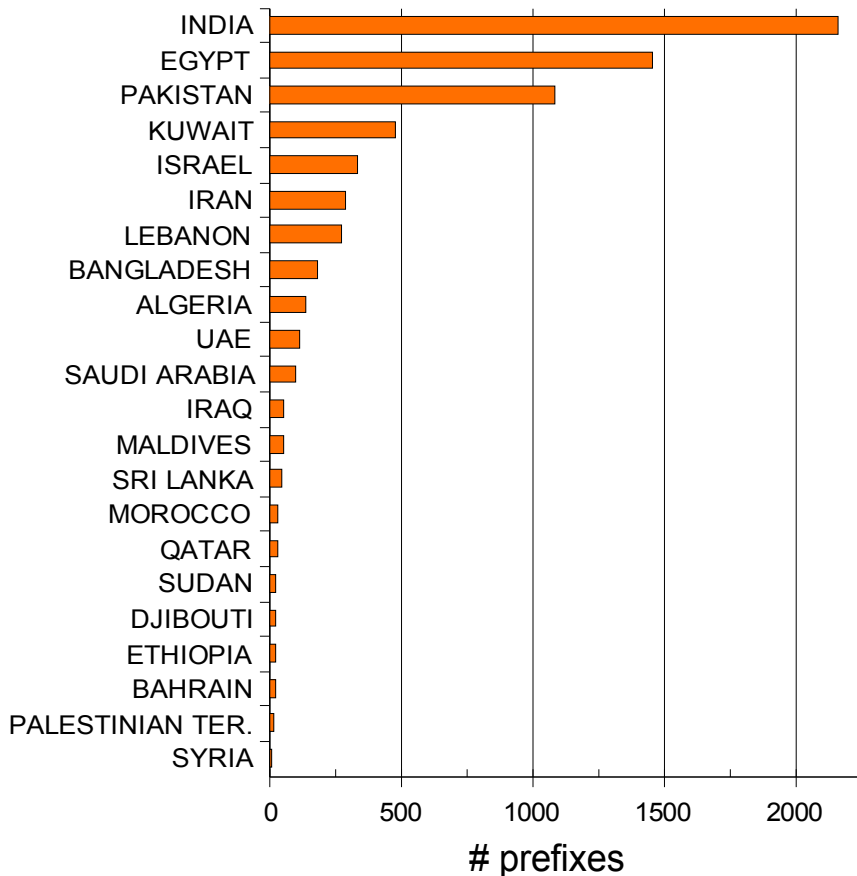
Outages — January 30th

Outages over Time
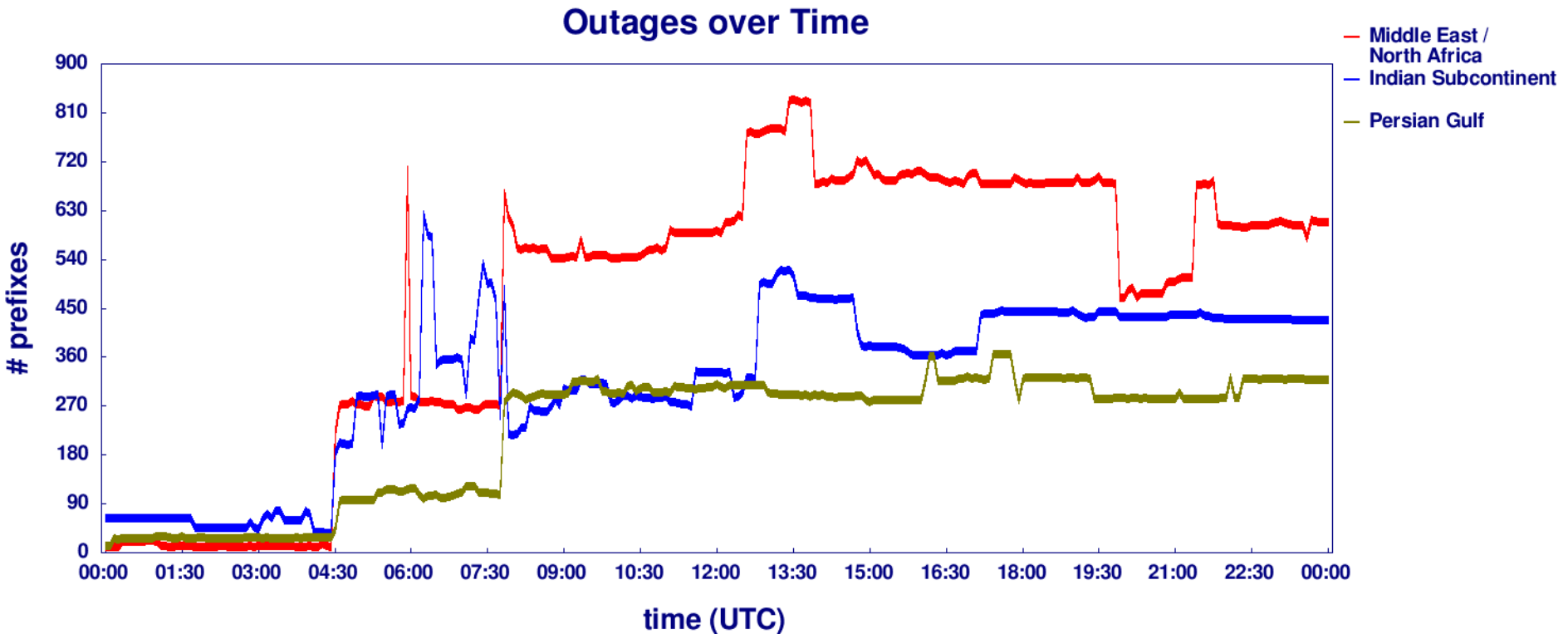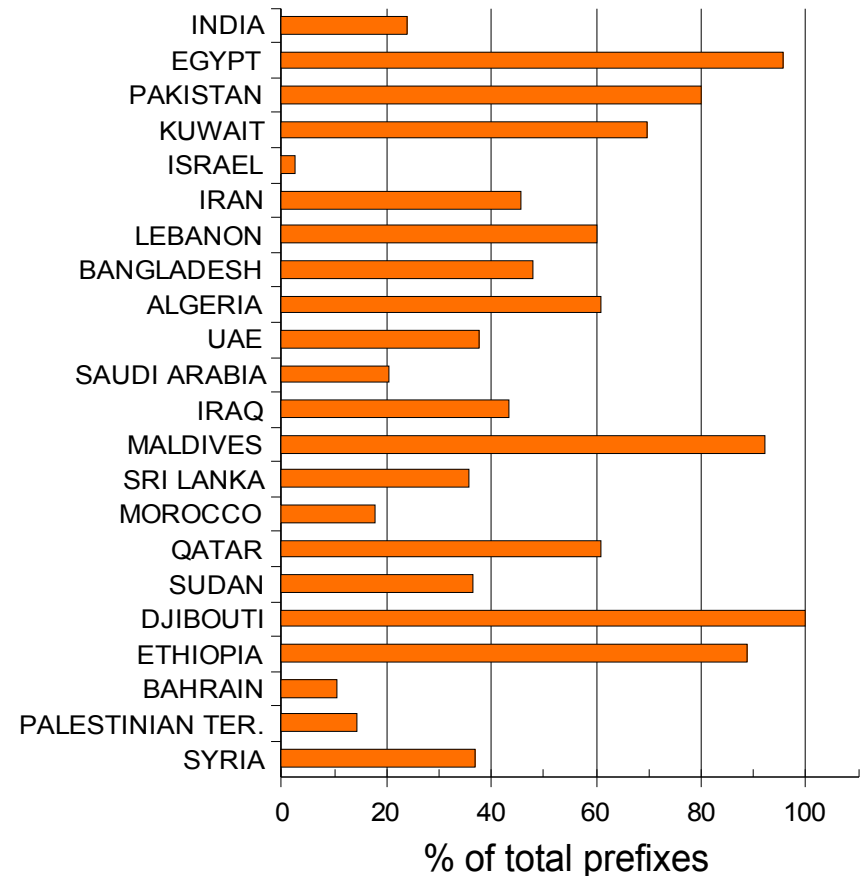
Outages — A week from January 30th

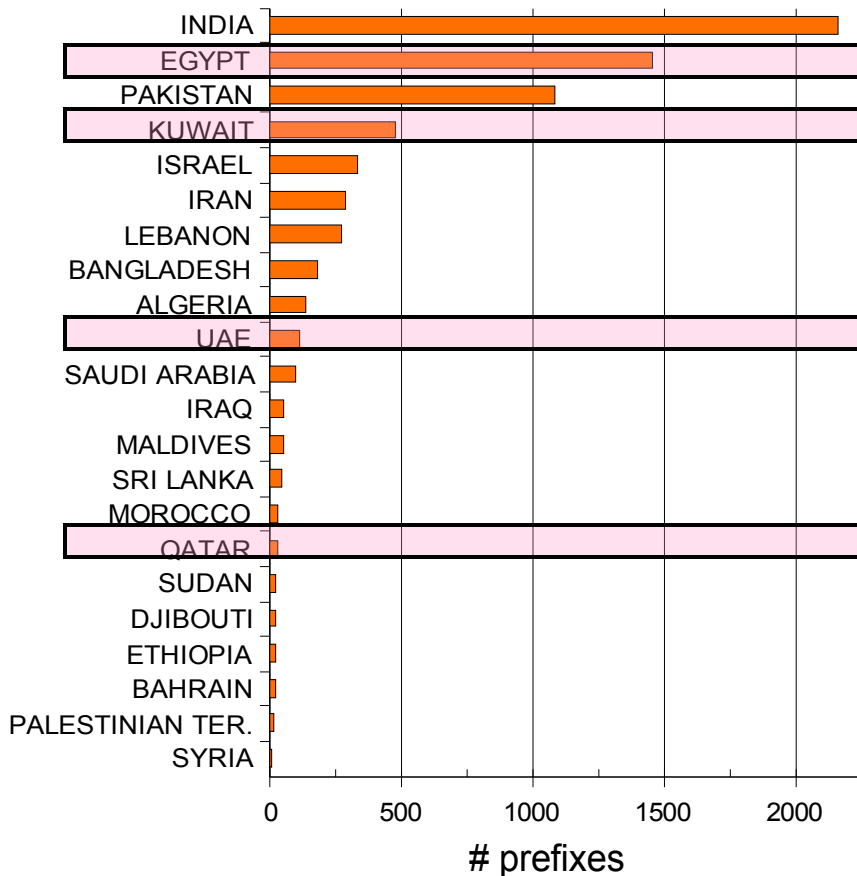Outages over Time
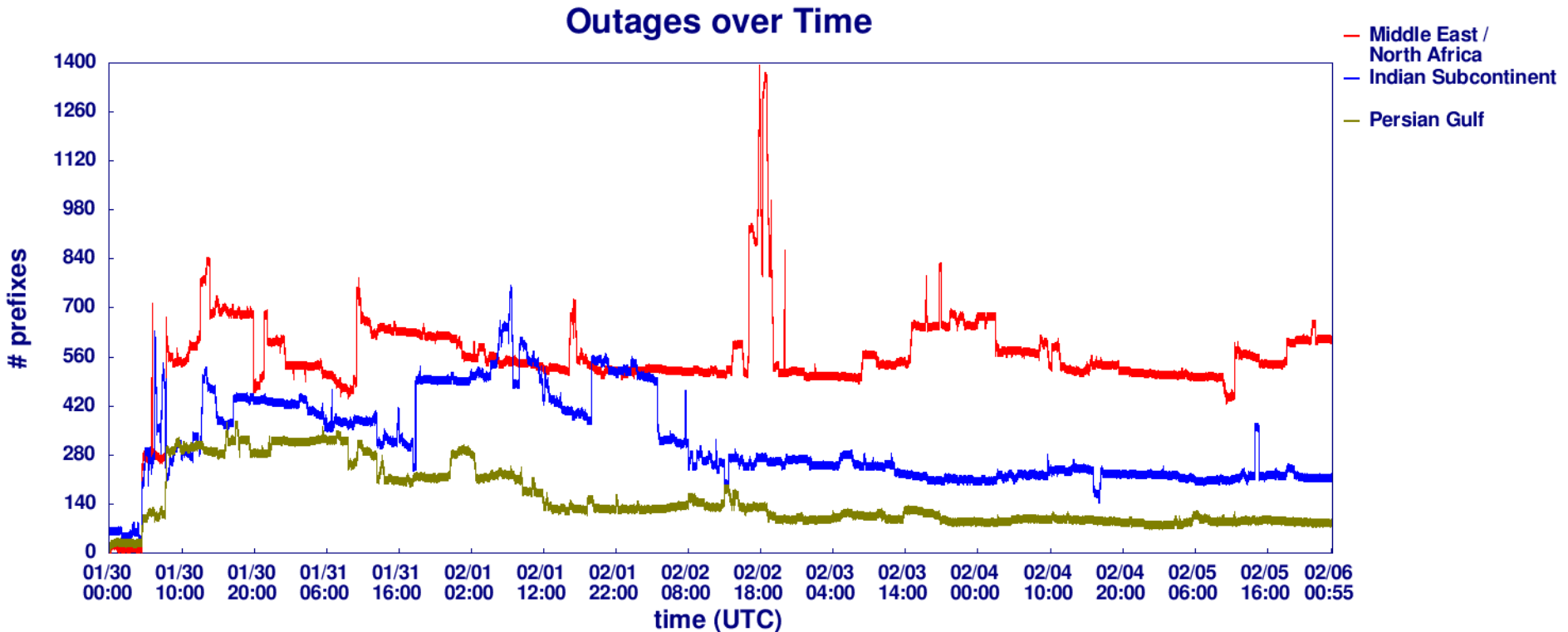
Outages per Country

Outages per country (# pfxs)

Outages per Country (%)
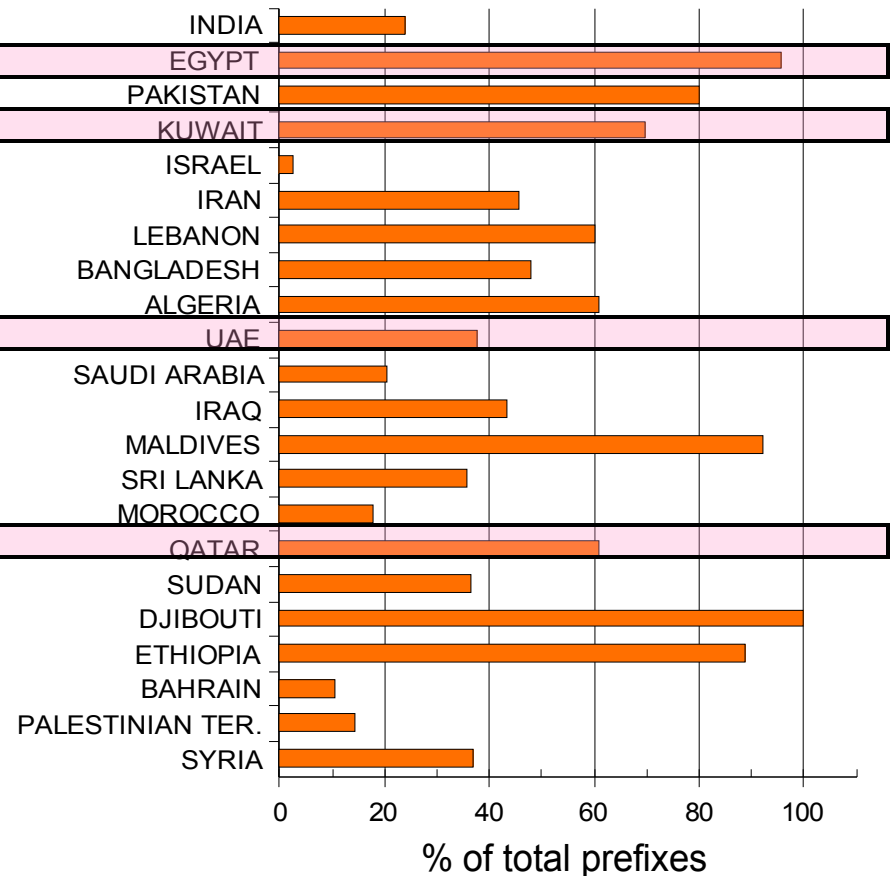
We examine 4 countries: based on MENOG attendance as of end of March
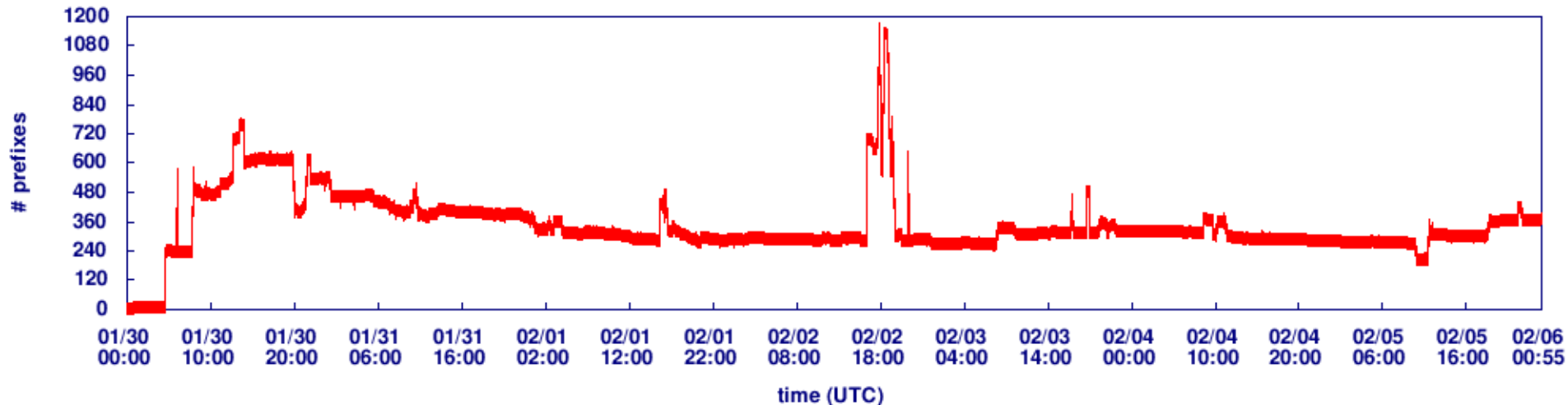
Outages per country (# pfxs)

Country	# prefixes
INDIA	~2150
EGYPT	~1450
PAKISTAN	~1100
KUWAIT	~470
ISRAEL	~330
IRAN	~290
LEBANON	~270
BANGLADESH	~170
ALGERIA	~120
UAE	~110
SAUDI ARABIA	~90
IRAQ	~60
MALDIVES	~50
SRI LANKA	~40
MOROCCO	~30
QATAR	~30
SUDAN	~20
DJIBOUTI	~20
ETHIOPIA	~20
BAHRAIN	~15
PALESTINIAN TER.	~15
SYRIA	~5

Outages per Country (%)

Country	% of total prefixes
INDIA	~22
EGYPT	~95
PAKISTAN	~80
KUWAIT	~68
ISRAEL	~3
IRAN	~45
LEBANON	~60
BANGLADESH	~48
ALGERIA	~60
UAE	~38
SAUDI ARABIA	~20
IRAQ	~43
MALDIVES	~92
SRI LANKA	~35
MOROCCO	~17
QATAR	~60
SUDAN	~36
DJIBOUTI	~100
ETHIOPIA	~88
BAHRAIN	~10
PALESTINIAN TER.	~14
SYRIA	~37

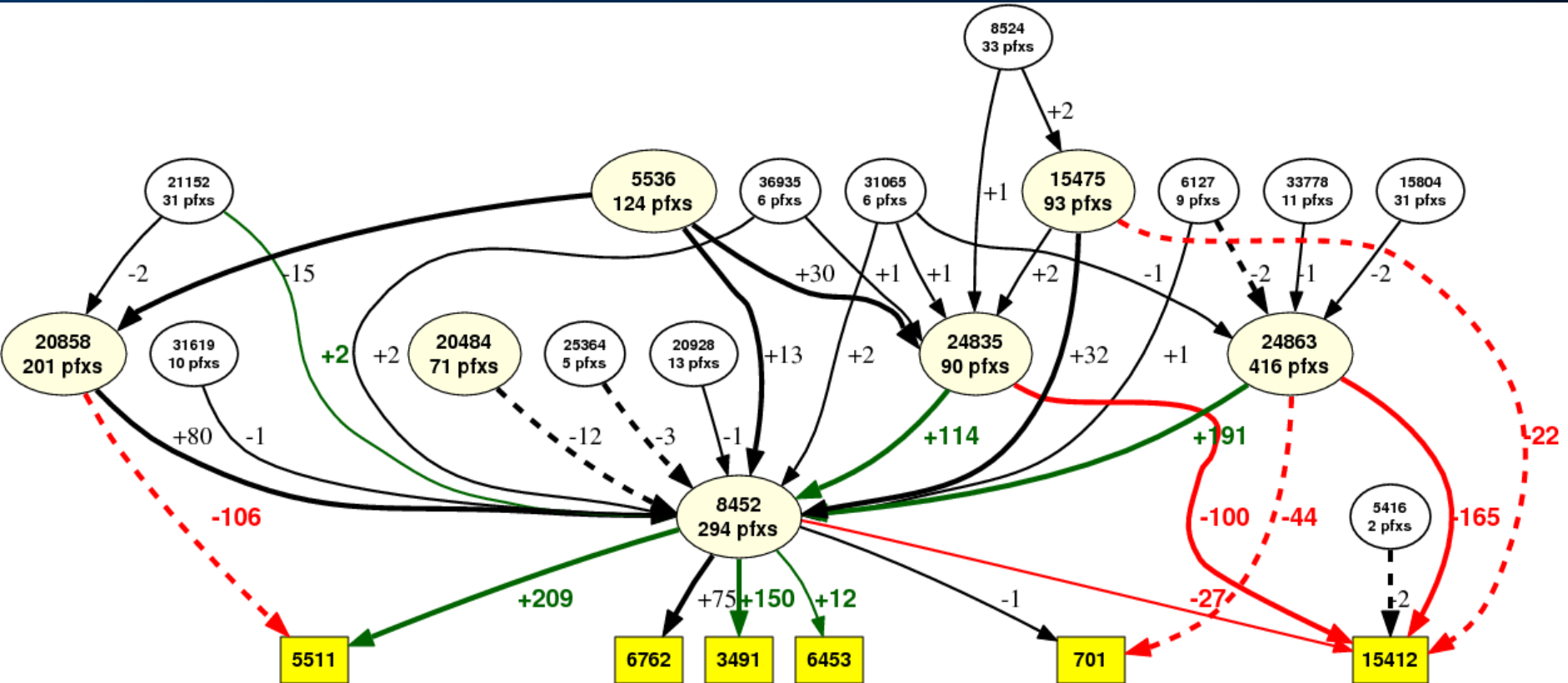# Egypt – during week of the cable breaks

Outages

- 96% of prefixes suffered some outage
  - 1456 out of 1520
- Events:
  - Jan 30th around 04:30 UTC and 08:00 UTC (cable breaks)
  - Feb. 2nd from 16:25 UTC to 19:45 UTC (engineering problem?)

Legend for Simplified Provider Maps

- All changes are shown relative to the state of the networks immediately *before* the cable breaks

- A "lost" prefix is ignored if there exists a routed covering prefix with the same origin (much re-engineering after the cable repairs)

- <u>Edges</u> (annotated with ± change in carried prefixes)
  - Shown only if there was **some change**, ≥ 2 prefixes seen by ≥ 25 Renesys peers, and seen for a reasonable amount of time
  - **Thick:** carries > 40 prefixes at some time
  - Red: losses of > 20 prefixes
  - Green: new provider (carried no prefixes before the cable breaks)
  - **- - - -** : effectively gone (carries no prefixes now)

- <u>ASes</u> (annotated with number of originated prefixes)
  - **Bold**: originates ≥ 50 prefixes
  - 12345 : egress AS from country

Egypt — Simplified Provider Map (1 week later)

701 **Verizon**	6127 IDSC	**15412** **Flag Telecom**	20928 Noor Advanced Technologies	31065 EG Ministry of Comm.
3491 **PCCW**	**6453** **Teleglobe**	**15475** **Nile Online**	**21152** **Soficom**	31619 City Stars
5416 Batelco	**6762** **Telecom Italia**	15804 The Way Out	**24835** **RAYA Telecom - Egypt**	33778 Mantrac Group
5511 **France Telecom**	**8452** **TEDATA**	**20484** **Yalla Online**	**24863** **LINKdotNET**	36870 It Worx
5536 **Internet Egypt Network**	**8524** **AUCEGYPT**	**20858** **EgyNet**	25364 Egypt Cyber Center Network	**36935** **Vodafone Egypt**

Legend:
- **Bold** — **Big Edge**
- **Green** — **New Customer**
- **Red** — **Big Loss**

Egress

Egypt — Major Immediate 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 (2 months later)

701	Verizon	6127	IDSC	**15412**	**Flag Telecom**	20928	Noor Advanced Technologies	31065	EG Ministry of Comm.
3491	**PCCW**	**6453**	**Teleglobe**	**15475**	**Nile Online**	**21152**	**Soficom**	31619	City Stars
5416	Batelco	**6762**	**Telecom Italia**	15804	The Way Out	**24835**	**RAYA Telecom - Egypt**	33778	Mantrac Group
5511	**France Telecom**	**8452**	**TEDATA**	20484	Yalla Online	**24863**	**LINKdotNET**	36935	Vodafone Egypt
5536	**Internet Egypt Network**	**8524**	**AUCEGYPT**	**20858**	**EgyNet**	25364	Egypt Cyber Center Network		

Egypt — Lasting Changes

- Telecom Egypt (8452) retained their new providers
  (but fewer prefixes are routed this way):
  - PCCW (3491)
  - France Telecom (5511)
  - VSNL/Teleglobe (6453)

- Telecom Egypt retained routes from:
  - LINKdotNET (24863)
- … but lost routes from:
  - EgyNet (20858)
  - RAYA Telecom (24835)
  - Nile Online (15475)

- Flag (15412) largely recovered
- Telecom Italia (6762) and Verizon (701) both lost

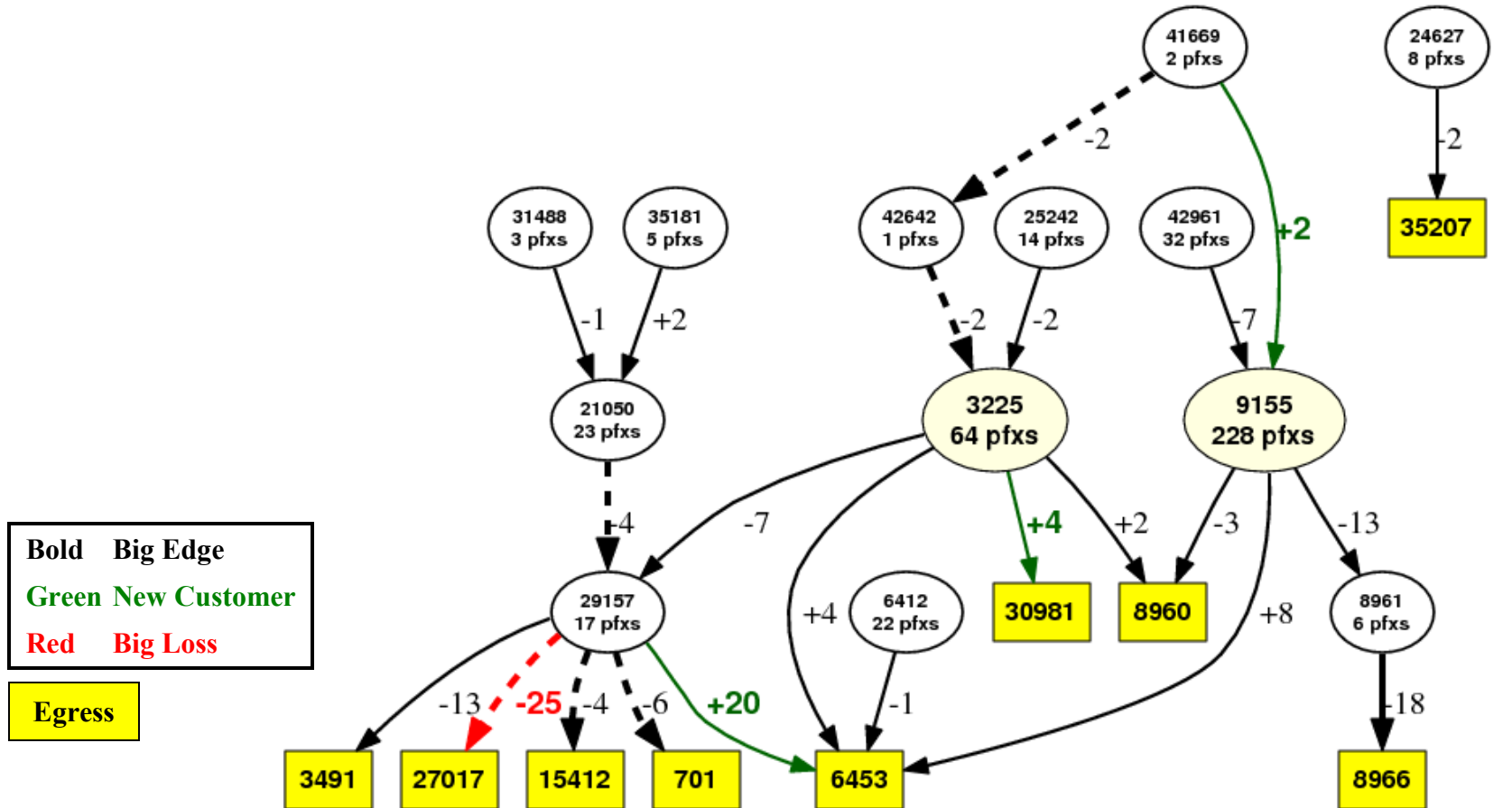# Kuwait – during week of the cable breaks
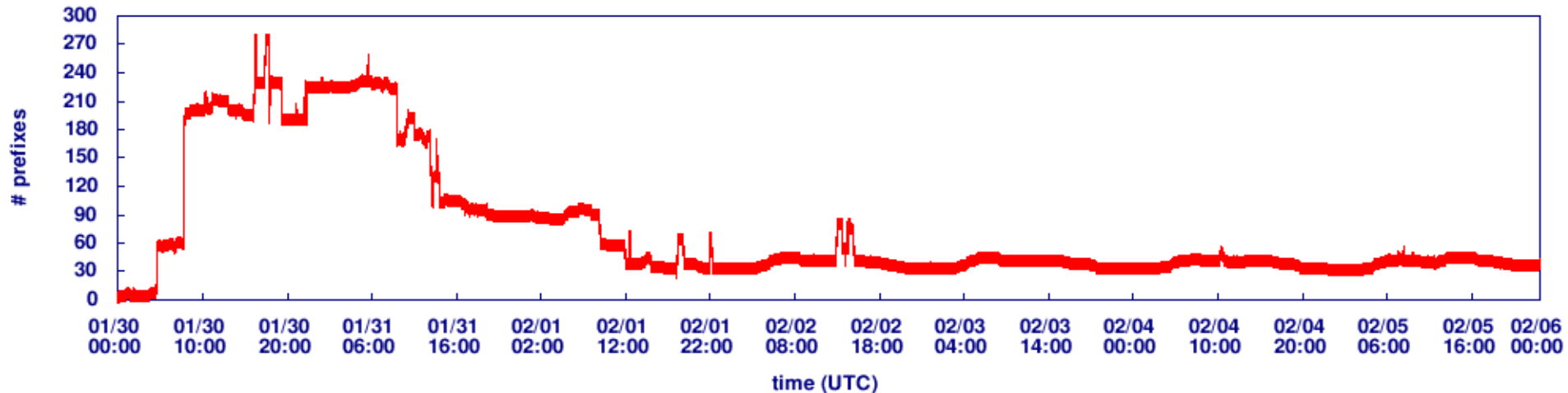
Outages

- 70% of prefixes suffered some outage
  - 474 out of 681
- Events:
  - Jan 30th at 04:38 UTC and 07:54 UTC (cable breaks)
  - Jan 31st at 09:00 UTC and 13:00 UTC (partial recovery)
  - Feb 1st – recovery complete for all prefixes that eventually returned.
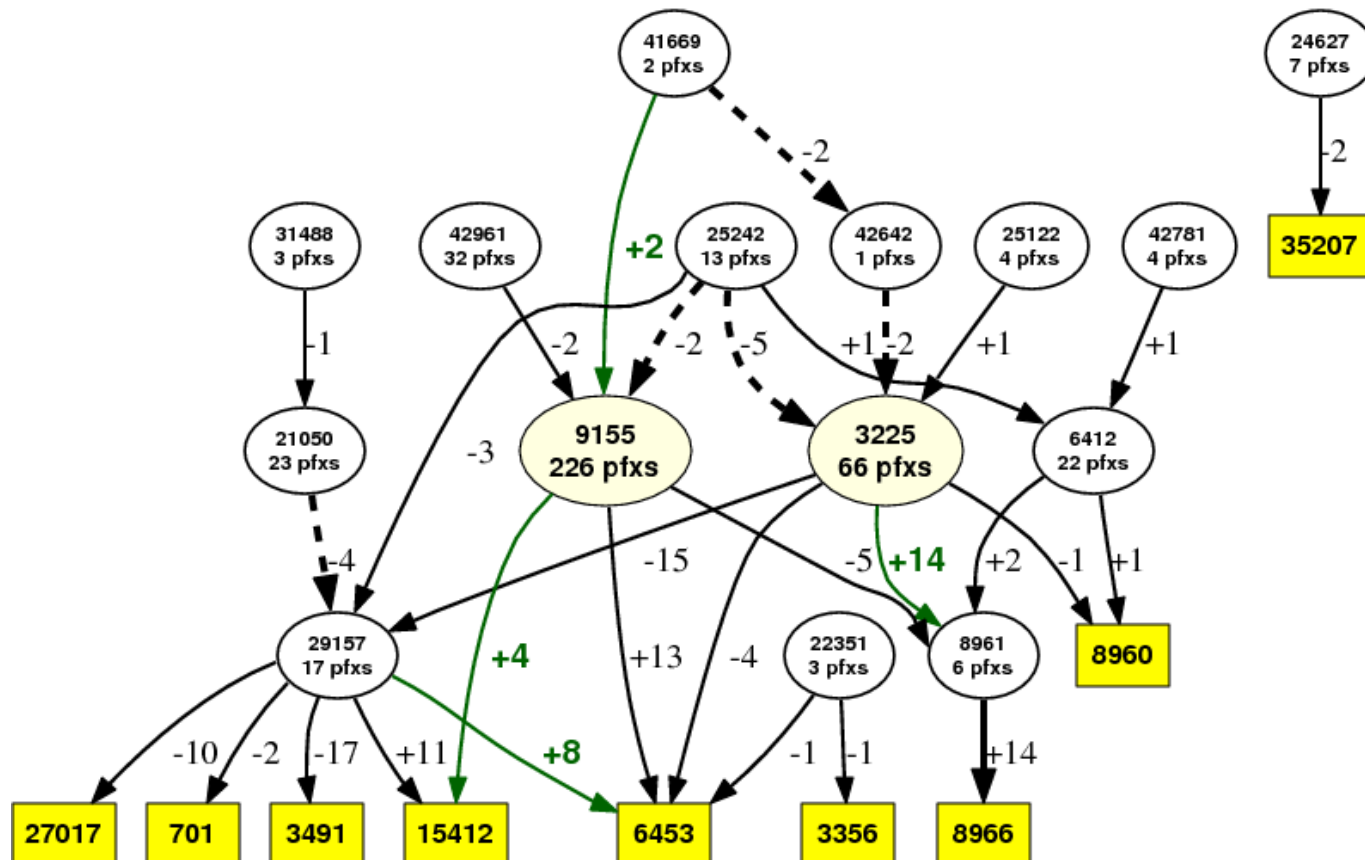
Kuwait — Simplified Provider Map (1 week later)

Bold Big Edge
Green New Customer
Red Big Loss

Egress

701	**Verizon**	**6453**	**Teleglobe**	22351	INTELSAT	29157	Kuwait IX	41669	Tawasul Telecom
3225	**Gulfnet**	**8960-6**	**Emirates**	24627	Shownet	**30981**	**Horizon Satellite**	42642	Gulf Investment
3356	**Level 3**	**9155**	**QualityNet**	25122	Gulfsat	31488	Aiwagulf	42781	Zajil Int. Telecom
3491	**PCCW**	**15412**	**Flag**	25242	Univ of Kuwait	35181	Public Warehouse	42961	MTC GPRS
6412	KEMS	21050	KW.Fast Telco	**27017**	**Global Voicecom**	**35207**	**Stellar PCS**		

Kuwait — Major Immediate Changes

- <u>VSNL/Teleglobe gains routes from regional ISPs:</u>
  - Gulfnet Kuwait (3225)
  - QualityNet (9155)
  - Kuwait Internet Exchange (29157)

- <u>Horizon Satellite (30981) enters the market</u>

- <u>Emirates (8966) and PCCW (3491) both lost routes</u>

- <u>Kuwait IX (29157) drops …</u>
  - Verizon (701)
  - Flag (15412)
  - Global VoiceCom (27017)

Kuwait — Simplified Provider Map (2 months later)

701	**Verizon**	**6453**	**Teleglobe**	22351	INTELSAT	29157	Kuwait IX	41669	Tawasul Telecom
3225	**Gulfnet**	**8960-6**	**Emirates**	24627	Shownet	**30981**	**Horizon Satellite**	42642	Gulf Investment
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6412	KEMS		21050	KW.Fast Telco	**27017**	**Global Voicecom**	**35207**	**Stellar PCS**

Kuwait — Lasting Changes

- VSNL/Teleglobe (6453) retains most of its gains

- Flag (15412) and Emirates (8966) recover

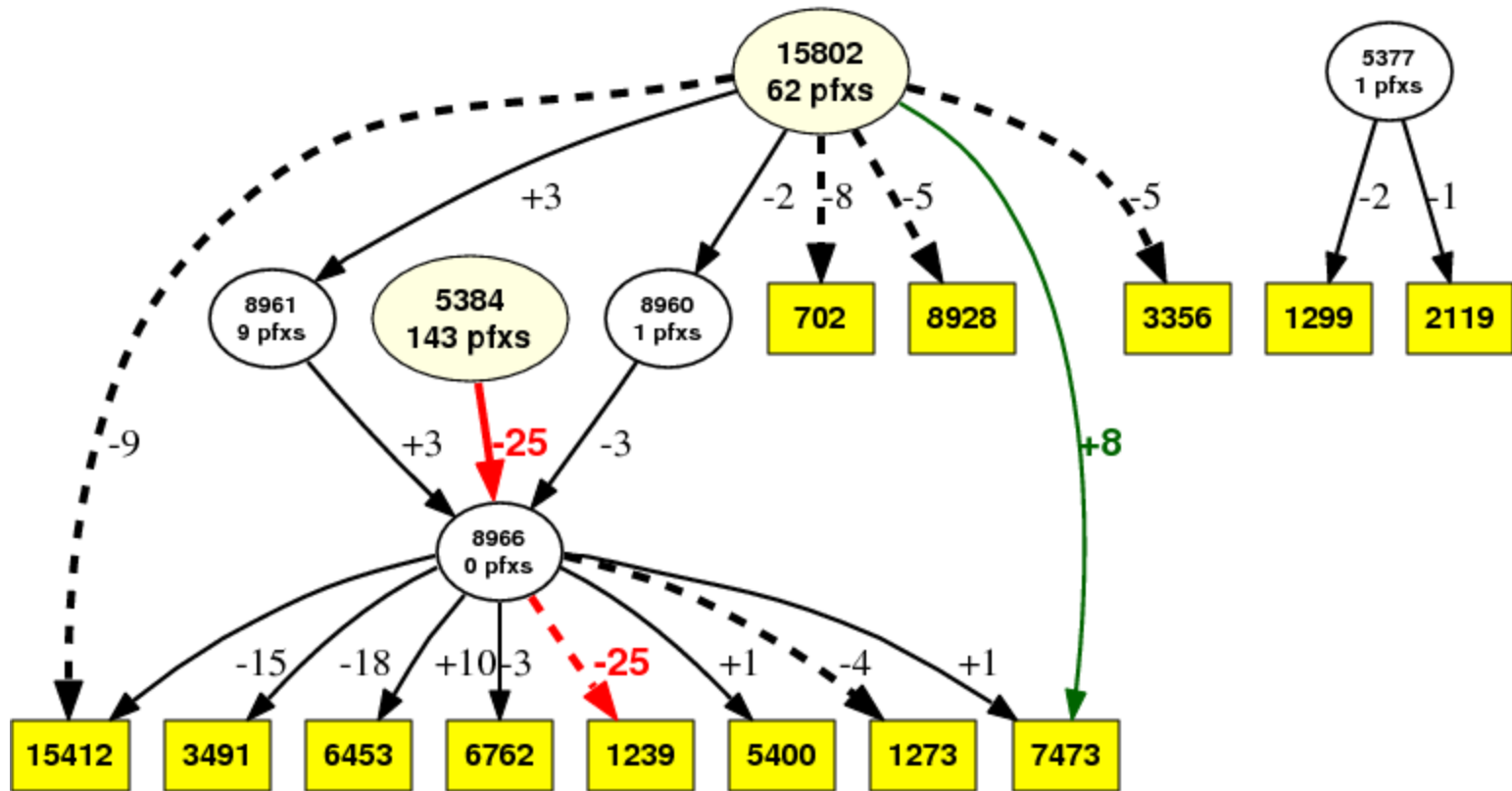- Global VoiceCom (27017) & PCCW (3491) lose the most

United Arab Emirates – during week of cable breaks

Outages over Time
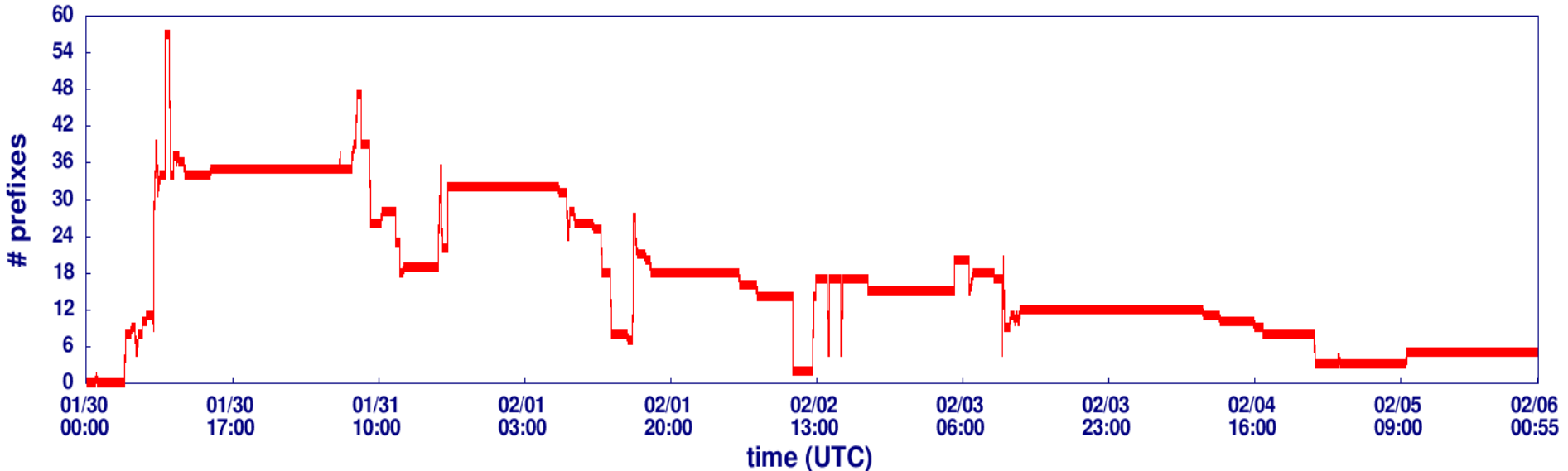
- 43% of prefixes suffered some outage
  - 108 out of 250
- Events:
  - Jan 30th at 04:32 UTC and 07:53 UTC (cable breaks)
  - Jan 30th at 09:13 UTC (re-engineering attempt?)
  - Erratic recovery over the week

701-2	Verizon	**3320**	DTAG	**5400**	BT	8960-6 Emirates
1239	Sprint	**3356**	Level 3	**6453**	Teleglobe	**15412** Flag
1273	C&W	**3491**	PCCW	**6762**	Telecom Italia	**15802** Emirates
1299	Telia	5377	Taide	**7473**	SingTel	24493 Stixlite
2119	T.net	**5384**	Emirates	**8928**	Interoute	

Egress

Bold   **Big Edge**

Green   **New Customer**

Red   **Big Loss**

UAE — Major Immediate Changes

- Emirates Telecomm has all in-country ASes

- Most large carriers lost routes …
  - Verizon (702)
  - Sprint (1239) – gone
  - C&W (1273) – gone
  - PCCW (3491)
  - Level 3 (3356)
  - Flag (15412)

- Teleglobe (6453) and SingTel (7473) both win
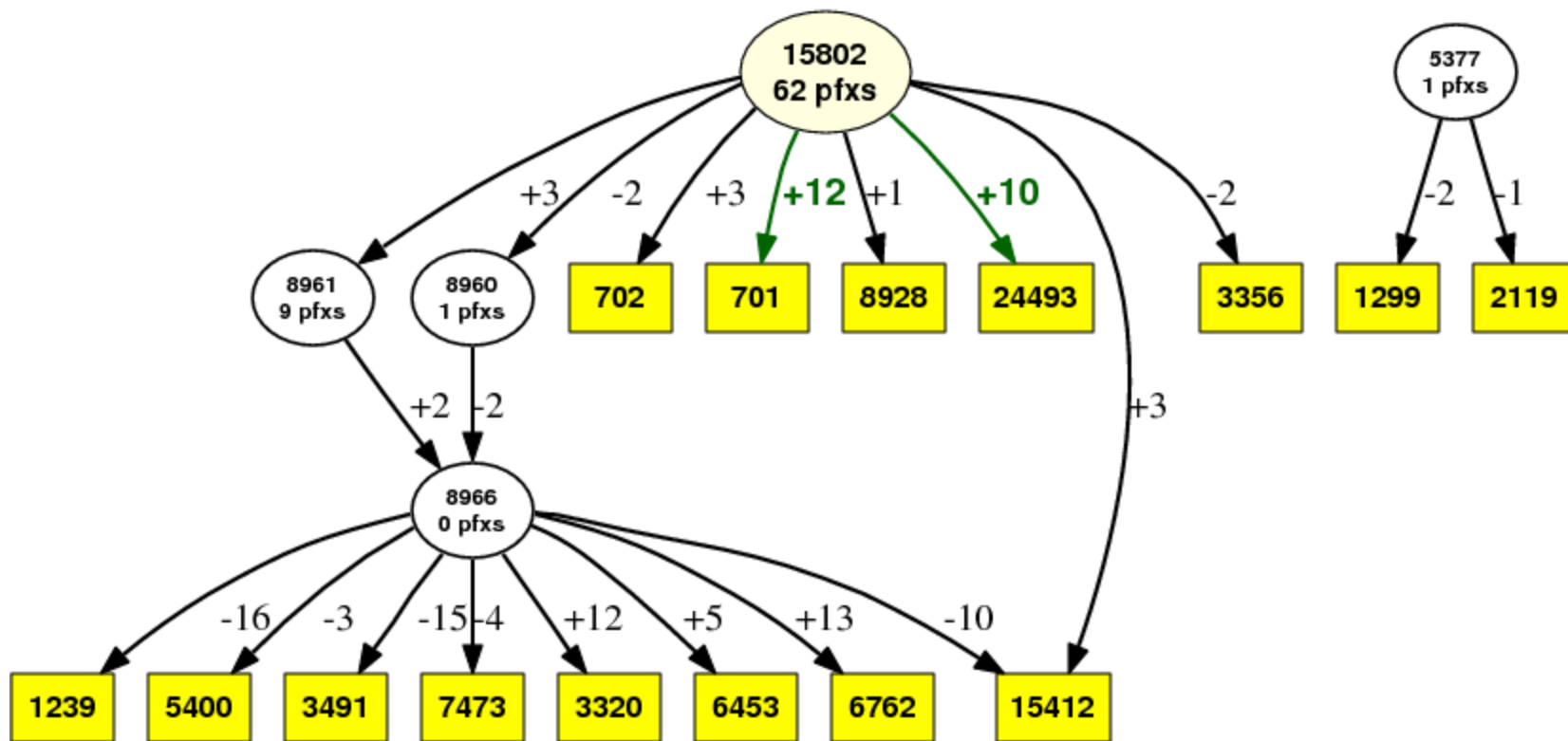
Egress

Bold	Big Edge
Green	New Customer
Red	Big Loss

| 701-2	Verizon	3320	DTAG	5400	BT	8960-6	Emirates
1239	Sprint	3356	Level 3	6453	Teleglobe	15412	Flag
1273	C&W	3491	PCCW	6762	Telecom Italia	15802	Emirates
1299	Telia	5377	Taide	7473	SingTel	24493	Stixlite
2119	T.net	5384	Emirates	8928	Interoute		

UAE — Lasting Changes

- A lot of re-engineering observed
- Most large carriers bounce back and pick up more routes.
- C&W (1273) came back to *exactly* pre-break status, so are not shown.
- Flag (15412), PCCW (3491) and Sprint (1239) lose the most
- Stixlite (24493) enters market

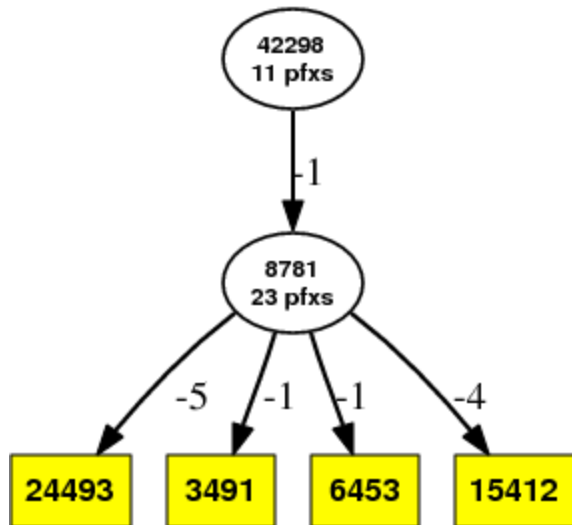# Qatar – during week of the cable breaks
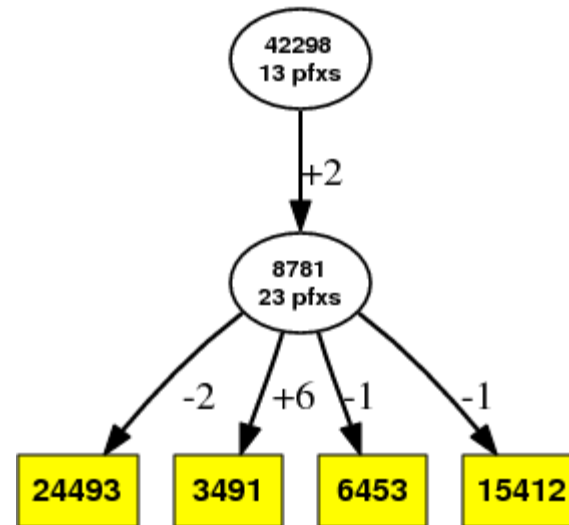

Outages over Time
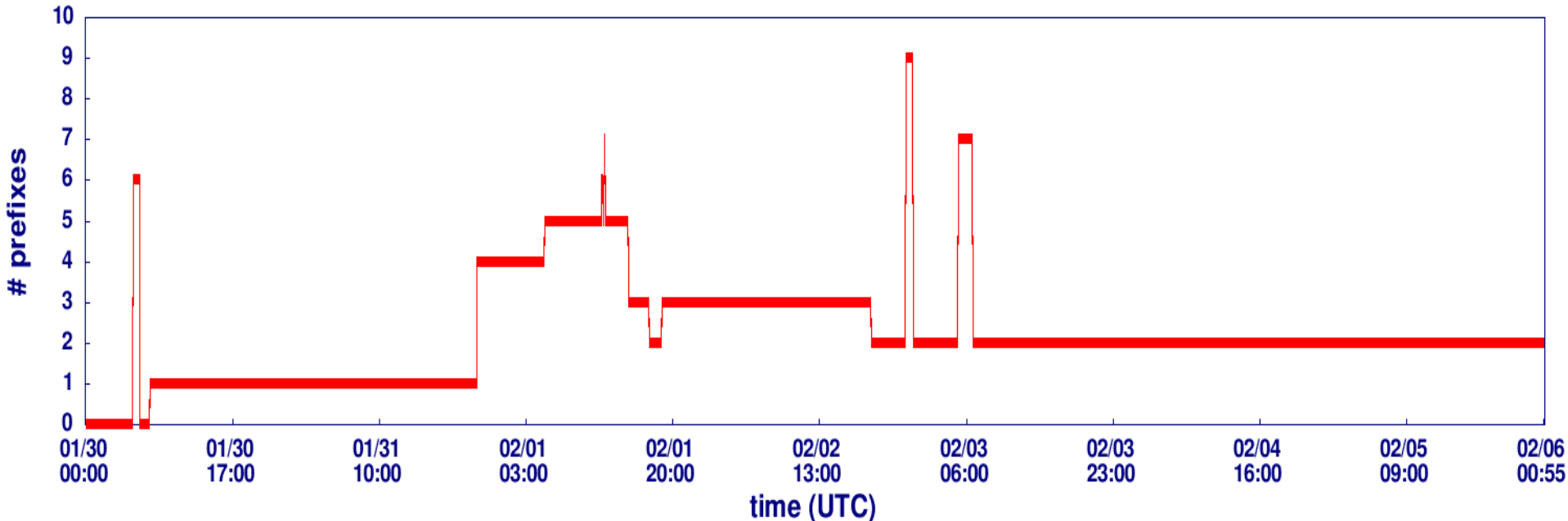
- 61% of prefixes suffered some outage
  - 25 out of 41
- Events:
  - No correlation with Mediterranean cable breaks

Qatar — Simplified Provider Maps

1 week later

2 months later

Egress

Bold	Big Edge
Green	New Customer
Red	Big Loss

3491	PCCW	8781	Qatar Telecom	24493	Stixlite
6453	Teleglobe	15412	Flag	42298	Qatar Telecom

Qatar — Major Changes

- Flag (15412) largely recovered
- Stixlite (24493) lost a little
- PCCW (3491) gained the most
- No new providers entered the market

Conclusions from the data

- New providers entered the market and *stayed,* resulting in more competition.

- Providers with capacity in *both* directions …
    - PCCW (3491)
    - VSNL/Teleglobe (6453)

  or *satellite* providers
    - Horizon Satellite (30981)

  had more options to route around the breaks

- In Egypt, the local incumbent quickly gained new transit and could assist smaller providers

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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