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Regional Connectivity Update

MENOG12

James Cowie, CTO

6 March 2013

Why study Internet structure and growth?

- We're all seeking higher performance, higher stability, lower cost, lower risk for our global Internet connectivity
- Some countries attract more Internet growth than others. What tips the balance?
- **Hypothesis: costs, latencies and richness of interconnectivity determine the winners.**

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What's Most Important?

Ironically, cost and latency are largely determined by richness of interconnectivity!

- **Costs** are a function of competition and choice
- **Latencies** (beyond lightspeed minima) are a function of straight paths and detour avoidance
- **Detour avoidance** requires peering and rich interconnection (eliminate hairpin routes to Europe)

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How Renesys Surveys Growth

BGP collection backed by active measurement:

- Birth and death of Autonomous Systems
- ASN-ASN Interconnection Counts
- Diversity of cross-border interconnection
- Largest Provider Dominance
- Latencies to content

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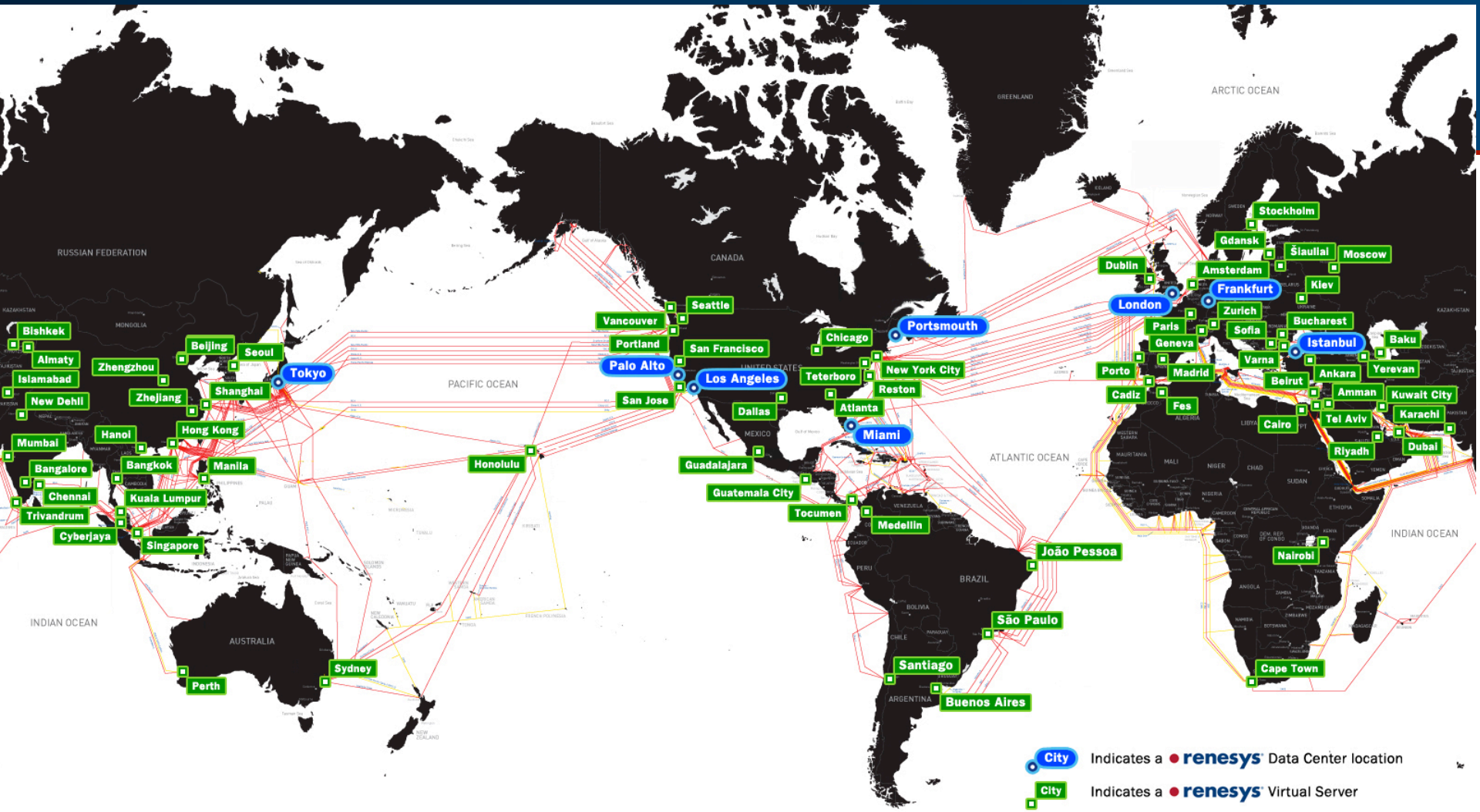
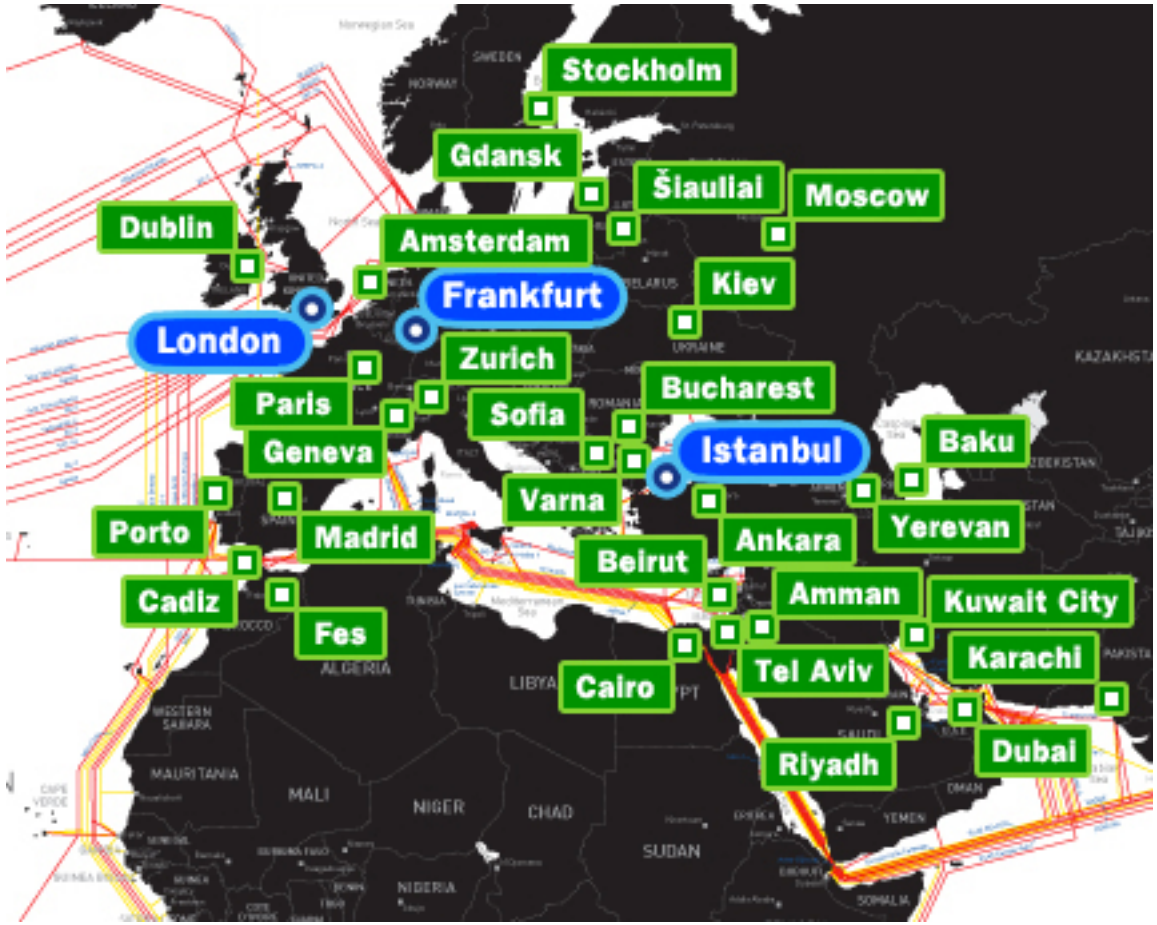


renesys **Traceroute Infrastructure** - March 2013 (plus Global Submarine Cable Map)

Note: Some cities host multiple collectors. Cable map credit: Telegeography

Renesys EMEA Traceroute Collection



- Goal is to minimize latency to closest collector worldwide
- Over 100M daily traces
- More than 1 million end hosts each day from each site

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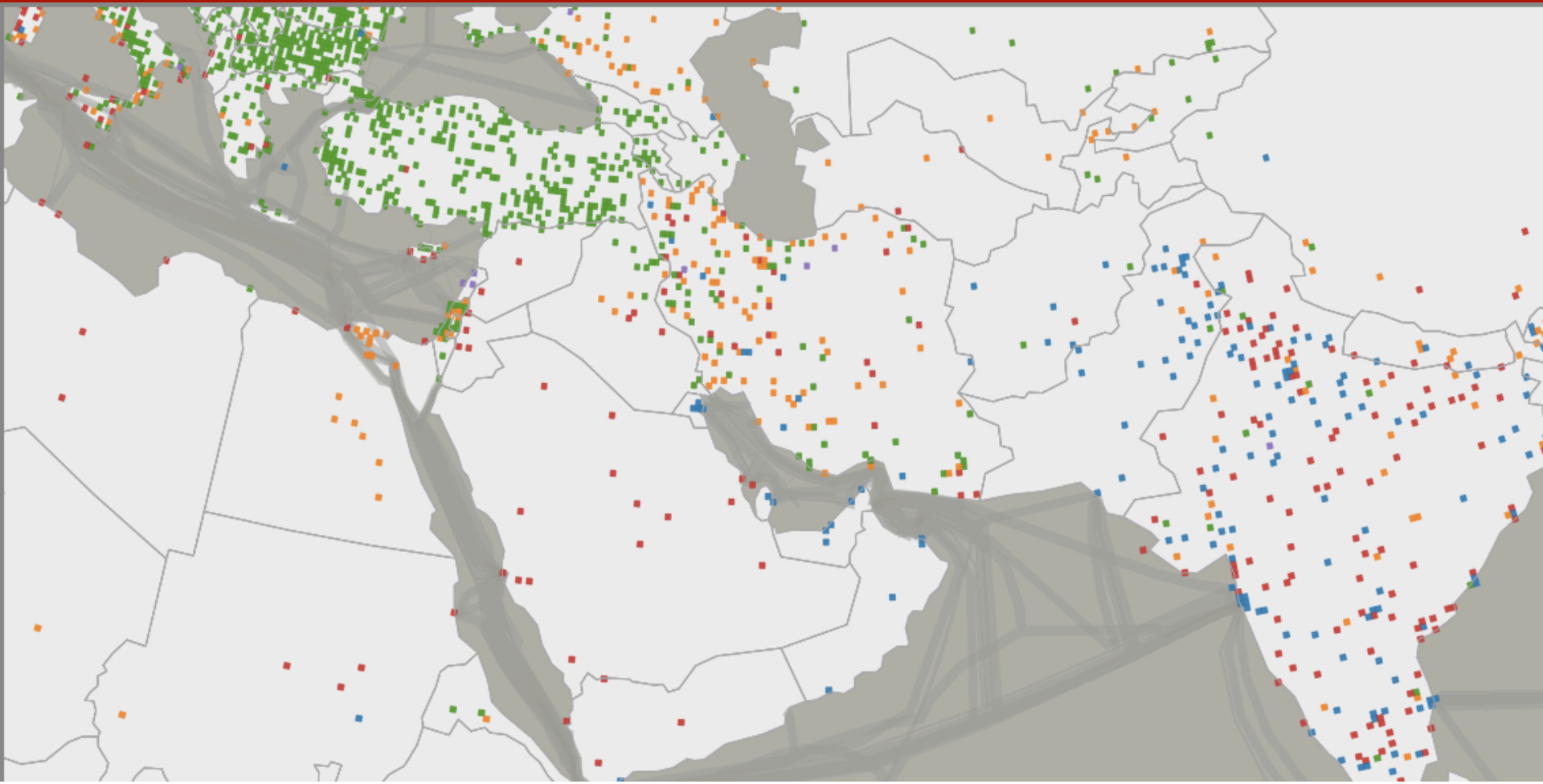
Istanbul, Beirut, Cairo, Dubai, Riyadh **



** ¼ degree cells, ‘closest’ median city

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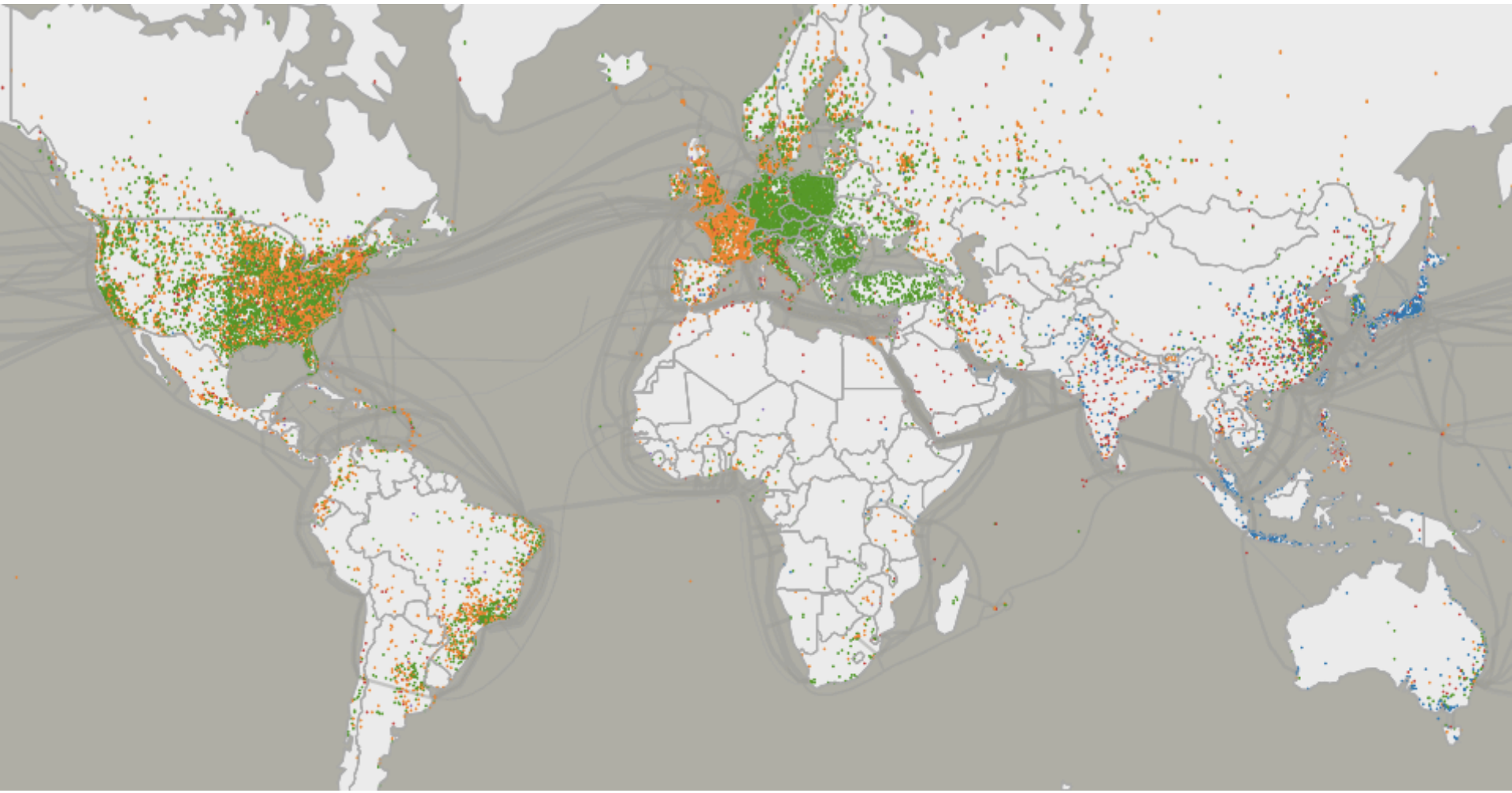
Istanbul, Beirut, Cairo, Dubai, Riyadh **



**¼ degree cells, ‘closest’ median city

No clear winner from latency alone!

Let's identify a few possible metrics that might set countries apart from each other:

1. *What countries have high ASN growth?*
2. *What countries have dominant largest providers?*
3. *Which countries make it easiest to get direct connectivity to international providers?*

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Growth Question 1: Domestic ASNs

- How deep is the pool of enterprises that speak BGP in a given country?
- That is, who has the largest number of domestic ASNs?

- *Where are most new domestic ASNs being born in 2013, and why?*

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Definition: “Domestic Provider” ASN

- **70%+ of** worldwide customer base in one country, within the last 2 years

- Example: Turk Telekom (AS9121)
  - 90% of customers are in **Turkey**, where AS9121 is domestic provider
  - 3.5% of customers are in Syria, where AS9121 is international provider
  - 2.4% of customers are in Oman, where AS9121 is international provider
  - ..and so forth.

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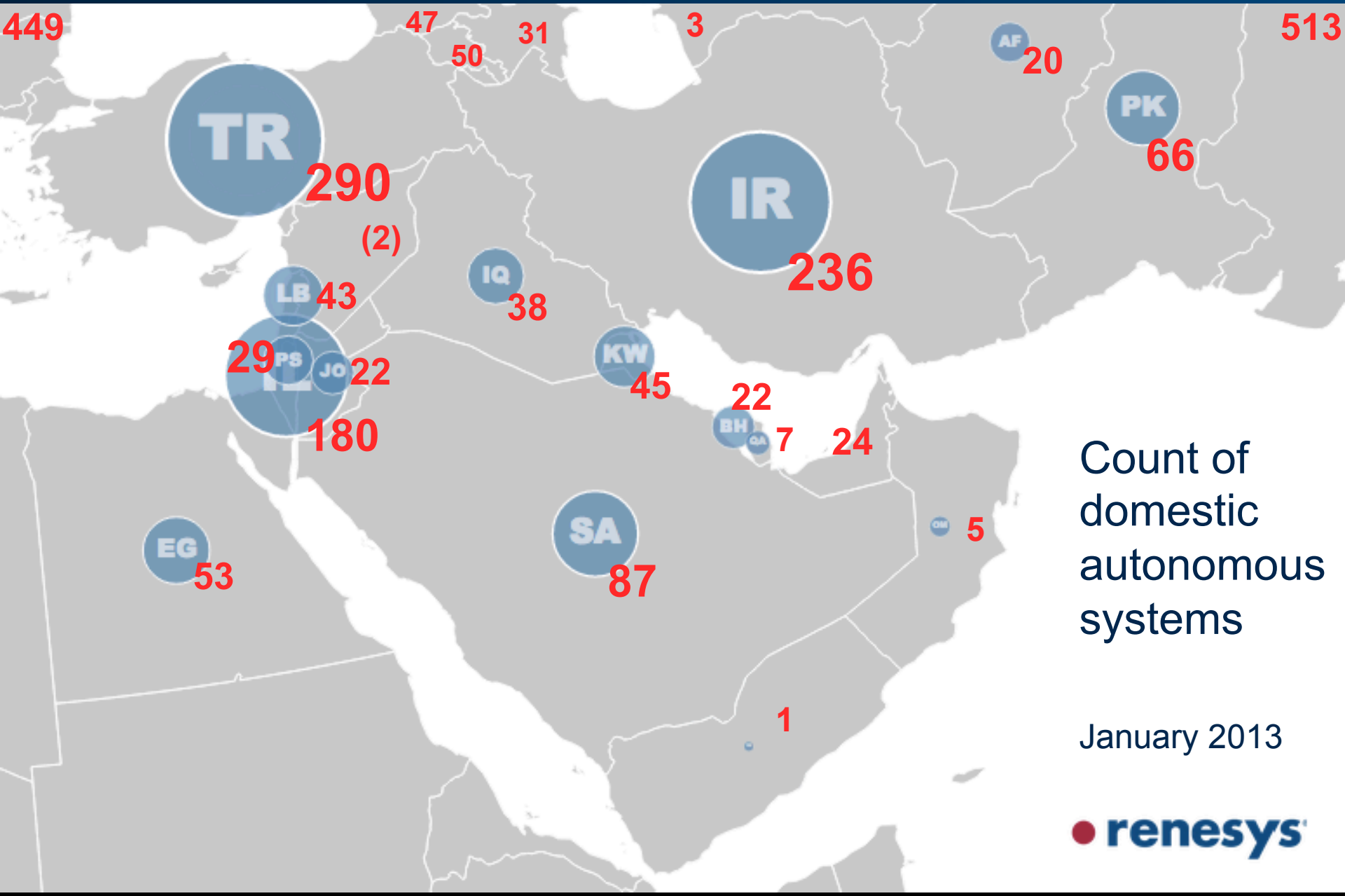
449
47
50
31
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513
AF
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(2)
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JO
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KW
45
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BH
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SA
87
EG
53
5
1
Count of domestic autonomous systems
January 2013
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ASN Growth Resumed Strongly in 2013

	AE	BH	EG	IL	IQ	IR	JO	LB	OM	PS	QA	SA	SY	TR	YE
2011	12	23	53	166	14	130	22	35	4	23	4	78	4	253	1
2012	12	22	50	169	16	178	23	35	4	26	4	80	2	253	1
2013	24	22	53	180	38	236	22	43	5	29	7	87	2	290	1

- **Strong growth** in UAE, Iraq, Iran, Qatar
- **Moderate** in IL, PS, Lebanon, Saudi Arabia, Turkey
- **Stable** in Bahrain, Egypt, Jordan, Kuwait, Oman, Syria, Yemen

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Highlight: Iranian Growth in 2013

- Net increase from 178 to 236 ASNs
- Every year, Iran adds “one Egypt”
  - May exceed Turkey in size by 2014
  - Already exceeds SA+BH+AE+OM+QA+KW
- IPv4 expansion in 35 cities, including Esfahan, Tehran, Shiraz, Tabriz, Malard, Mashhad, Yazd
- “Halal Internet” on the way, IPv6 growth strong

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Sidebar: IPv6

- **Iran** is the clear leader in the Middle East
- **85%** of the ASNs in the world still ignore IPv6 entirely
- … **92%** of the ASNs in the Middle East

Country	ASN	Provider Name
BH	35313	2Connect
BH	51964	Equant
EG	20928	Noor Group
EG	24835	Vodafone Data
EG	24863	Link Egypt
EG	31065	MCIT
EG	36992	Etisalat Misr
IR	12660	Sharif University, Tehran
IR	15696	Arian
IR	24631	Azadnet
IR	30783	Rased Maral Ava Jonoob
IR	31732	Parsun
IR	39501	Neda Gostar Saba
IR	41881	Fanava
IR	42337	Respina
IR	42440	Shahrad Net
IR	43965	Tehran University
IR	44285	Shahrad Net
IR	44498	Tosee Resan Pasargad
IR	44889	Farhang Azma
IR	47262	Hamara Tabriz
IR	48608	Mellat Insurance
IR	50530	Shabdiz Telecom
IR	51074	Gostaresh-e-Ertebatat-e Mabna
IR	51469	Petiak
IR	51541	Sepehr
IR	57199	Peyk Navidsazan Farda
IR	6736	IPM

Country	ASN	Provider Name
AE	15802	du
AE	47201	UAE TRA
AE	51182	UAE University
AE	57171	American University at Sharjah
AE	8966	Etisalat
JO	47887	Damamax
JO	57393	Blue Zone East
JO	8376	Jordan Data Comm
JO	8697	Orange Jordan
JO	8934	NITC
KW	3225	Gulfnet Kuwait
KW	42781	Zajil
KW	9155	QualityNet
OM	28885	Omantel NAP
OM	50010	Nawras
QA	8781	Qatar Telecom
SA	25019	Saudinet
SA	29684	Nournet
SA	29690	Atheer Jeraisy
SA	30857	CITC
SA	31416	Applied Technologies
SA	35819	Etihad Etisalat
SA	41176	Sahara Net
SA	47794	Etihad Atheeb
SA	57458	Global Arabian
SA	8895	KACST

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Highlight: UAE Growth in 2013

- Doubled from 12 to 24 ASNs
- Fully half are 32-bit ASNs
- Nearly all new ASNs are enterprise/ university customers behind Etisalat AS8966
- Provider infrastructure still dominated by 8966/5384 and 15802 (du)

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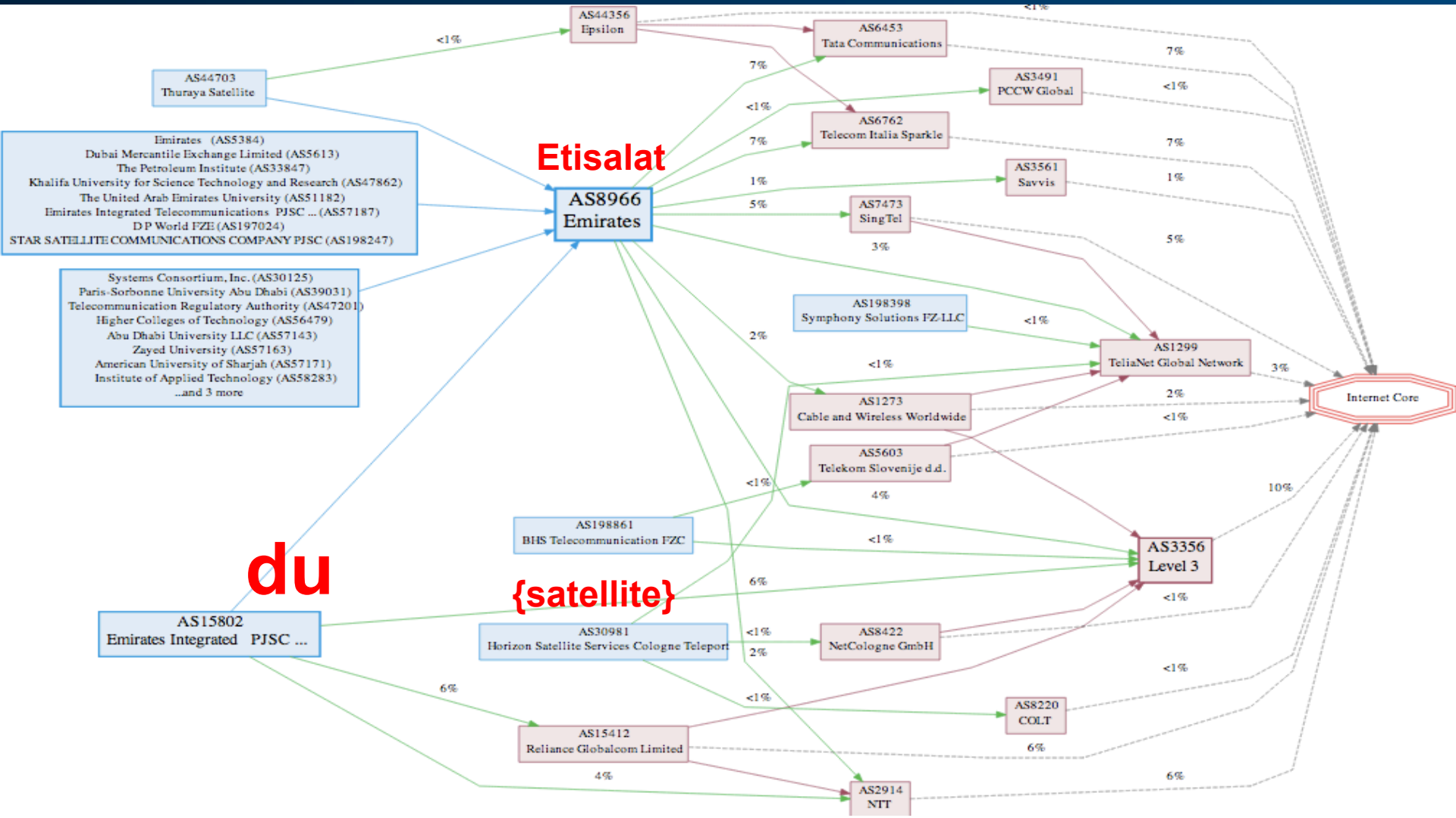
UAE Provider Duopoly



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Growth Question 2: Domestic Concentration

- Who's the largest domestic provider in each country?
- What's their "on-net" percentage of the national Internet?

- *How has that changed in the last two years?*

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Largest Domestic Provider, Jan 2011

- What percentage of the country was “on net” with the largest domestic provider?

- Red: more than 90%
- Grey: 50-90%
- Green: Less than half

PS	12975	100
YE	12486	100
OM	8529	100
SY	29386	98
TR	9121	98
LY	21003	96
AE	8966	97
IR	12880	90
JO	8697	76
LB	42020	67
SA	39386	67
IL	9116	56
QA	42298	52
IQ	21277	44
KW	9155	42
EG	8452	40
BH	35019	29

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Largest Domestic Provider, Feb 2013

Improvement is evident, but also some reversals

- Red: more than 90%
- Grey: 50-90%
- Green: Less than half

	1/1/11	Percent	2/1/13	Percent
YE	12486	100	12486	100
SY	29386	98	29386	99
TR	9121	98	9121	98
LB	42020	67	42020	96
AE	8966	97	8966	97
LY	21003	96	21003	94
IR	12880	90	12880	86
PS	12975	100	12975	82
JO	8697	76	8697	76
IQ	21277	44	50710	71
EG	8452	40	8452	61
BH	35019	29	41426	56
OM	8529	100	8529	50
SA	39386	67	35819	48
QA	42298	52	42298	47
IL	9116	56	9116	42
KW	9155	42	42961	41

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More alternatives for some, fewer for others

- Nawras in Oman
- Mobily in SA
- STC Viva in BH
- ScopeSky in IQ
- TE resumes wholesale growth in Egypt
- In Lebanon, IMEWE creates artificial concentrations for Ogero

	1/1/11	Percent	2/1/13	Percent	Improvement
OM	8529	100	8529	50	50
SA	39386	67	35819	48	19
PS	12975	100	12975	82	18
IL	9116	56	9116	42	14
QA	42298	52	42298	47	5
IR	12880	90	12880	86	4
LY	21003	96		94	2
KW	9155	42	42961	41	1
TR	9121	98	9121	98	0
JO	8697	76	8697	76	0
YE	12486	100	12486	100	0
AE	8966	97	8966	97	0
SY	29386	98	29386	99	-1
EG	8452	40	8452	61	-21
IQ	21277	44	50710	71	-27
BH	35019	29	41426	56	-27
LB	42020	67	42020	96	-29

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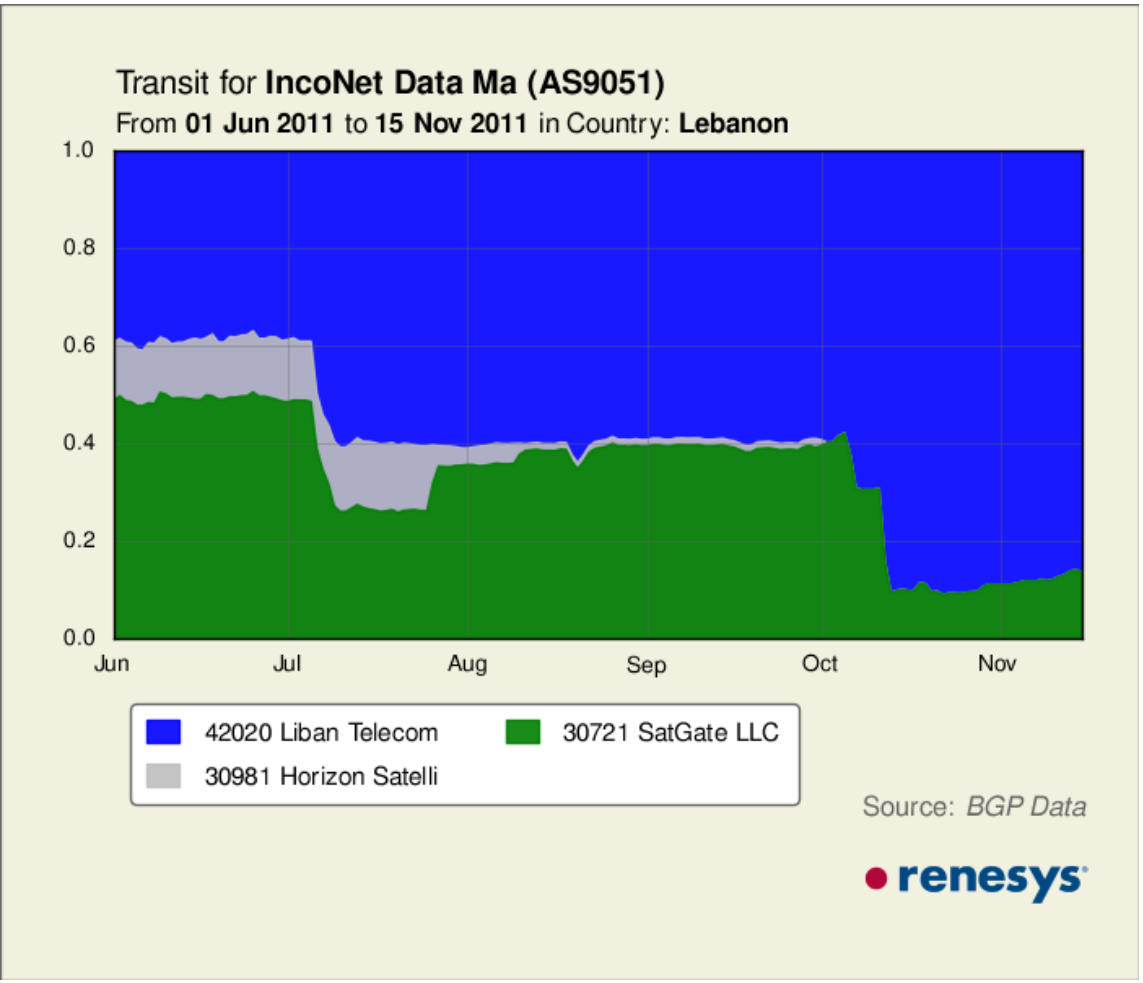
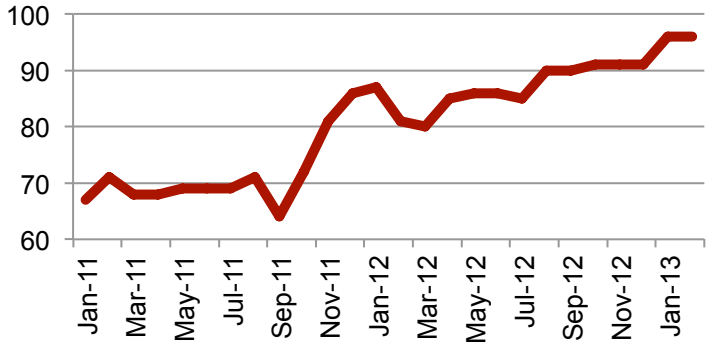
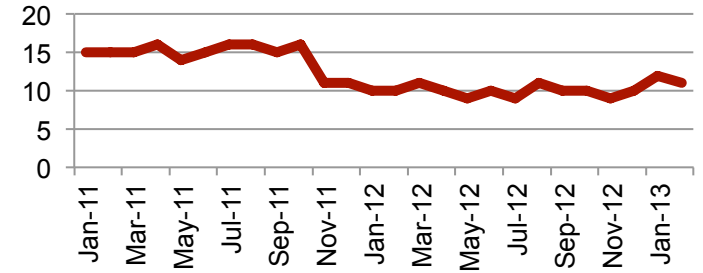
Lebanon: IMEWE Cable Concentrates Risk



AS42020 %pct Lebanon On-Net



ASNs with Cross-Border Connectivity



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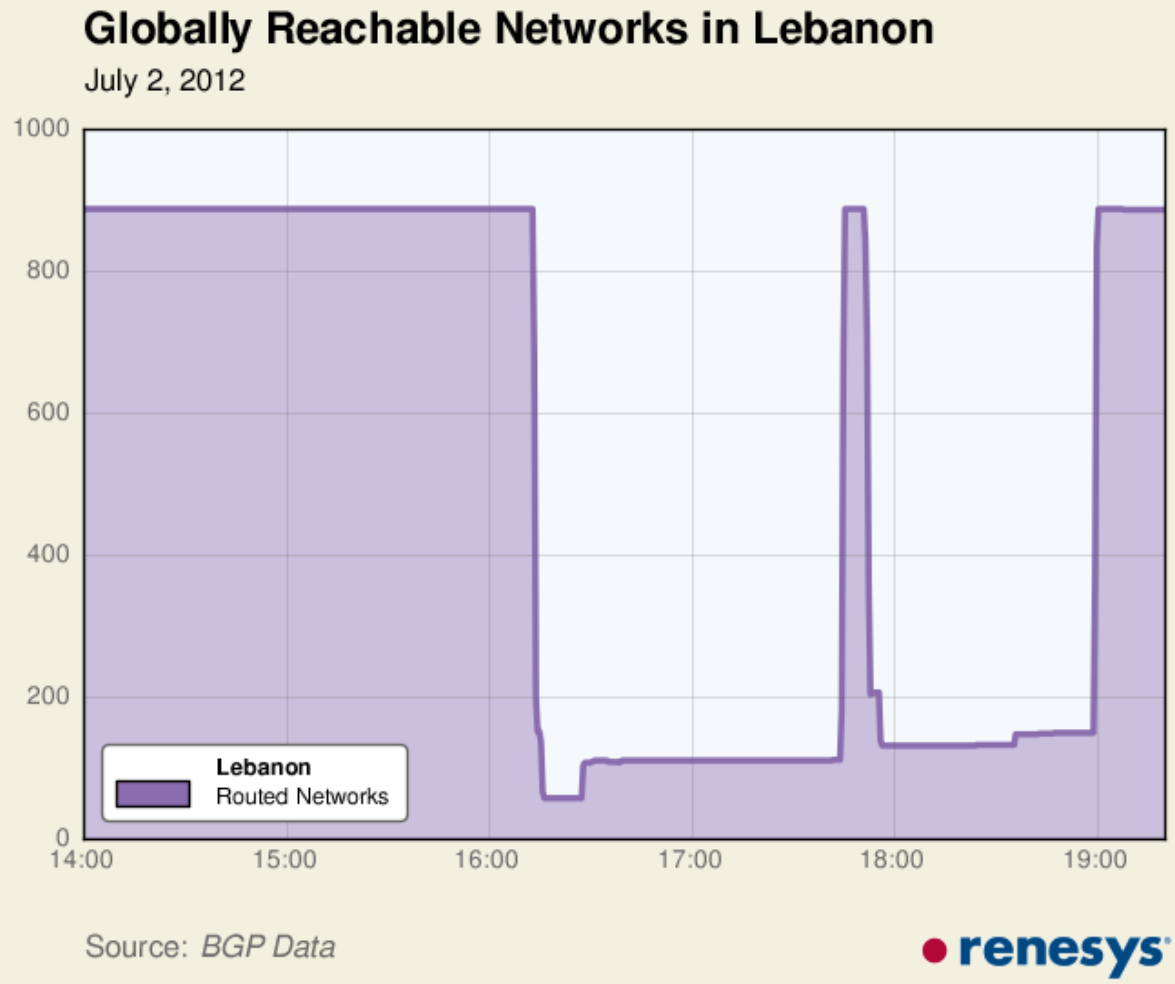
IMEWE Cable Maintenance, 2 July 2012



IMEWE Cable Maintenance, 2 July 2012

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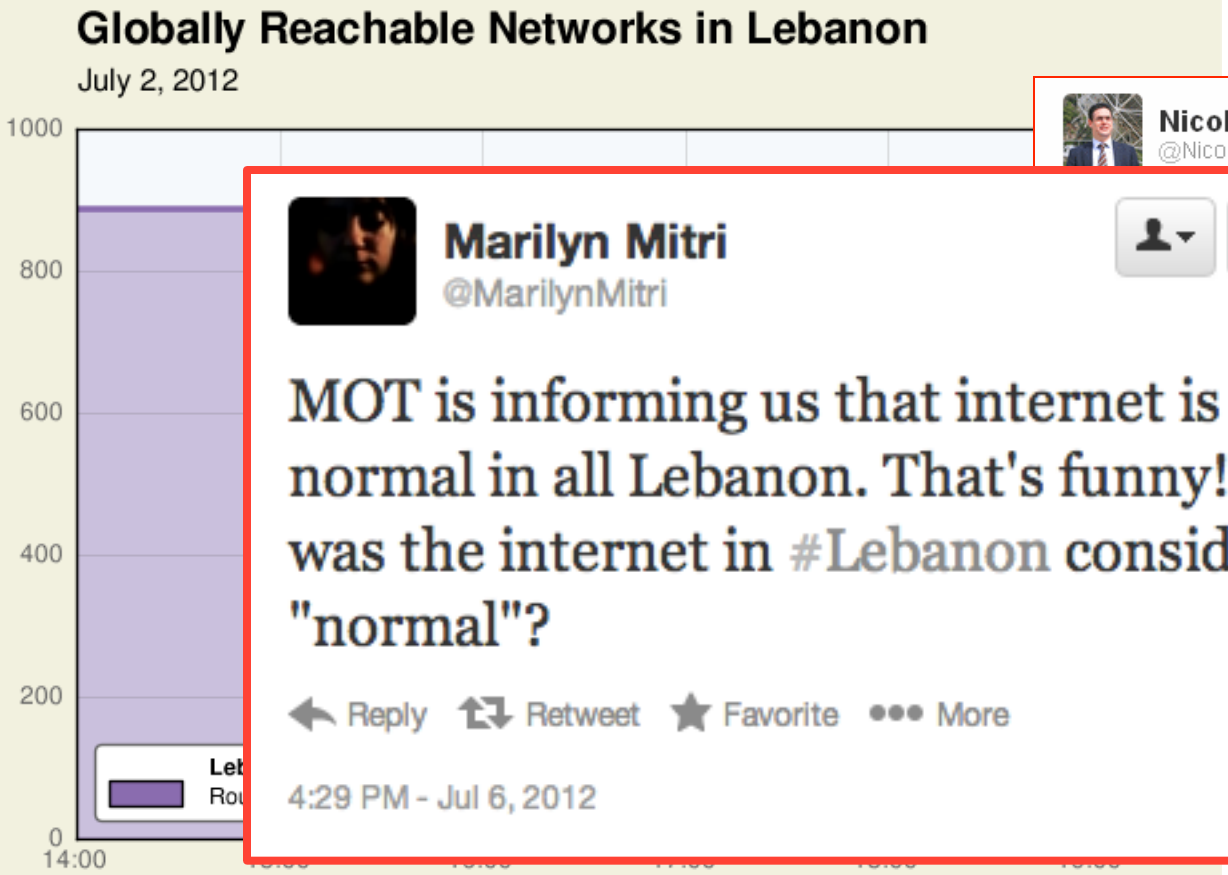
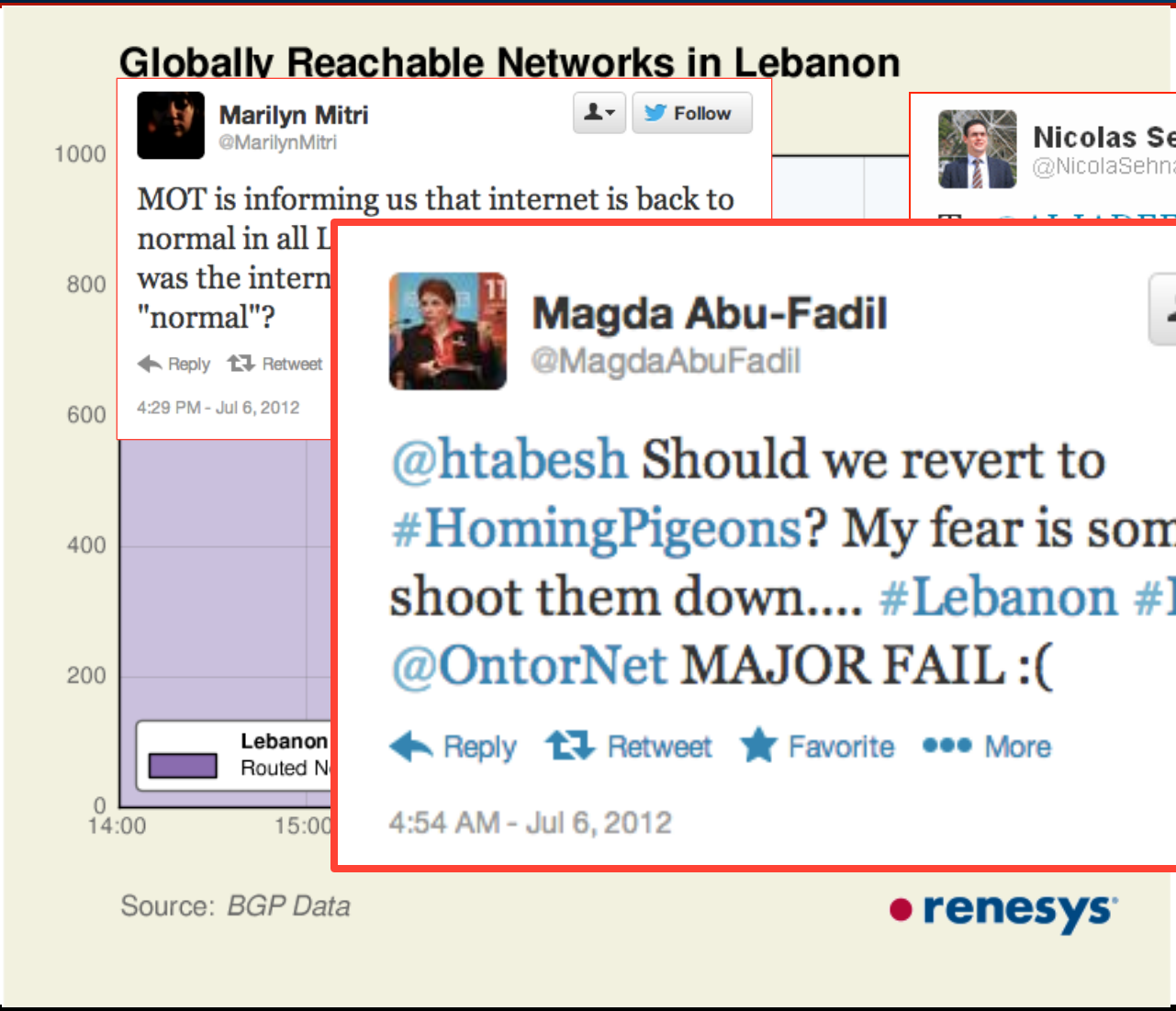


IMEWE Cable Maintenance, 2 July 2012



Marilyn Mitri
@MarilynMitri
Follow

MOT is informing us that internet is back to normal in all L
was the intern
"normal"?

Reply Retweet

4:29 PM - Jul 6, 2012

Nicolas Sehnaoui
@NicolaSehnaoui
Follow

rade in
not notify

Magda Abu-Fadil
@MagdaAbuFadil
Following

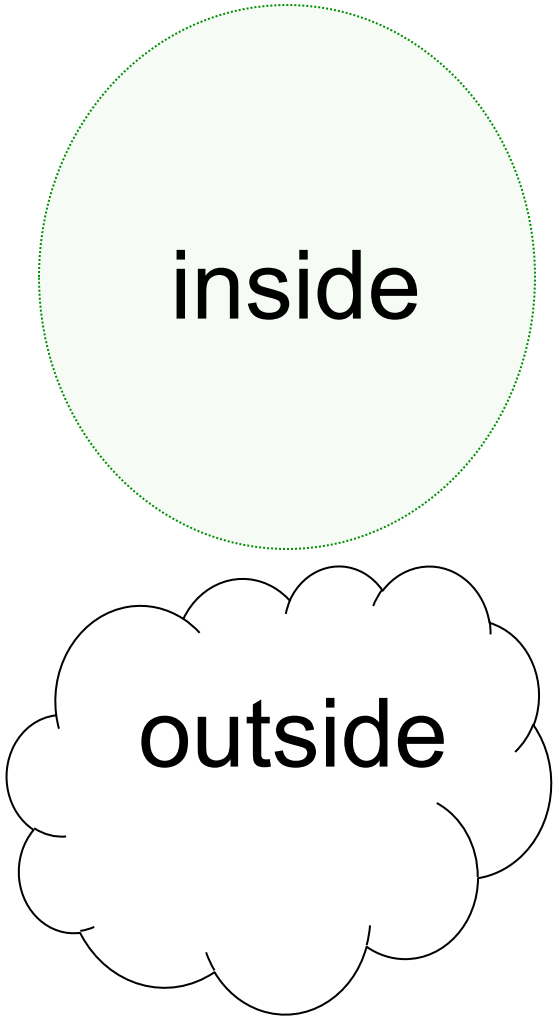
@htabesh Should we revert to #HomingPigeons? My fear is someone will shoot them down.... #Lebanon #Internet @OntorNet MAJOR FAIL :(

Reply Retweet Favorite More

4:54 AM - Jul 6, 2012

Growth Question 3: Transit Relationships

- Does it matter more whether your country grows on the *inside* or on the *outside*?
- Does your country encourage direct connection to international providers?



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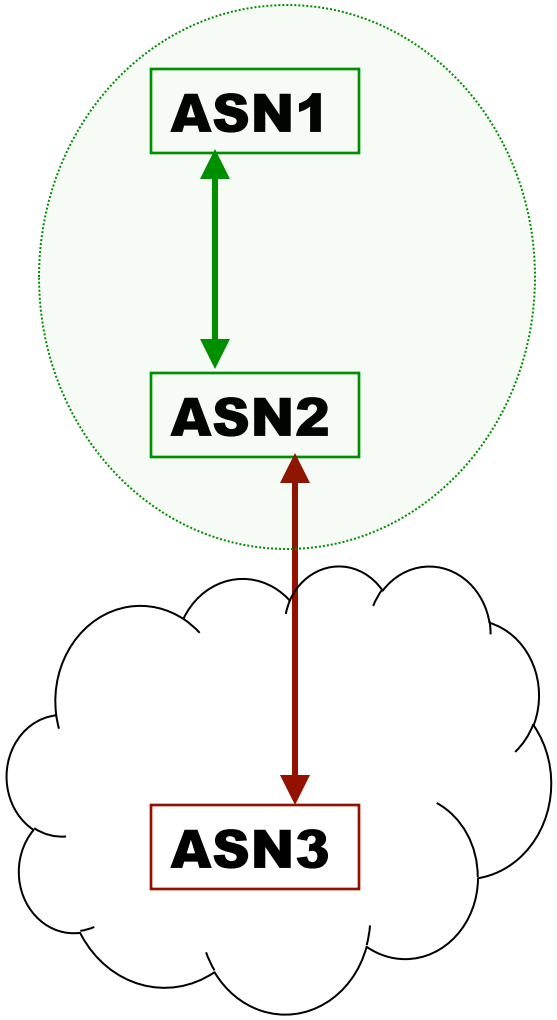
Growth Question 3: Transit Relationships

- Some connections are between two domestic providers. ("domestic relationship")
- Some are between a domestic and an international provider ("cross-border")



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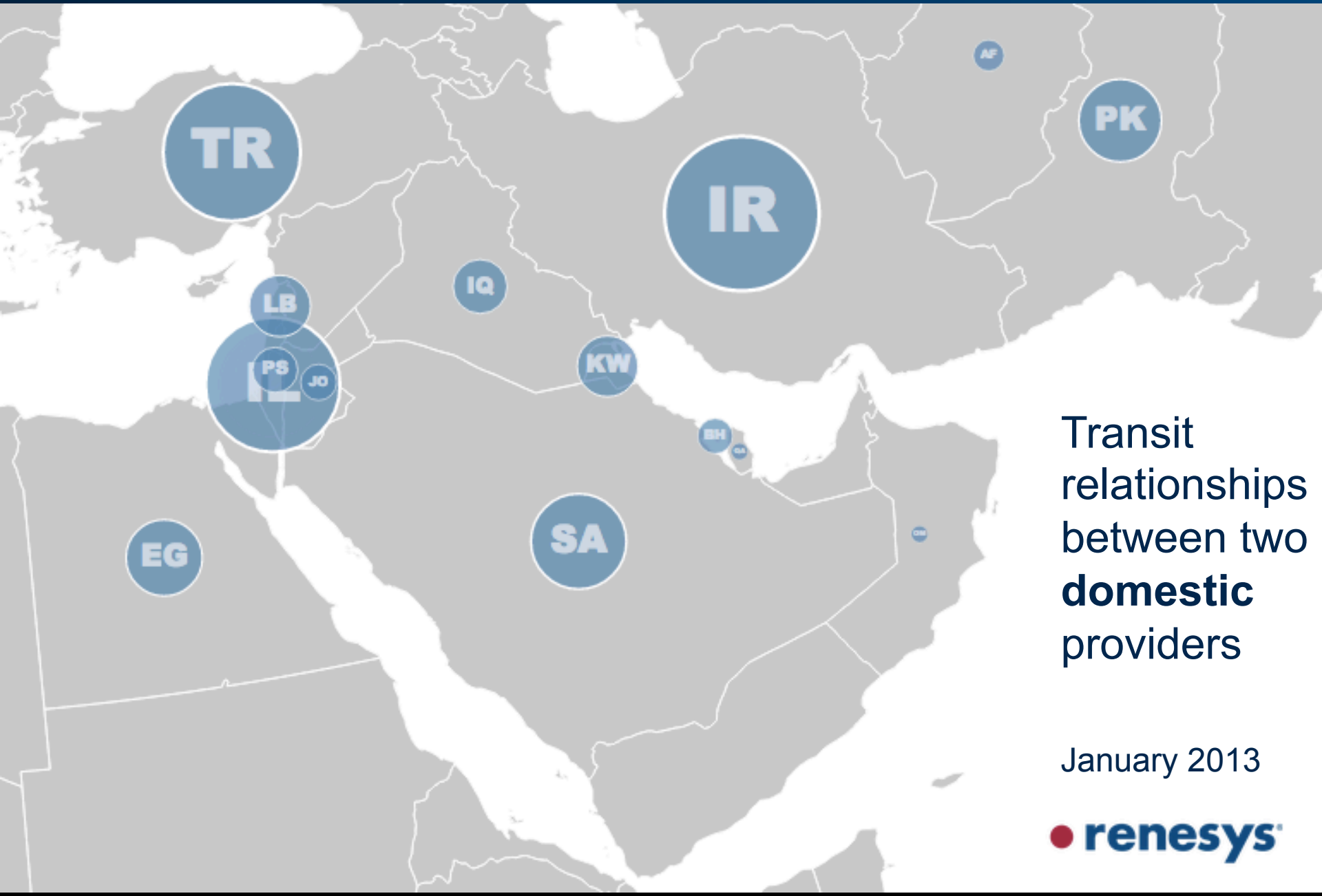

Transit relationships between two **domestic** providers

January 2013

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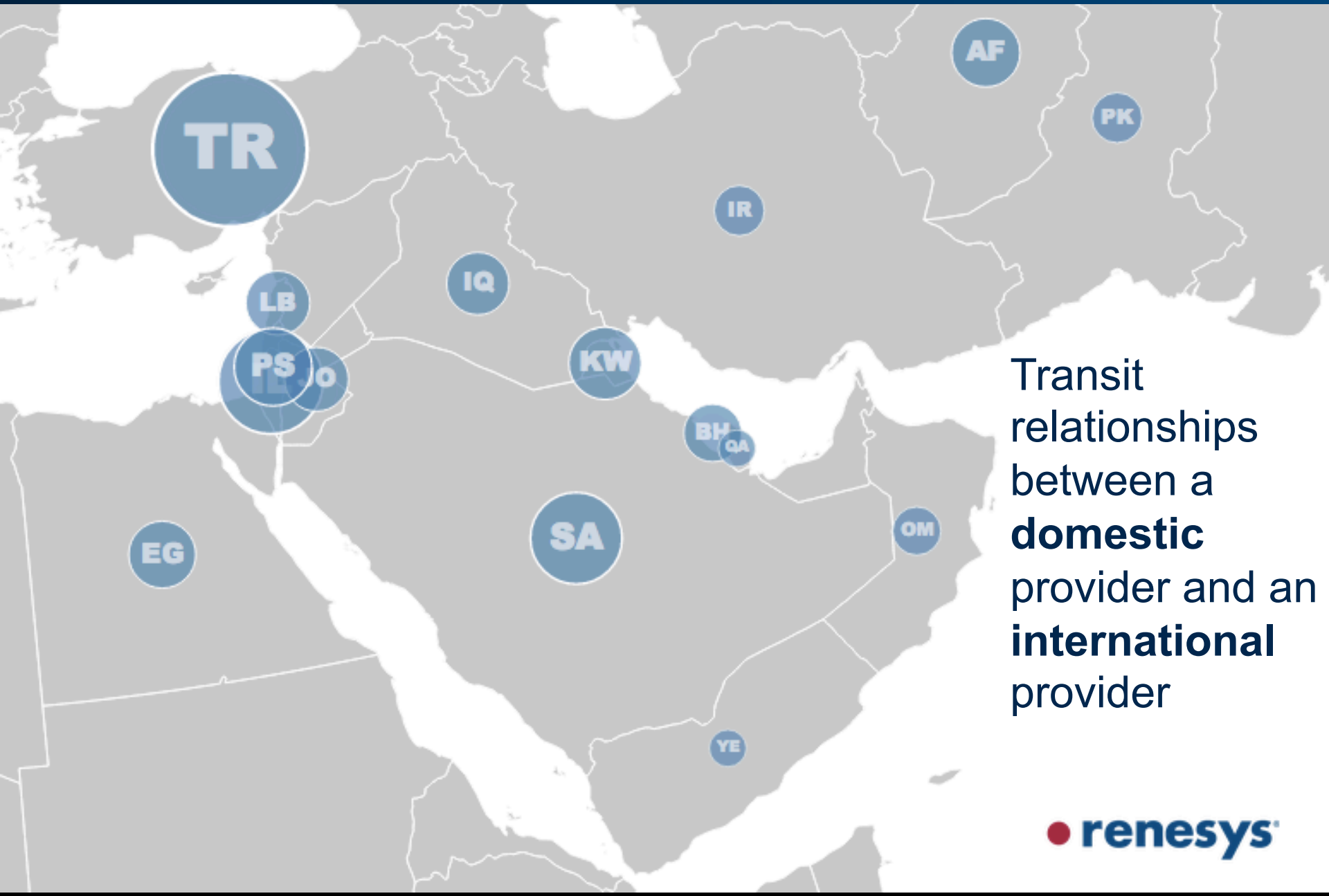

Transit relationships between a **domestic** provider and an **international** provider

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Middle East cross-border ratios

- **26.8** Iran (349 domestic: 13 cross-border)
- **4.7** Israel (265:56)
- **3.6** Egypt (85:23)
- **3.0** Saudi Arabia (133:43)
- **2.6** Lebanon (55:21)
- **2.2** Turkey (276:122)
- **2.1** Iraq (43:20)
- **1.3** UAE (25:19)
- **1.0** Bahrain (18:17)

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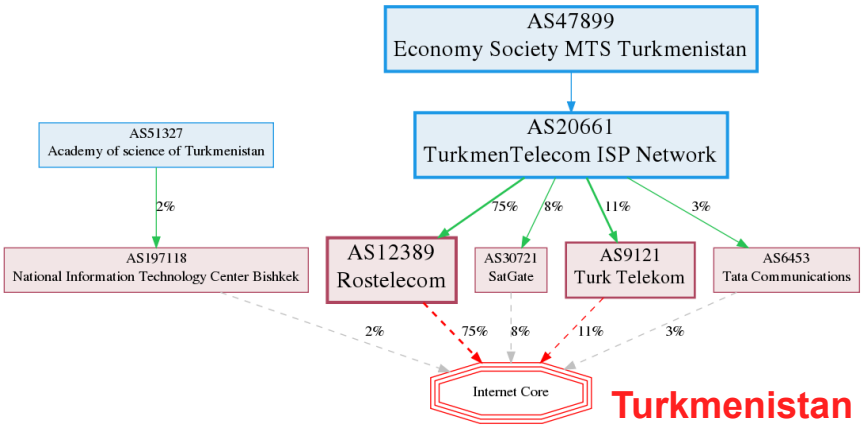
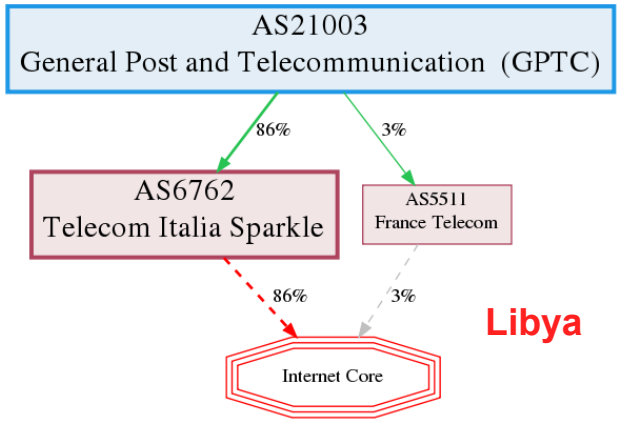
An important choice countries make

When Internet economies are small :

- Cross-border, in-country relationships equally likely
- Maybe natural for one incumbent to take charge of cross-border relationships





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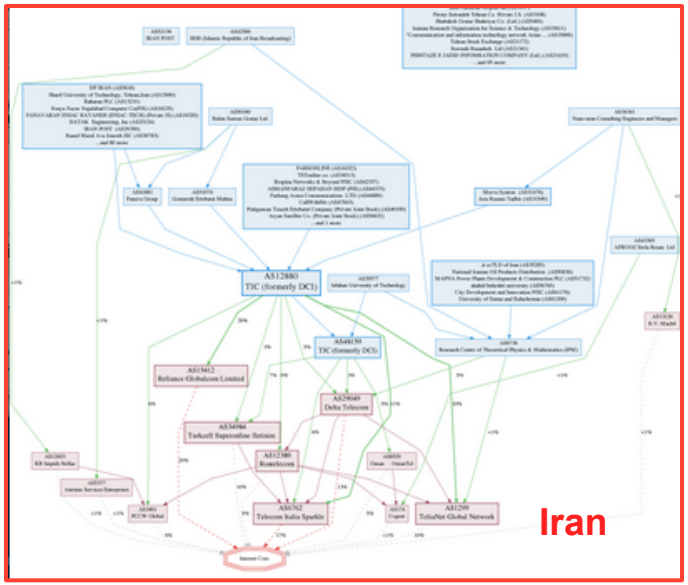
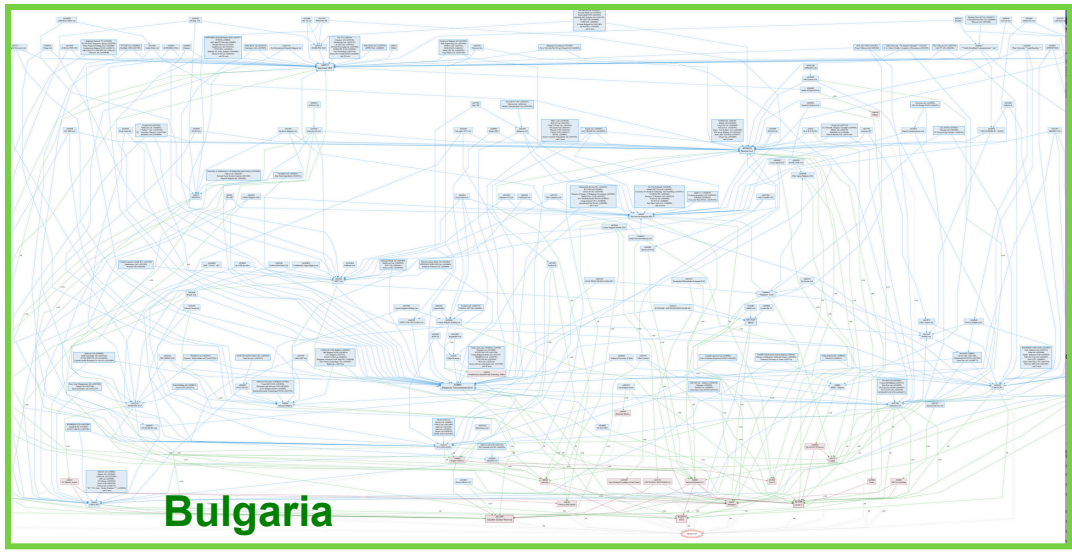
As Internet economies grow……



Strict limit on cross-border relationships creates a small number of critical ASN gateways, or…

…Open policy encourages direct foreign connection



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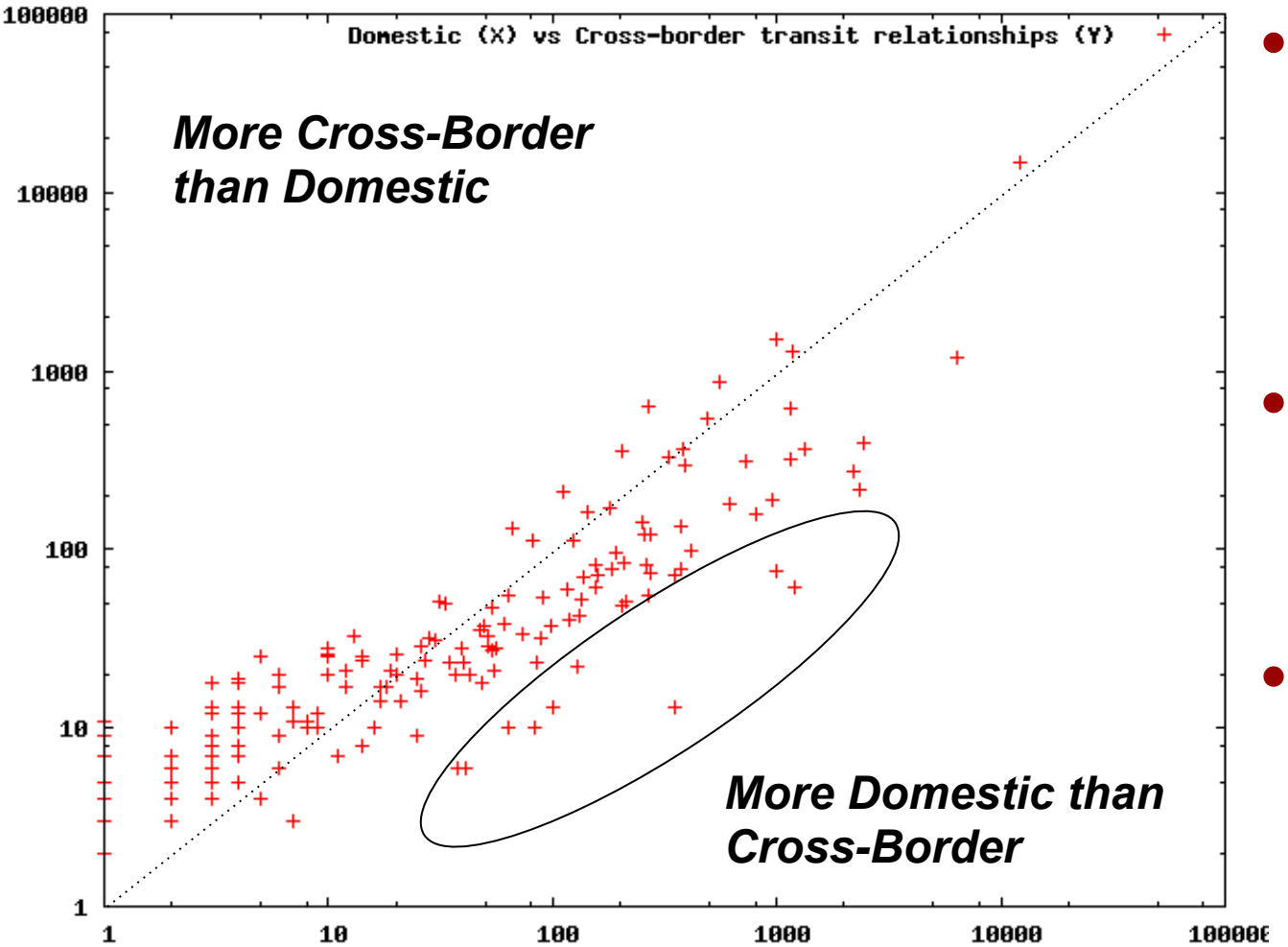
Domestic (x) vs Cross-Border (y)



- Outliers have "too little" cross-border transit
- World average **1.46:1**
- These have greater than **5:1**

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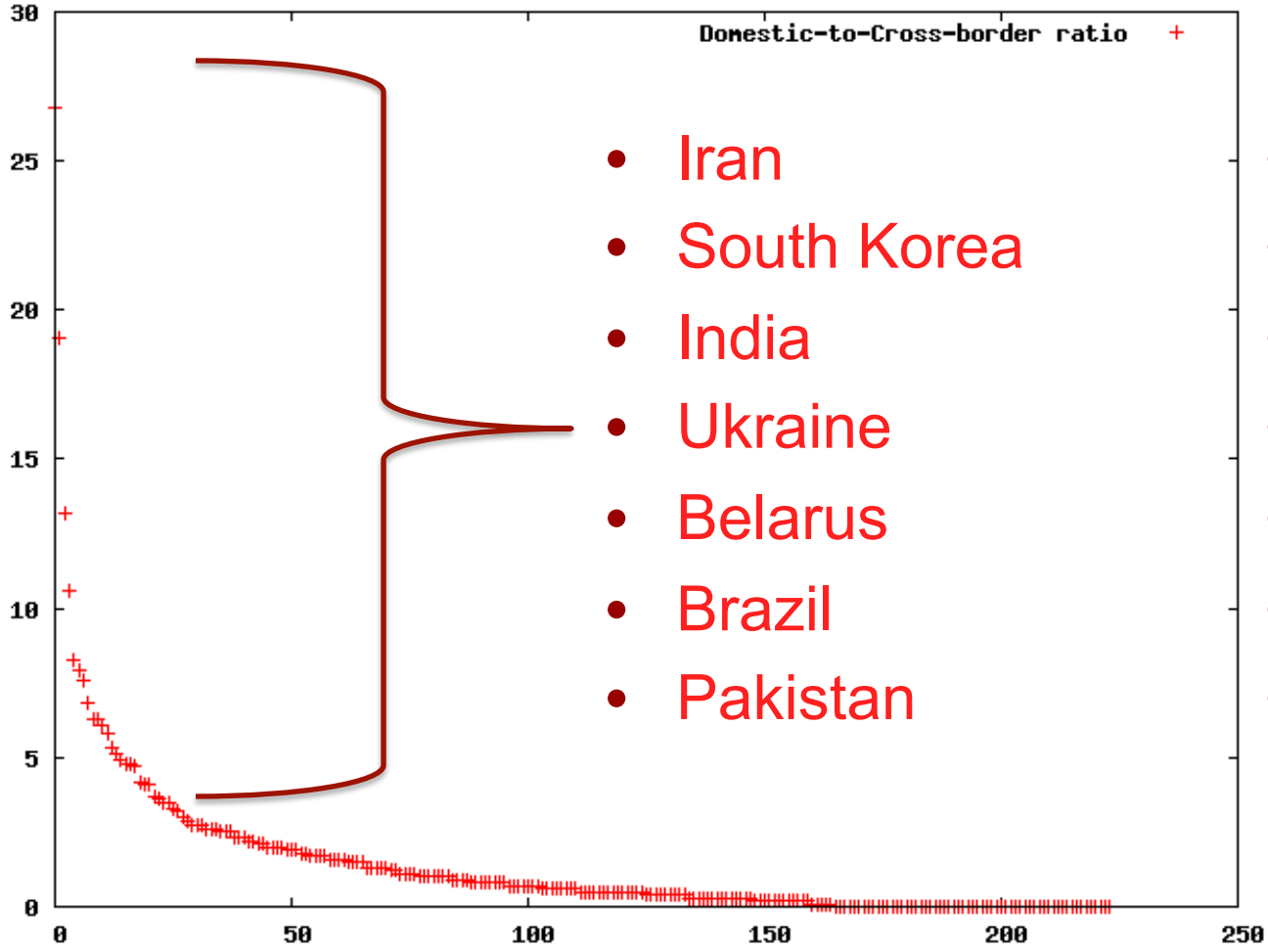
Constrained ecosystems grow up to be:



- Iran
- South Korea
- India
- Ukraine
- Belarus
- Brazil
- Pakistan

- Uzbekistan
- Mongolia
- Armenia
- Poland
- Kazakhstan
- Russia
- Indonesia

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“Can Disconnection Happen Here?”

- Renesys ranked countries according to the number of **directly connected ASNs** at the international frontier

- Not very scientific, but interesting
  - **One or two:** “severe risk of disconnection”
  - **Fewer than 10:** “significant risk”
  - **Up to 40:** “low risk”
  - **More than 40:** “resistant”

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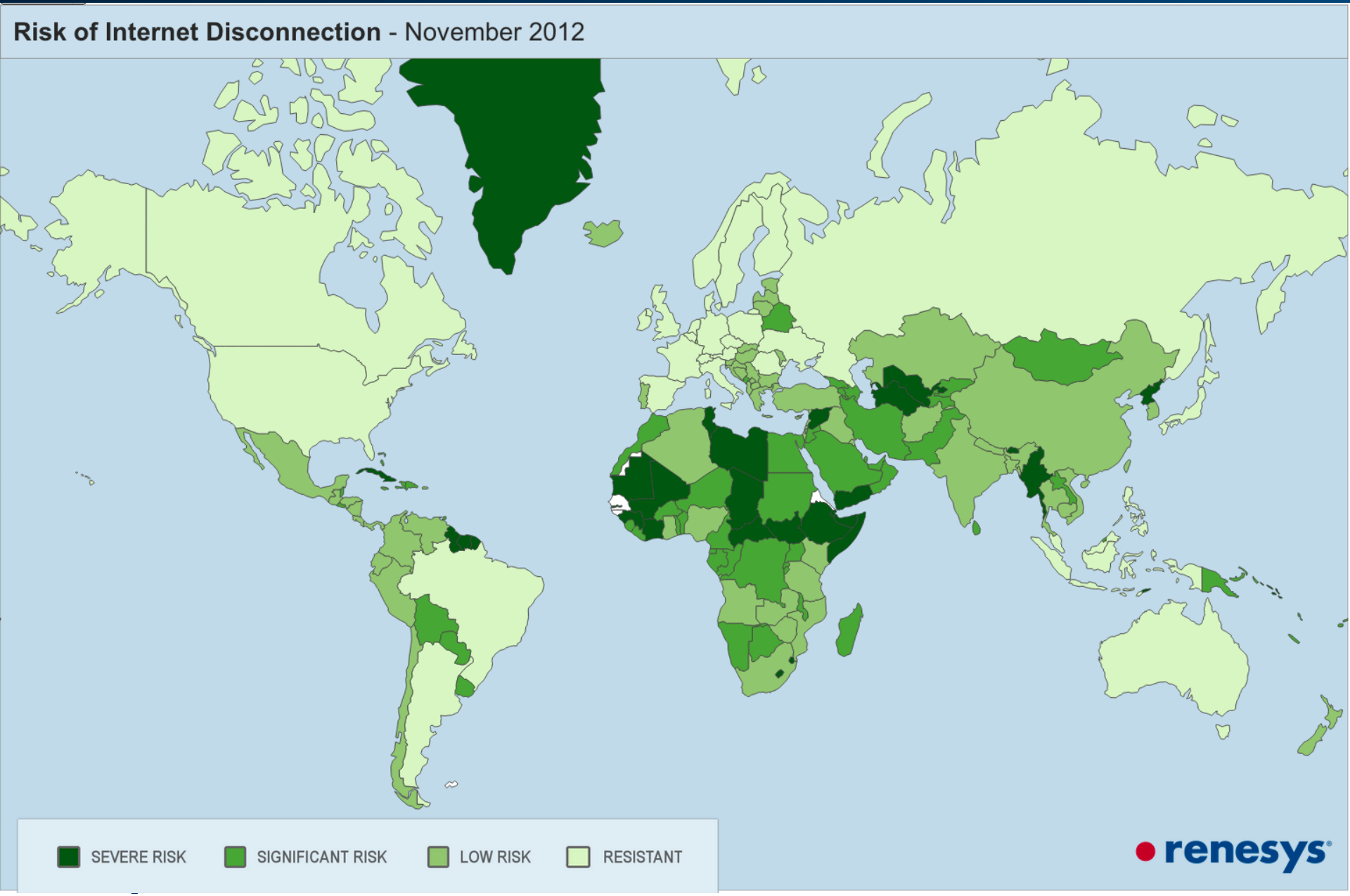
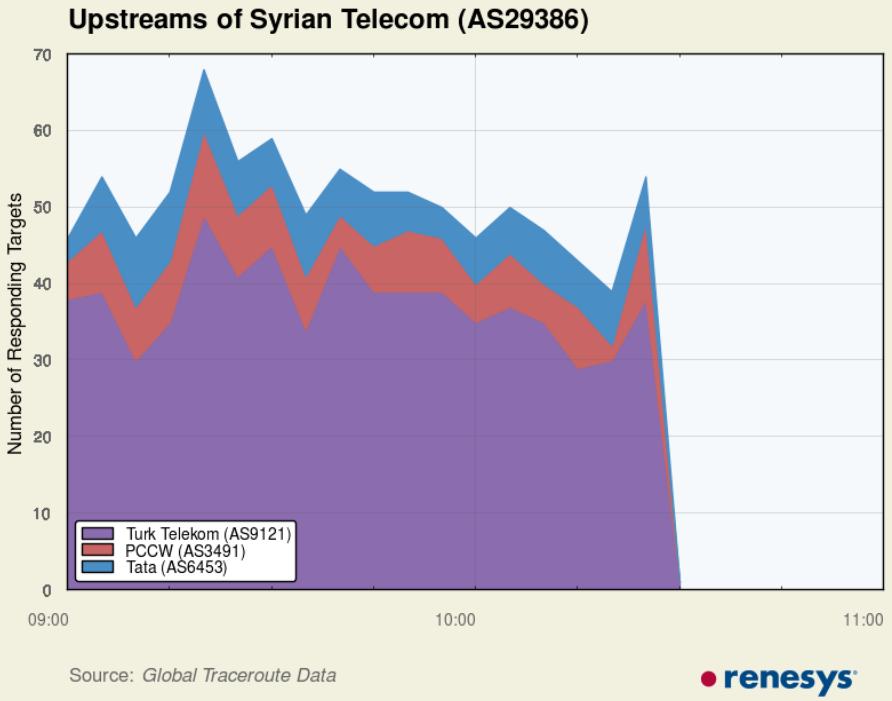
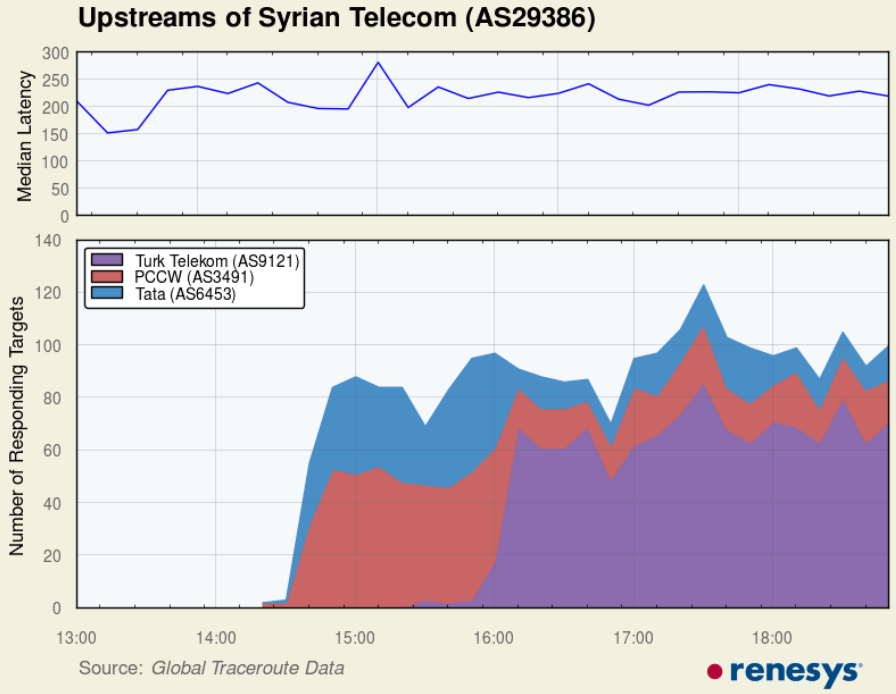


Syrian Outage, 29 November 2012





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ASNs with International Transit

- Low risk (<=40)
  - Turkey, Bahrain, Iraq, Kuwait, Lebanon, Palestinian Territories, Afghanistan
- Significant risk (<=10)
  - Oman, Iran, Saudi Arabia, Qatar, UAE
- Severe risk (1 or 2)
  - Libya, Yemen, Syria

Nature of risk is not specified: **diversity** creates resilience to natural disasters, manmade disasters

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Conclusions

- Middle Eastern countries **will** grow from dozens of ASNs to hundreds or thousands of ASNs
- Competition within and outside the region to attract content and ICT investment
- Enterprises are reading the available signals to figure out where the Internet is stable, cheap, fast enough to support their business goals

- **What policies for domestic peering and direct interconnection might drive these metrics in the right direction for rapid growth?**

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Thank you!

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