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The Internet Intelligence Authority

Bahrain's Internet Ecosystem: 2012 Overview

December 2012

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Executive Summary

At the request of the Bahrain TRA, Renesys periodically evaluates the blend of Internet transit provider alternatives that are available to Internet Service Providers in the Kingdom. Using publically visible BGP routing data collected from several hundred global vantage points worldwide, each provider's transit arrangements are summarized to provide insight into the current state of the market.

This report updates the evolution of Bahrain's Internet ecosystem, as seen through the lens of each Bahraini ISP's Internet routing announcements on 1 December 2012.

Key Trends in the Domestic Market

In Bahrain several positive trends have been evident throughout 2012:

- Domestic providers continue to show evidence of transit mobility; that is, they are actively weighing the market alternatives and changing their domestic and international transit arrangements as new alternatives become available.

- Because of the availability of alternatives in the market, Internet transit diversity in Bahrain continues to increase. Qatar Telecom grew its presence in Bahrain in 2012, adding a fifth significant international provider to the existing quartet of Tata, Flag, Saudi Telecom, and Etisalat.

- As a result of this increased diversity, Bahrain's consumers felt less impact from Internet outage events in 2012 than in any prior year. A FOG cable cut in March caused some rerouting and temporary increase of latency, but because of increases in transit provider diversity in recent years, no significant consumer-visible Internet routing blackouts occurred as a result.

- Saudi Telecom Bahrain (AS41426) continues to attract new customers. Important domestic providers such as Kalaam and Menatelecom now rely heavily on STC for connectivity, a potentially worrisome single-provider trend from the standpoint of resilience and survivability. Zain Bahrain points the way to a more diverse strategy, adding QTel as a backup to STC.

- On a positive note, STC continues to increase its own upstream diversity. In January 2012, STC added a connection to Flag/Reliance as a backup to its use of the STC backbone (AS39386) for Internet transit. This, in turn, may have

allowed STC customer Menatelecom to decide that it could spare the expense of maintaining its own second connection to Flag.

- Bahrain's providers are starting to consider the migration to IPv6 from IPv4, and at least two providers (2Connect and SITA/Equant) have now begun advertising IPv6 network resources in the global routing table. This should continue to be a topic for discussion in 2013, as the scarcity of IPv4 address resources is likely to create additional costs for Bahrain's service providers, and may become a limiting factor for the Kingdom's Internet growth within the next decade.

- The Bahrain Internet Exchange has become solely dependent on Tata for its connectivity, and with the departure of 2Connect, only counts about 4% of the Kingdom's routing table among its customers, down from 36% at its peak in 2009. If this had simply been the result of in-house migration of BIX customers from BIX transit to Tata transit on the new submarine cable, one would have expected to see a corresponding rise in direct Tata transit. Instead, customers who left the BIX tended to secure replacement transit in 2012 from Qatar Telecom, Viva Bahrain, or Etisalat, rather than Tata.

- We confirm our 2011 analysis that Flag's customer base diversity in the Kingdom appears to have peaked, after a short period of strong growth in 2010. No significant new Flag customers (other than Saudi Telecom) have emerged in 2012.[1]

[1] Here and elsewhere in this report, it's important to distinguish the observed *technical* relationship (a "provider-customer" relationship in the BGP table; i.e., logical adjacency between two autonomous systems) from the actual *commercial* relationship, which may be mediated by a third party, not observed in routing. For example, Flag transit in the Kingdom is often mediated by Batelco as a reseller of access to the Flag cable, but the Batelco autonomous system does not appear in any of the globally visible routing relationships or traffic paths between Flag and the end customer.

ASN	NSP	Jul 2008	Jan 2009	Jul 2010	Jan 2010	Jul 2010	Jan 2011	Jul 2011	Jan 2012	Jul 2012	**Dec 2012**
8781	Qtel								1%	5%	**35%**
6453	Tata	92%	99%	97%	93%	93%	99%	77%	82%	92%	**98%**
15412	Flag	32%	26%	22%	26%	20%	64%	52%	40%	89%	**74%**
8966	Etisalat	27%	31%	35%	35%	38%	29%	16%	11%	28%	**14%**
39386	STC						24%	27%	44%	64%	**60%**

Table 1. Percentage of Bahrain's Internet market that is at least partially routed through ("on net with") various international network service providers (NSPs) and their autonomous system numbers (ASNs). Numbers may sum to more than 100% due to multihoming (purchase of Internet transit from multiple NSPs to promote redundancy) and because of provider-customer relationships among these NSPs.

- As seen in Table 1, the share of the Bahrain market that's at least partially routed through ("on net with") Saudi Telecom seems to have peaked. In only 18 months, STC went from a new market entrant to having fully 64% of the Kingdom on-net; by year's end, that number had dropped slightly to 60% as a result of increased customer wins by Qatar Telecom.

- Tata's on-net percentage has rebounded to over 98%, not because they are providing more direct transit to Bahrain's providers, but because they ultimately provide offshore transit to both STC and QTel. Because they are shared by several providers, high on-net percentages for global carriers Tata and Flag are not cause for alarm. They suggest that the majority of Bahrain's smaller providers are now able (directly or indirectly) to access a diverse blend of Tata, Flag, Saudi, Qatari, and Emirati transit.

This report also examines the regional Internet ecosystems of surrounding countries, in order to see how their Internet transit diversity and growth rates compare to those of Bahrain.

Regionally, Renesys observed the following trends in 2012:

- UAE incumbent Etisalat (AS8966) has been shedding observed BGP peer relationships in the region throughout 2011-2012, while du (AS15802) has been gaining international peering, especially in Asia through its participation at Equinix Singapore (see analysis, page 26). Du's BGP connectivity should increase throughout 2013 as a result of its launch, through its Datamena brand, of the UAE-IX carrier neutral transit and content hub.

- The balance between Saudi Telecom and Mobily continues to shift in Saudi Arabia, with Mobily now representing a larger share of the Kingdom's Internet address space in the global routing table than the incumbent. Mobily also continues to have significant impacts in neighboring Internet markets, carrying an increasing share of transit from Jordan and Yemen.

- Oman's Nawras has begun to move out of the shadow of incumbent Omantel, dropping all but a token amount of transit dependence and buying Internet connectivity directly from international providers instead. Omantel drops from having 84% of the Omani Internet on-net at the start of the year, to just 52% in December 2012; Nawras has a largely disjoint 48%.

- Qatar, the UAE, Yemen, and Syria continue to maintain centralized ecosystems, in which a single provider maintains more than 90% of the domestic Internet routing table as its on-net customers.

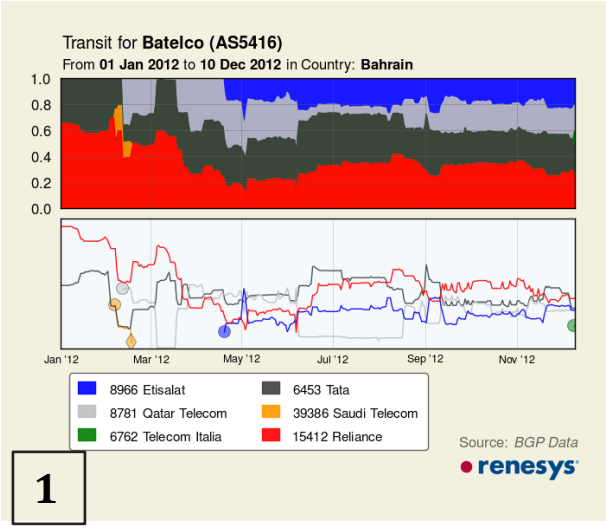
- Lebanon actually chose to rejoin the 90%+ club in 2012, as the incumbent (Liban Telecom) carefully controlled access to the newly operational IMEWE submarine cable.

- As a result of their lack of internal transit diversity, both Syria and Lebanon suffered multiday Internet outages that blacked out the entire country in 2012.

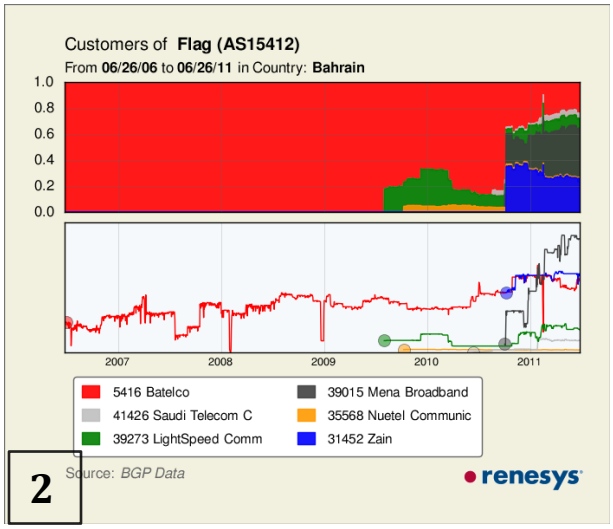
Methodology and Interpretation

Renesys continually monitors the global Internet routing table, synthesizing second-by-second changes in the advertised paths to every connected network on earth, and measuring round-trip latencies to those networks from around the world. Years of consecutive continuous observations are then mined to produce summaries of evolving interprovider relationships in each country, and each region of the world.

1. Transit shift plots present a histogram of a given provider's route selection percentages to each of their upstream transit providers, summing to 100%. The thickness of colored bands gives a visual indication of the importance of each provider in supplying Internet transit to the autonomous system in question. Below the histogram, the unnormalized customer base is plotted as a line plot, to give a sense for the growth or loss of transit volume over the lookback period.



2. Customer transit plots provide equivalent information for the provider's customer base, indicating the relative contribution of each downstream ASN to the provider's total customer base. Customer transit plots consist of a normalized stacked histogram on top, and an unnormalized line plot of the same customer base size data below.



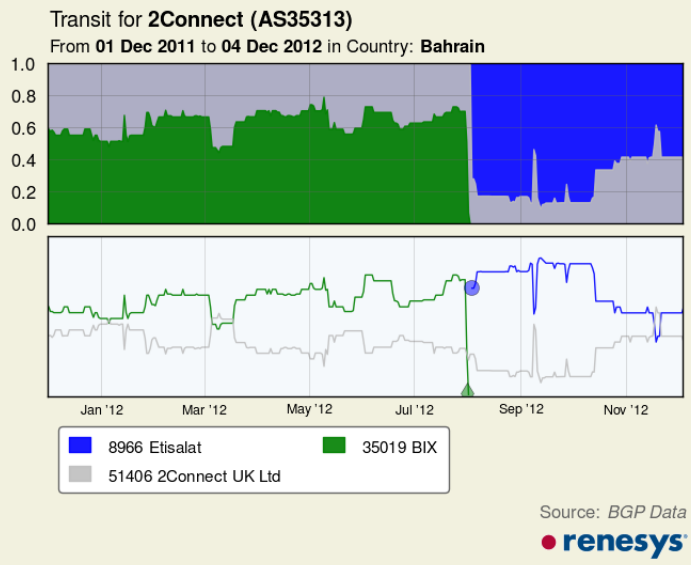
Bahrain's Autonomous Systems

In the following section, we briefly describe the Internet transit arrangements of each of the primary autonomous systems (in alphabetical order) that provide service within the Kingdom of Bahrain, and identify significant changes that occurred during 2012.

2Connect (AS35313)

2Connect started the year receiving transit from the BIX, and from its UK operation in London. Between May and October 2012, 2Connect began providing transit in turn to its first downstream customer, The Benefit Company (AS30882).

As the BIX prepared to move entirely to Tata transit, 2Connect responded by dropping BIX transit in favor of Etisalat in August 2012.

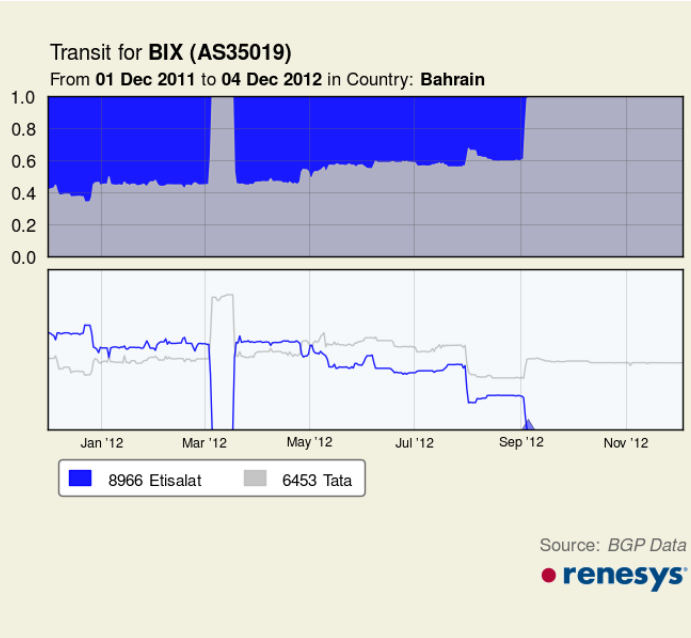


Bahrain Internet Exchange (AS35019)

The BIX has historically purchased transit from Etisalat and Tata.

During the March 2012 FOG submarine cable cut, Etisalat transit became unavailable. From May through September, the BIX gradually increased its use of Tata as a transit provider.

In September, the cutover to the new Tata submarine cable was completed, and the BIX became single-homed behind Tata, losing Etisalat transit altogether.

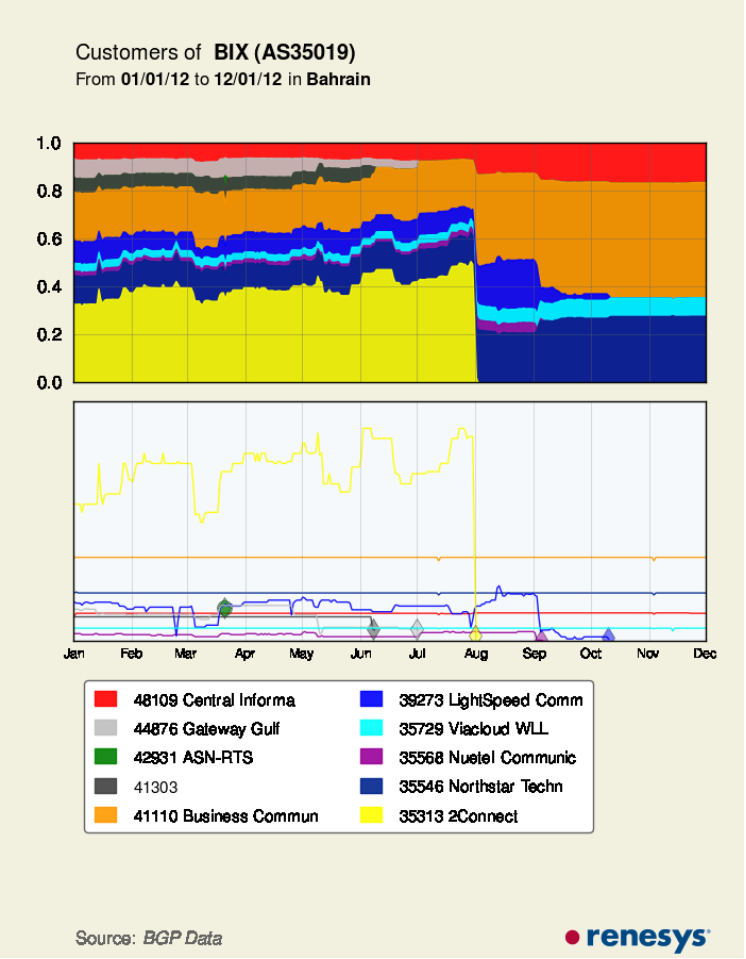


The BIX provided Internet transit to ten autonomous systems in 2012, but ended the year with only four remaining.

Ascentech (AS41303) disconnected early in June. Gateway Gulf (AS44876) appears to have shuttered their BIX connectivity at the end of June as well. Nuetel (AS35568) ended service in September, and Lightspeed (AS39273) did so in October.

Most significantly, 2Connect, representing a large component of all routes advertised at the BIX, turned off service in August.

The BIX ends the year with four routed customers (Central Informatics Agency, Northstar, Viacloud, and BCN) and just 4% of the Kingdom's routing table on-net.

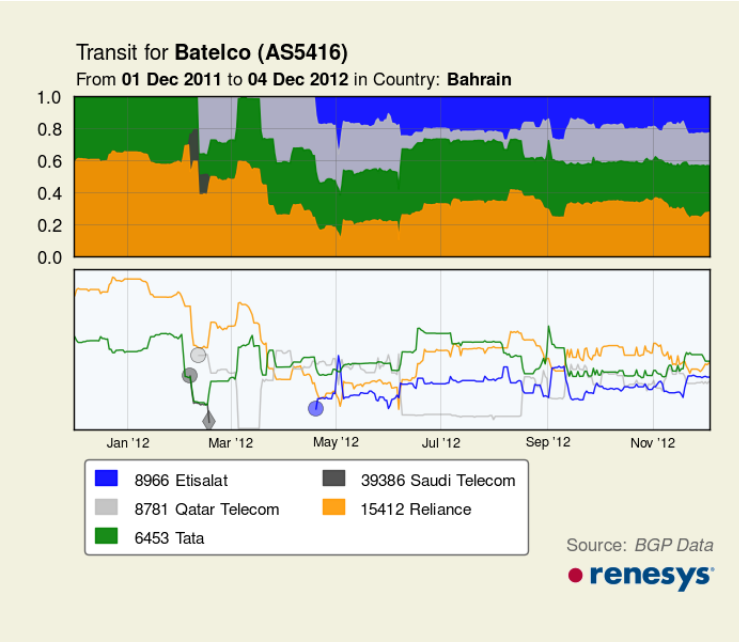


Batelco (AS5416)

is the Kingdom's incumbent provider, and now receives transit from four separate international transit providers. Batelco's transit has historically been a straightforward blend of FLAG/Reliance (AS15412) and Tata (AS6453).

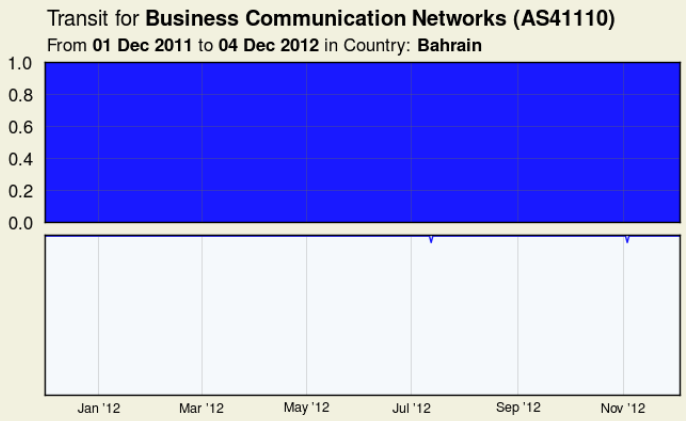
For a week in February, Batelco briefly received transit from STC (AS39386); at the same time, they began a transit relationship with Qatar Telecom (AS8781) that has continued.

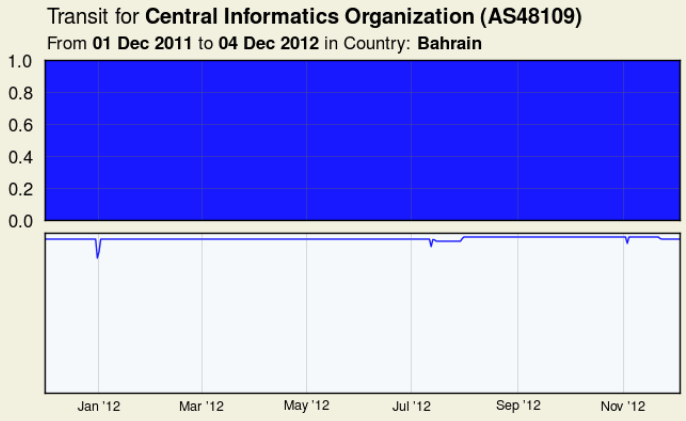
In April Batelco added Etisalat as a fourth provider, and those four (Etisalat, Qtel, Tata, Flag) have persisted stably through the last 6 months of 2012.



Business Communications Network (AS41110) , Central Informatics Agency (AS48019)

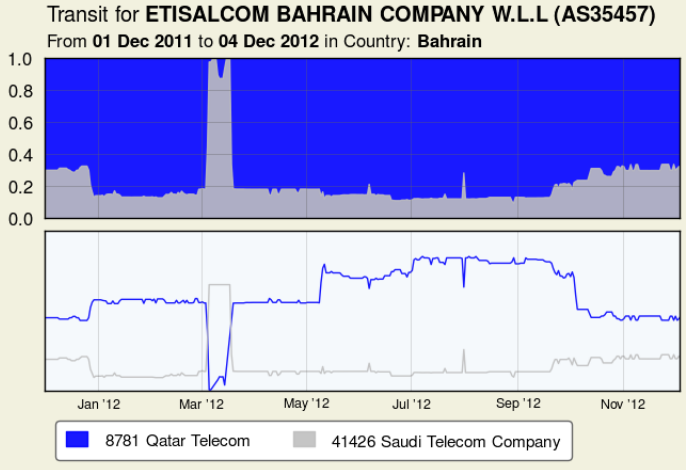
These autonomous systems are both long-standing single-homed customers of the BIX, and remained with the BIX throughout 2012.





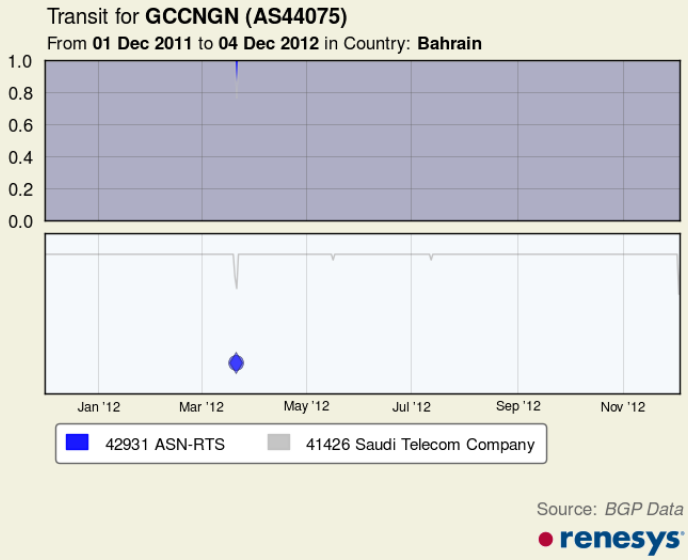
Etisalcom Bahrain (AS35457)

Etisalcom routes through STC (AS41426) and Qatar Telecom (AS8781), with the latter being substantially preferred. During the March FOG outage, this ratio reversed itself, and the west-bound route to STC became primary until FOG was repaired.



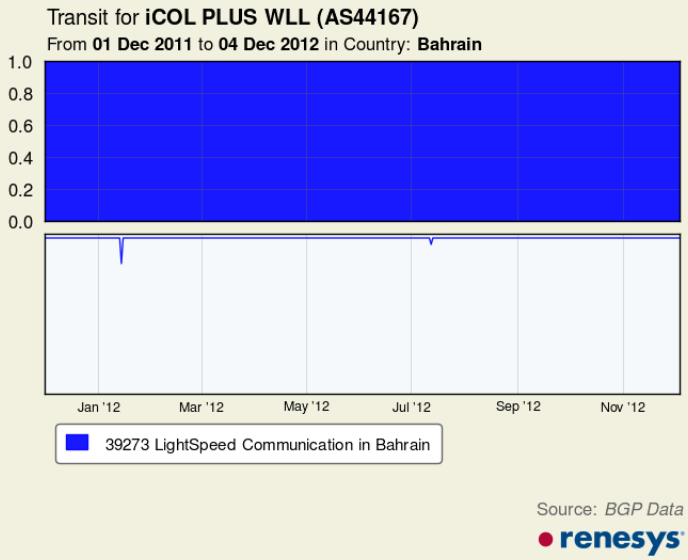
GCC-NGN (AS44075)

continues to get its Internet transit through Saudi Telecom (AS41426). A brief routing mistake caused them to transit parent company Rawabi on a single day in March 2012.



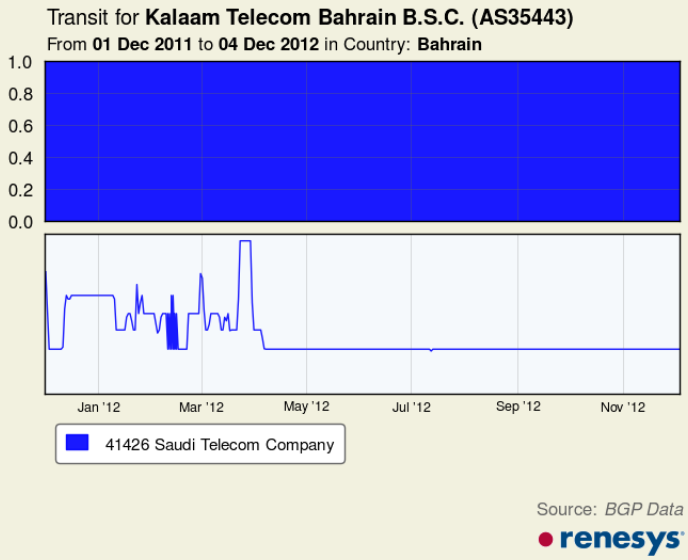
iCol Plus (AS44167)

iCol Plus continued to be a singlehomed customer of LightSpeed throughout 2012.



Kalaam (AS35443)

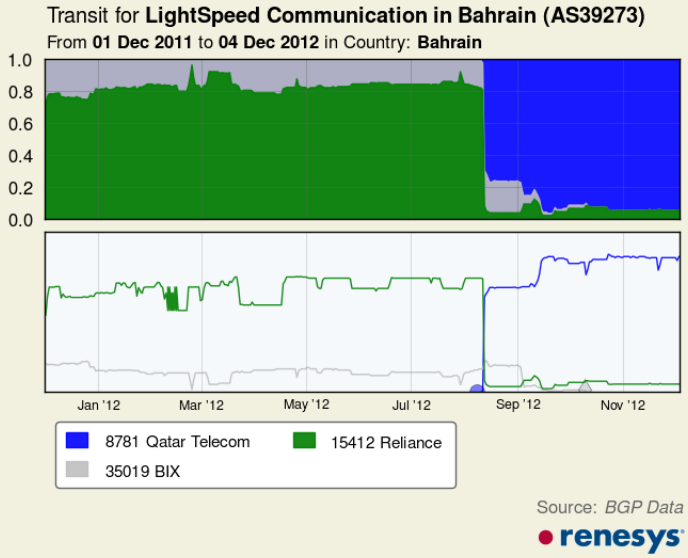
continues to get all of its Internet transit from Saudi Telecom (AS41426).



Lightspeed (AS39273)

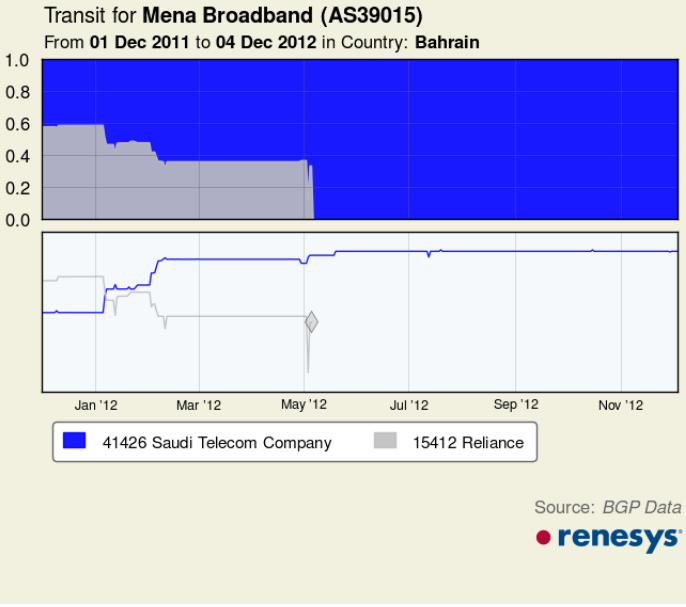
had another year of significant adjustments to transit strategy in 2012. Until August, Lightspeed relied on Flag/Reliance (AS15412) for the majority of its transit, with a backup connection through the BIX. In August, however, they switched from Flag to Qatar Telecom (AS8781), and in October, dropped their backup connectivity through the BIX. Lightspeed closes the year primarily reliant on QTel for all transit, with a little-seen backup route through Flag.

Lightspeed provides transit to iCol Plus (AS44167) and Life Telecommunications (AS196896), as well as a single SITA prefix from Orange (AS5583).



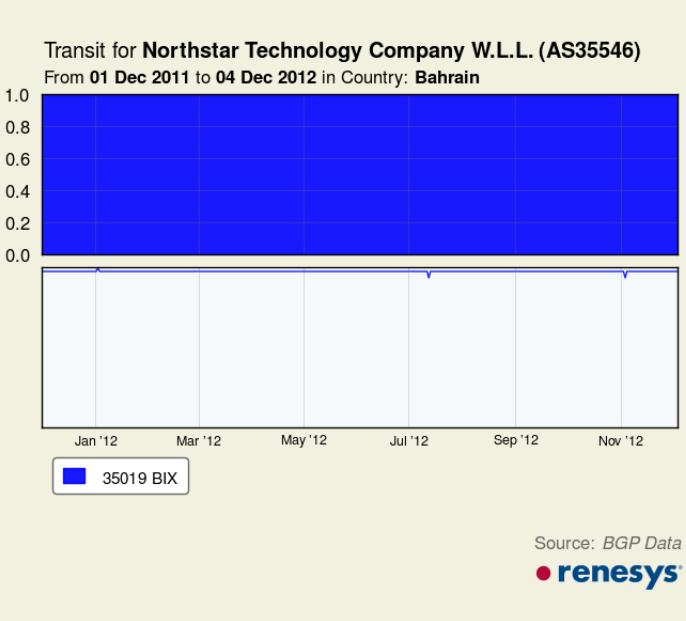
Menatelecom (AS39015)

has phased out Flag/Reliance (AS15412) as its second transit provider, leaving it 100% reliant on Saudi Telecom (AS41426).



Northstar (AS35546)

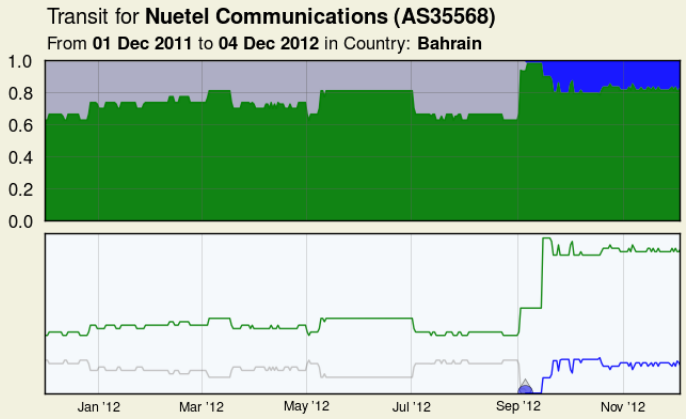
is another single-homed customer of the BIX.



Nuetel (AS35568)

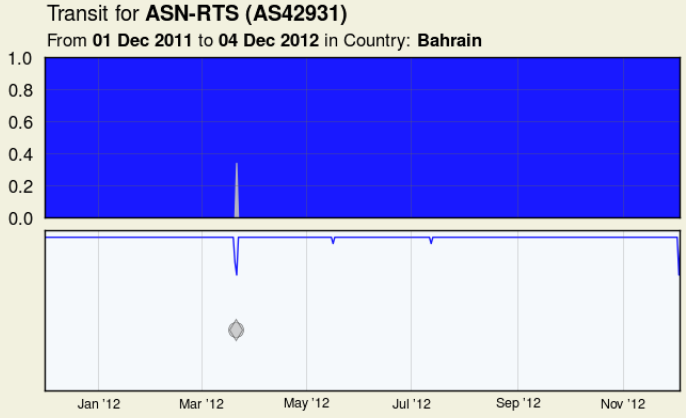
used Flag/Reliance (AS15412) as primary transit provider, and BIX as the backup provider, until September. In September Nuetel stopped transiting the BIX, and began using STC Viva Bahrain (AS51375) as backup transit instead.

At the end of 2012, other than Nuetel, and Batelco, only one other provider in Bahrain uses Flag/Reliance in a significant transit capacity: Saudi Telecom (AS41426, see below).



Rawabi (AS42931)

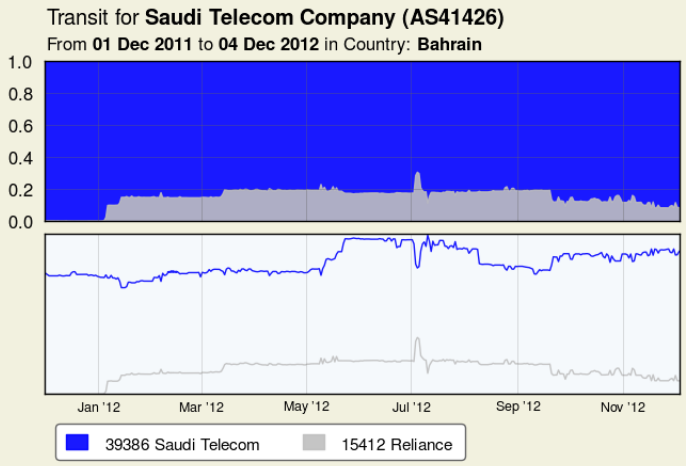
which joined the BIX in 2011, and now relies exclusively on Saudi Telecom for Internet transit. On one day in May, they briefly transited BIX, in a likely misconfiguration, mirroring their accidental provision of transit to GCC-NGN on the same day.



Saudi Telecom Bahrain (AS41426)

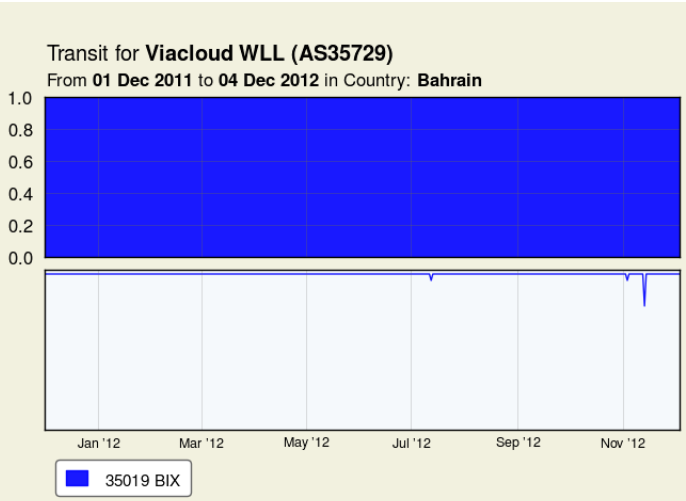
understandably gets most of its transit through Saudi Telecom (AS39386), utilizing GCCIA-owned fiber, and an alternative path along the causeway to Saudi Arabia.

In January 2012, however, STC started drawing on Flag/Reliance transit (AS15412) as a backup provider, presumably to create physical redundancy. This move substantially increases the resilience of STC's Bahrain network, which has become an increasingly important source of connectivity for providers within the Kingdom.



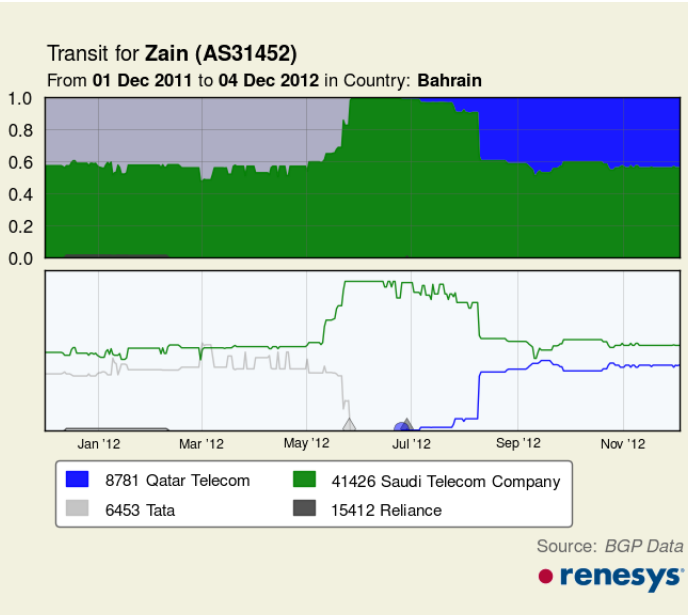
Viacloud WLL (AS35729)

remains a single-homed customer of the BIX.



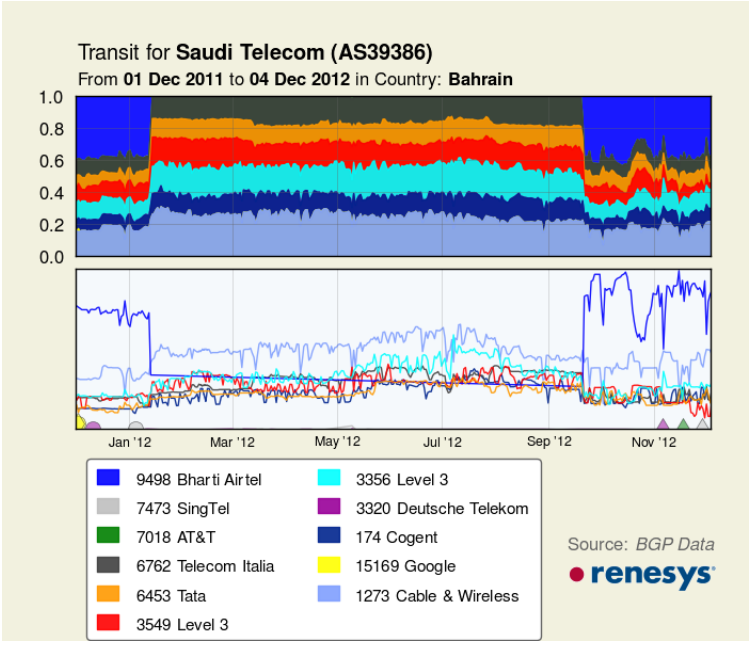
Zain (AS31452)

offers a striking look at a shift toward Saudi Telecom transit, away from traditional providers such as Tata (AS6453) and Flag (AS15412). By June 2012, Zain had reduced its Tata transit to zero, and had only a single token network prefix transiting Flag/Reliance. In July, new transit through QTel appears, and Zain ends the year dual-homed to QTel and STC.



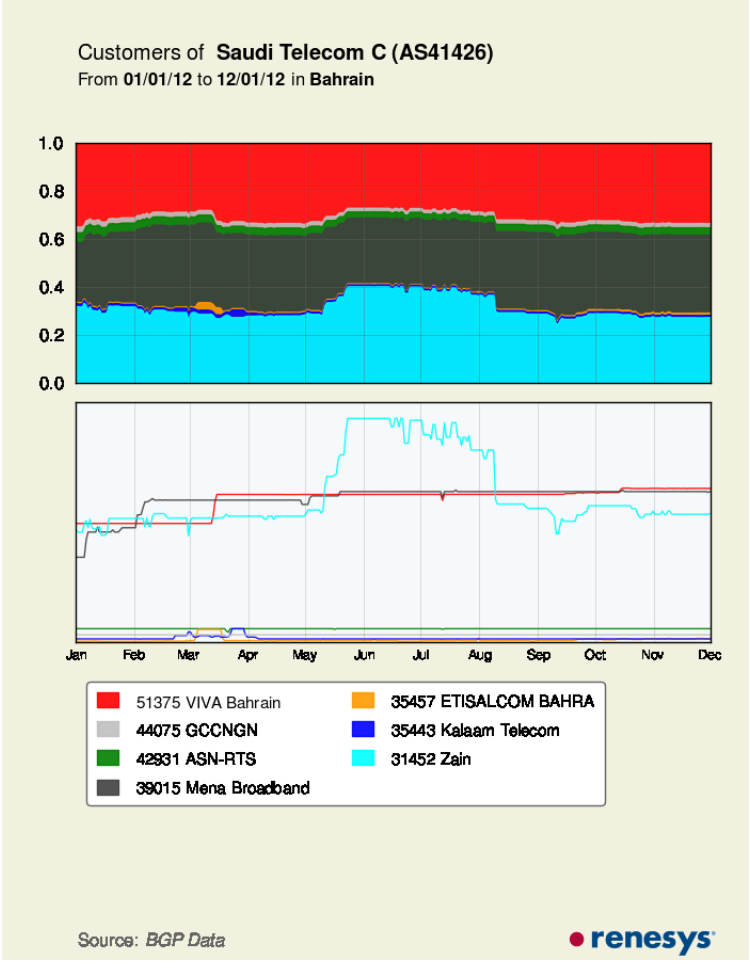
International Transit Providers Serving Bahrain: 2012

In this section we compare and contrast the downstream customers of each of the five major international Internet service providers that serve Bahrain: STC, Flag/Reliance, Qatar Telecom, Tata, and Emirates/Etisalat.



Saudi Telecom (AS39386)

provides transit to Bahrain via its single local customer, STC's AS41426. Note the high degree of multihoming in evidence, and the stability (except for the phaseout of Bharti in January, and its subsequent return in September) of STC's provider blend.



Saudi Telecom Bahrain (AS41426)

now serves more downstream customers than any provider in Bahrain.

Besides VIVA Bahrain (AS51375), its subsidiary downstream customer, STC now serves Rawabi, GCC/NGN, Menatelecom, Etisalcom Bahrain, Kalaam Telecom, and Zain.

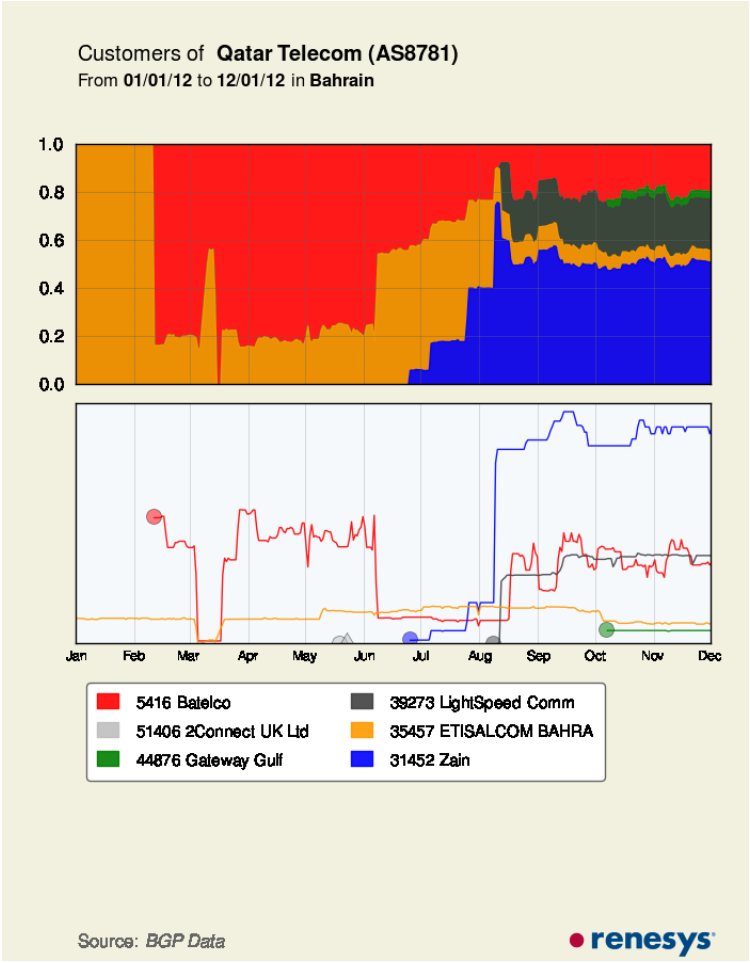
Zain, which was for a time single-homed through STC as it eliminated its dependence on Tata, has now hedged its bets with a second transit through Qatar Telecom.

Qatar Telecom (AS8781)

has had the most growth in Bahrain in 2012, in terms of bringing new transit customers on board. At the start of the 2012, QTel's only customer in the routing table was Etisalcom Bahrain.

Then they signed Batelco (in February), Zain (in June), Lightspeed (in August), and Gateway Gulf (in October). For two days in May, they appear to have transited 2Connect UK as well, briefly.

During the FOG cut in March, both Batelco and Etisalcom shifted away from QTel to their alternative providers (Tata for Batelco, STC for Etisalcom).



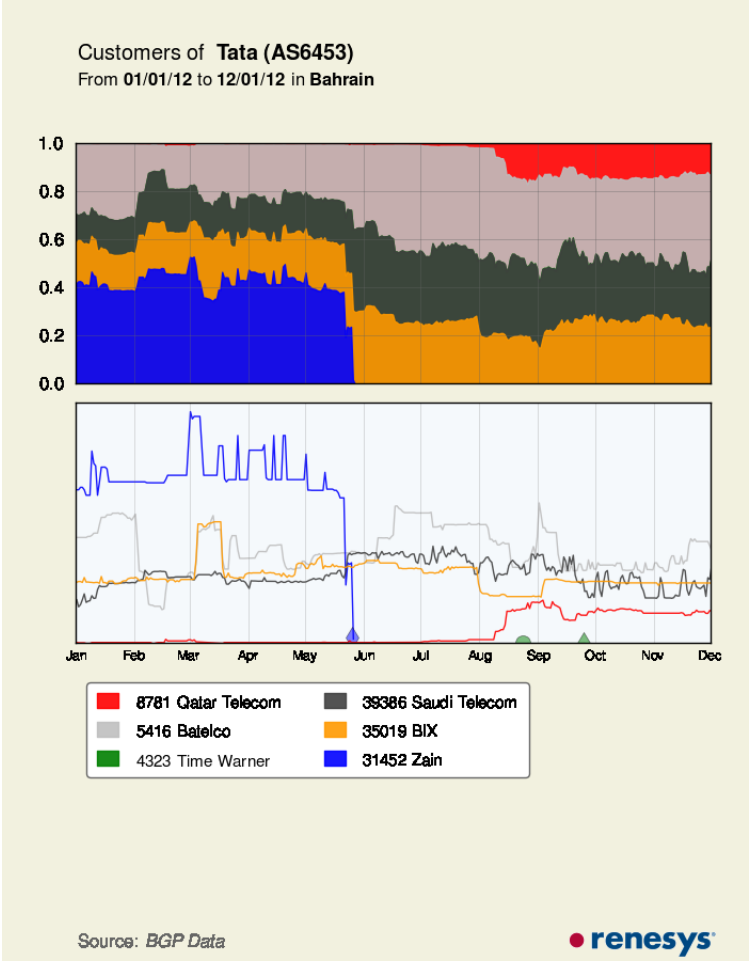
Tata (AS6453)

has seen relatively steady direct transit from remaining Bahrain customers Batelco and BIX.

Tata has also provided some minor upstream transit to STC's AS39386, on behalf of STC's AS41426 and thereby its other Bahraini customers.

The loss of Zain as a customer in May 2012 significantly reduces Tata's overall role in providing direct BGP-visible Bahraini transit, but Tata gained QTel as a customer in July.

It is likely that providers such as 2Connect are still making use of Tata's global network to reach London, though they do not appear downstream of Tata in the routing table. Combining this service with Tata's direct transit to Batelco and the BIX, and their indirect transit for STC and Qtel, Tata remains a key upstream provider for Bahrain.

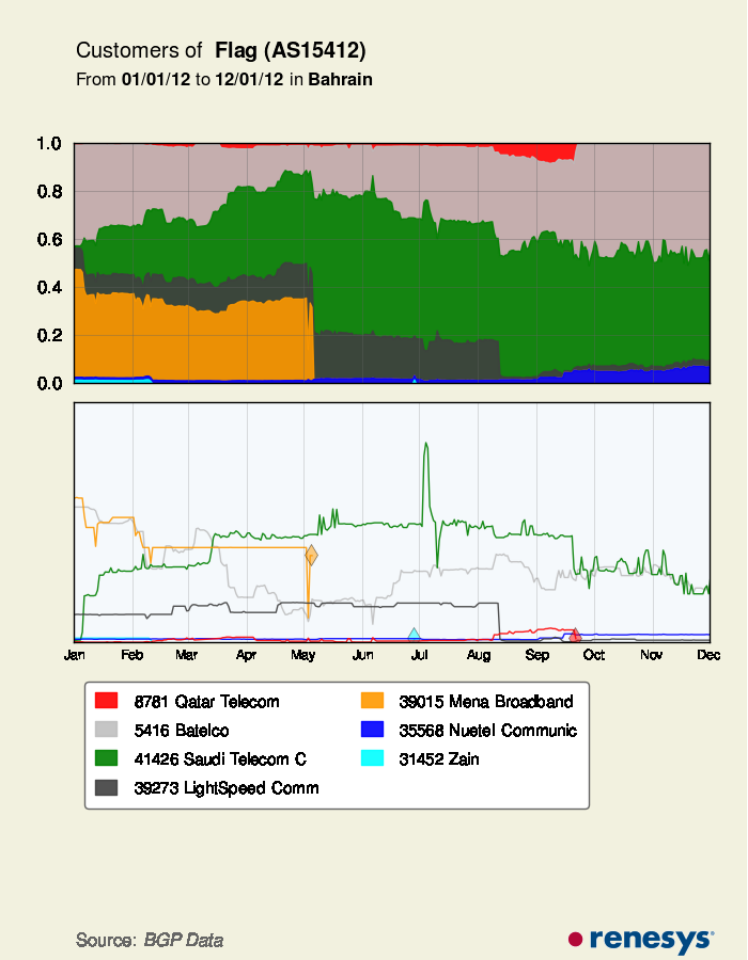


Flag/Reliance (AS15412)

continued to lose market share to Saudi Telecom and QTel for direct Bahraini transit in 2012.

Menatelecom dropped Reliance as a backup provider in May 2012, perhaps perceiving (correctly) that STC's own purchase of Reliance for backup transit in January 2012 made Menatelecom's connection largely redundant.

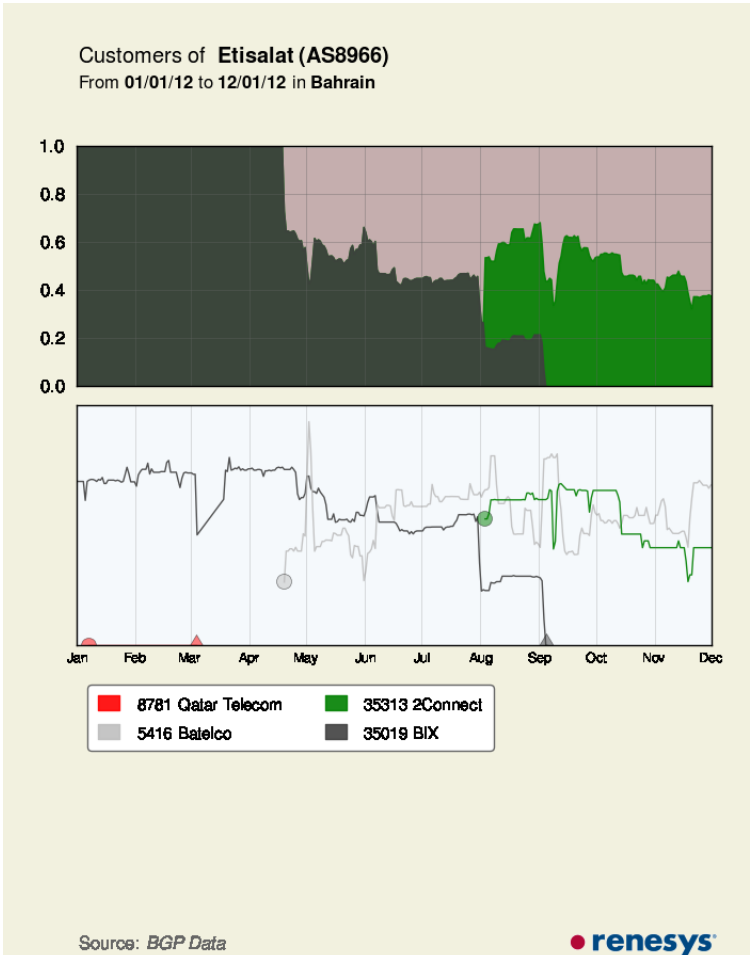
No other providers have stepped in to take advantage of Reliance's services in 2012. They are left with Batelco and STC as primary customers, with minor transit provided to Lightspeed, Nuetel and Zain.



Etisalat (AS8966)

gained Batelco as a second Bahrain transit customer in April, alongside the BIX. It's unclear why Batelco chose Etisalat as a fourth provider; however, the desire for path redundancy may have played a role.

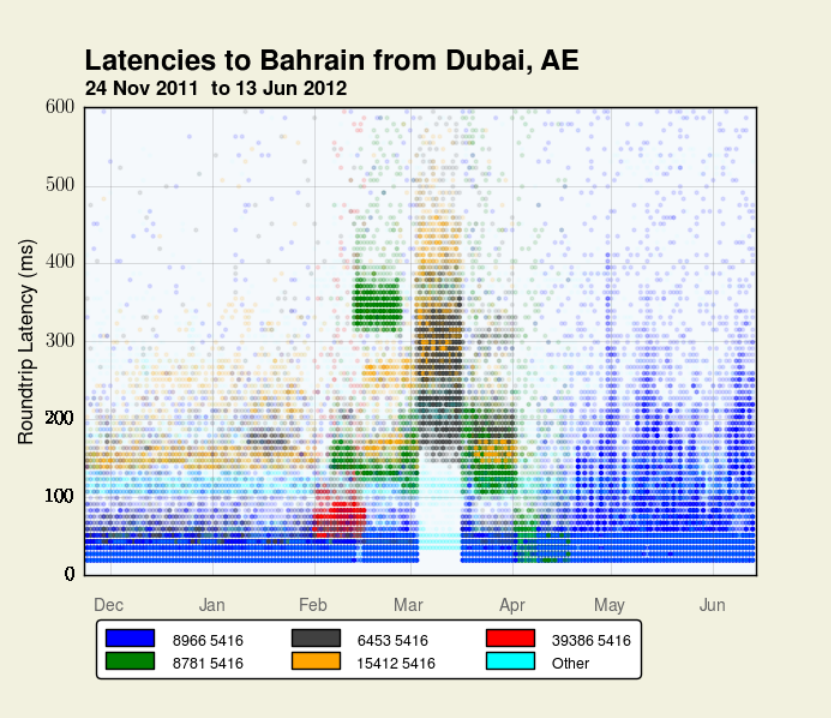
Etisalat also landed 2Connect as a customer in August, and then lost the BIX in September.



Event Analysis: March 2012 Cable Cut

Routing shifts and changes in inbound traceroute latencies both suggest that a significant interruption on the FOG cable took place between 3 and 18 March 2012.

This was not an officially acknowledged outage; however, the impacted providers make it reasonably clear that the event affected connectivity to Qatar Telecom and Emirates for providers in Bahrain. In each case, because alternative connectivity was available, either on FLAG or over the Causeway to Saudi Arabia, there were no serious impacts on regional connectivity beyond a temporary increase in latency; that is, there were no outright routing outages.



For example, the plot at right summarizes round-trip latencies into Bahrain from a Renesys traceroute collector in Dubai over the past six months. Traces to Batelco hosts are colored according to the upstream provider (e.g., Batelco's transit provider); traces to non-Batelco hosts are colored cyan.

In December 2011 and January 2012, one can see fairly stable typical latencies of 20ms (via Emirates, AS8966) or 140ms (via Flag, AS15412), with occasional higher measurements (presumably due to congestion).

In February, one can see a period in which Batelco is also reached via STC (in red), with slightly higher latencies of 50-100ms.

The most visible event, however, is the FOG cut in March. Note that Emirates transit (in blue, 20-50ms) and Qatar Telecom transit (in green, 140ms) both become unavailable, replaced by much slower paths through Tata (in dark grey, 150-300ms).

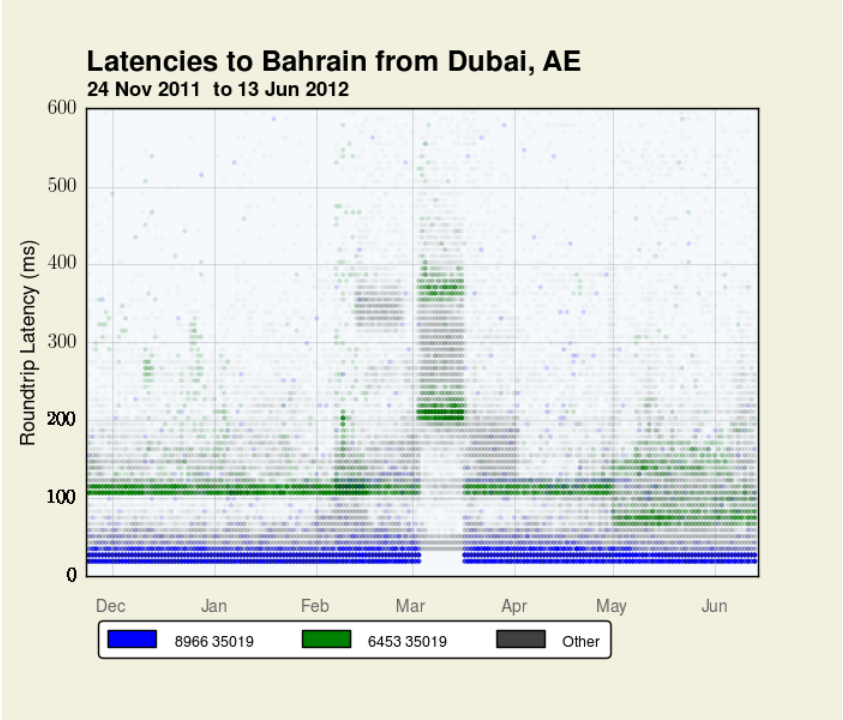
When the cable damage is repaired, the previous transit and latency patterns are reasserted.

In May and June, Emirates traces come to dominate the Batelco measurements from Dubai, with latencies that spike into the 200ms+ range on a daily basis.

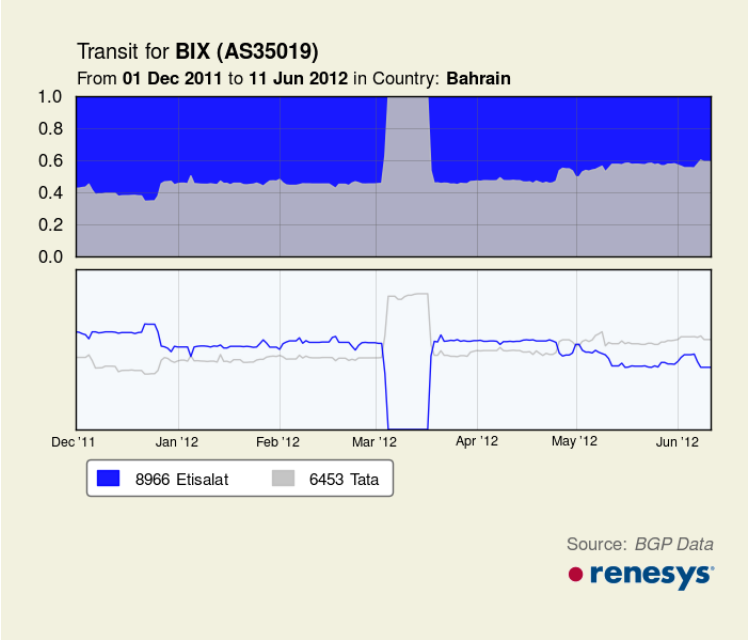
This plot of latencies from Dubai uses a different provider filter, examining only traces into the Bahrain Internet Exchange (others in grey).

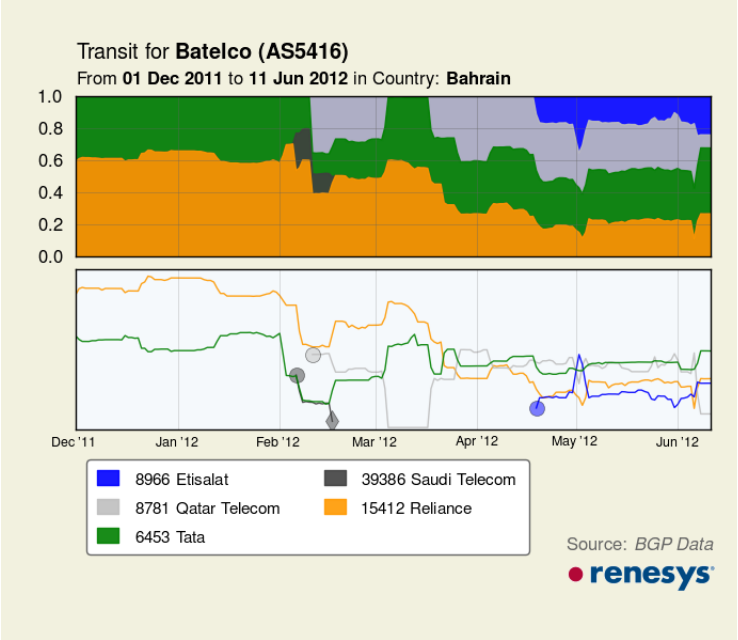
The fastest traces are those through Emirates (AS8966, in blue, at 20-50ms). The slower path is through Tata (AS6453, in green, at 100ms).

During the March FOG event, however, the Emirates path becomes unavailable. BIX is left with two physical paths to Tata, one with RTTs of 200ms, and the other around 375ms. We speculate that these may be round trips to London from Dubai, and back again across Saudi Arabia.



Comparing these to the BGP-based transit shift plots for Batelco and the BIX at the same time, the provider shifts that induced the latency increases are clearly evident.





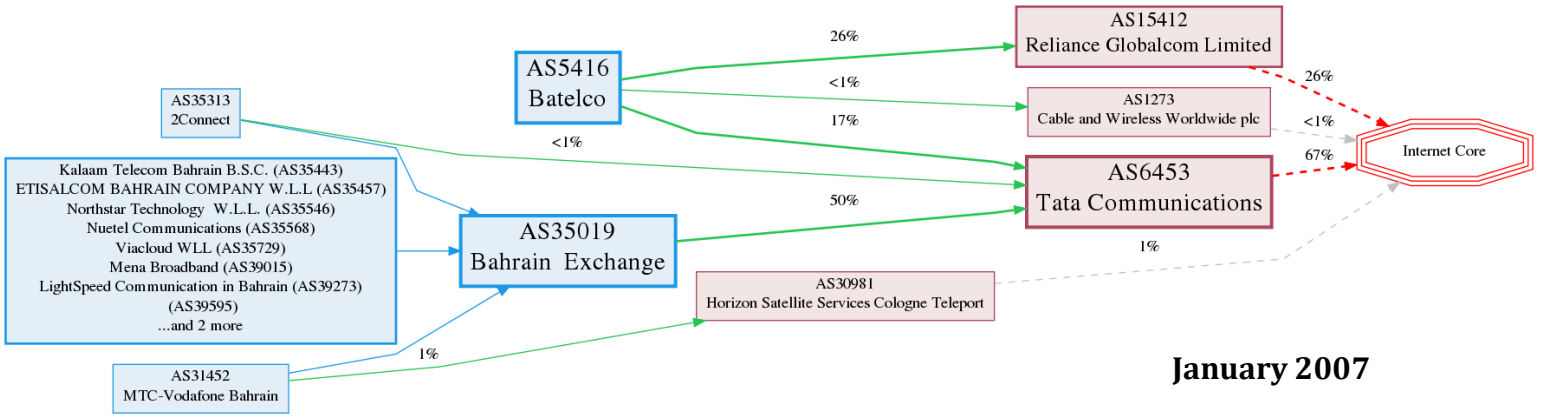
Bahrain Summary: 2007-2012 Evolution

To visually understand the evolution of the Bahrain market, it may help to compare the following two snapshots of the Kingdom's Internet ecosystem over five years.

Bahrain in 2007

At the start of 2007, Bahrain's Internet was relatively simple, roughly divided between Batelco and the Bahrain Internet Exchange (BIX).

Only Batelco used Flag/Reliance; all other providers were reliant on the BIX, or relied on expensive satellite Internet. Among competing providers, only 2Connect had a direct transit relationship with Tata.

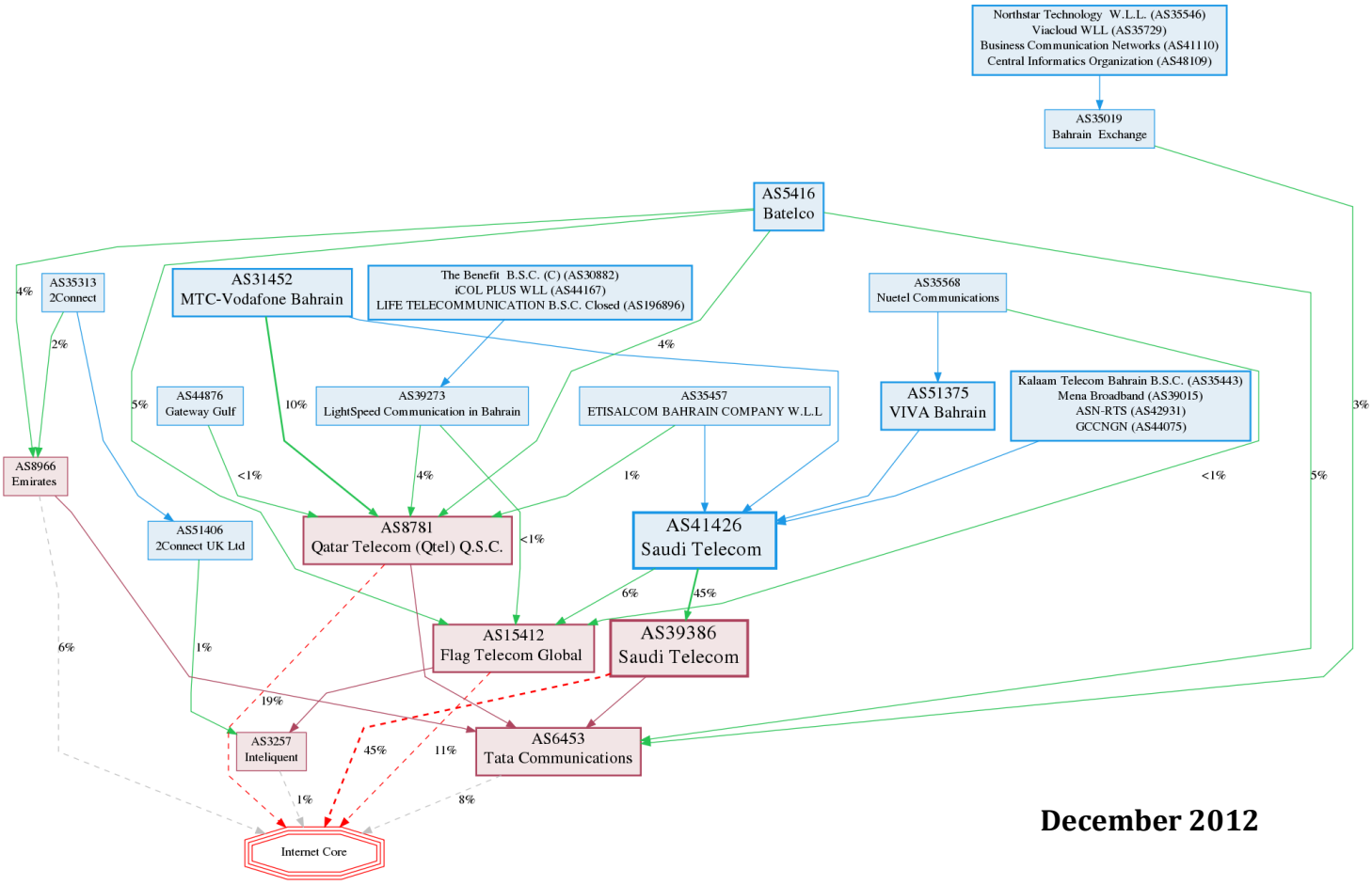


Bahrain in 2012

By the end of 2012, the Bahrain market has expanded considerably in depth and complexity.

Domestic providers now choose from a broader range of upstream service providers, including Flag, Tata, Saudi Telecom, Qatar Telecom, and Etisalat.

The number of providers that connect to the Internet using a registered Autonomous System number has increased from 13 to 20. These providers routinely utilize multihoming (multiple Internet connections, along multiple physical paths) to insulate themselves from dependence on any single cable or transit provider.



December 2012

Market Importance of Domestic Providers, By Country

On-net percentages[2] can be used as a reasonable metric for examining relative domestic provider importance around the region, by measuring the weighted percentage of the national market served as customers of a given provider (directly or indirectly).

If there are several domestic providers in a given market with similar on-net percentages below 50%, it's more likely that the market supports competition. If one domestic provider has more than 75% of the country's address space on-net, on the other hand, it can be a sign that competition is limited.

In the tables of domestic provider on-net numbers[3] on the following pages, note that **Iran, Syria, the UAE, Qatar,** and **Lebanon** all have a single largest domestic carrier with more than 75% of the domestic market on-net, potentially signaling an IP transit market in which competition is limited. **Lebanon** moved firmly back into this category in 2012.

Oman, Egypt, Iraq, and **Jordan** are intermediate cases, whose incumbent provider retains between 50% and 75% of the national market on-net. In each case, the emergence of a strong competitor (typically a mobile provider) is driving demand for international transit on better terms. As rival solutions to the international transit puzzle emerge, and domestic providers reach out to international carriers directly, the incumbent's share of domestic on-net market gradually declines. Like Lebanon, **Egypt** and **Iraq** are headed toward more concentration, not less, in the hands of the largest provider.

Only **Kuwait, Saudi Arabia,** and **Bahrain** have a largest domestic provider with less than 50% of the market on-net, indicating that no single provider controls access to a simple majority of IP space.

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[2] In service provider terminology, the term "on net" describes a block of IP space that is globally observed to be reachable through a given provider. Therefore, an ISP's "on-net percentage" in Bahrain is the percentage of the total volume of Bahrain's IP space that belongs to the ISP, or to its direct or indirect customers.

[3] Note that in this context, the term "domestic market" connotes the set of *routed IP network prefixes* within the country, not the economic market, for the purpose of competition assessment.

Here, on-net percentages **may sum to more than 100%** if one of these domestic providers sells to one of the other listed domestic providers, as they each get credit for their overlapping customer bases.

Things to note in these on-net tables:

- In **Oman**, the competitor (Nawras/Omani Qatari Telecom, 48%) continues to grow its market share relative to the incumbent, Omantel (now down to just 52%).
- In **Egypt,** a multiyear trend toward reduction of Telecom Egypt's on-net percentage has reversed itself. Since the summer of 2011, TE has risen from 36% to 56% on-net, at the expense of competing operators Etisalat Misr, Linkdotnet, and Raya Telecom.
- **Lebanon** is similarly significant for its increasing concentration of on-net share in Liban Telecom, up from 69% to 92% concentration in 2012 as a result of careful control over desperately needed IMEWE submarine cable bandwidth.
- In **Iraq**, a new provider (Earthlink Limited, AS50710) has emerged out of obscurity to take fully 69% of the national market on-net in just 18 months.
- **Saudi Arabia**'s STC has fallen to 45%, and for the first time has a smaller percentage of Saudi Internet addresses on-net than its competitor, Mobily (now 48%).
- **Bahrain** has the most evenly spread market share across domestic providers, now that Zain's ASN for mobile data (AS42961) has grown to 42% of the total routed Internet in **Kuwait**. Bahrain now has four independent providers (Viva Bahrain, Menatelecom, Zain Bahrain, Batelco) with at least 15% of the national market on-net; no single one of them has more than 25%.

Percentage of National Routed Internet, By Provider

CC	ASN	NSP	Jan09	Jul09	Jan10	Jul10	Jan11	Jul11	Jan12	Jul12	Dec12
AE	**8966**	**Emirates Telecom**	**97%**	**97%**	**98%**	**98%**	**97%**	**94%**	**98%**	**96%**	**99%**
AE	5384	Emirates Internet	78%	79%	80%	71%	72%	70%	69%	70%	70%
AE	15802	Du	20%	19%	19%	28%	27%	28%	29%	29%	29%
BH	**5416**	**BATELCO-BH**	**40%**	**34%**	**31%**	**27%**	**21%**	**20%**	**20%**	**18%**	**20%**
BH	31452	Zain Bahrain	24%	27%	27%	33%	25%	26%	23%	26%	25%
BH	39015	Menatelecom	5%	10%	15%	17%	26%	24%	24%	17%	17%
BH	51375	Viva Bahrain	--	--	--	--	9%	10%	14%	17%	18%
BH	35019	BIX	32%	36%	26%	21%	29%	17%	12%	12%	4%
EG	**8452**	**TE**	**82%**	**51%**	**39%**	**34%**	**41%**	**36%**	**42%**	**45%**	**56%**
EG	36992	ETISALAT MISR	--	18%	25%	34%	33%	39%	31%	26%	20%
EG	24863	Link Egypt	21%	31%	33%	27%	24%	24%	25%	27%	26%
EG	24835	RAYA Telecom	24%	20%	14%	16%	18%	16%	19%	23%	21%
EG	15475	Nile Online	13%	12%	14%	7%	6%	7%	--	--	3%
IQ	21277	Newroz	8%	17%	21%	26%	**45%**	**43%**	**33%**	**19%**	**19%**
IQ	44217	IQ Networks	--	--	--	12%	28%	21%	34%	31%	48%
IQ	50710	Earthlink Ltd	--	--	--	--	--	--	**22%**	**49%**	**69%**
IR	**12880**	**DCI**	**98%**	**94%**	**92%**	**90%**	**90%**	**90%**	**94%**	**92%**	**87%**
IR	6736	IRANET/IPM	5%	9%	11%	14%	16%	14%	12%	9%	8%
IR	21341	Soroush Rasaneh	15%	16%	13%	10%	7%	7%	6%	5%	4%
JO	**8697**	**Jordan Telecom**	**100%**	**88%**	**85%**	**77%**	**76%**	**79%**	**73%**	**73%**	**75%**
JO	8376	Jordan Data	46%	41%	44%	37%	41%	45%	38%	43%	46%
JO	47887	Damamax	--	--	--	--	10%	11%	10%	16%	14%
JO	42912	XOL Jo	--	1%	5%	11%	10%	8%	14%	13%	12%
JO	9038	Batelco Jordan	12%	11%	8%	8%	9%	9%	10%	11%	11%

Percentage of domestic market on-net with leading providers. Incumbents often have more than 75% of the domestic market on-net. Percentages that add to more than 100% signify multihoming (consumer networks on-net with multiple providers).

Percentage of National Routed Internet, By Provider (Continued)

CC	ASN	NSP	Jan09	Jul09	Jan10	Jul10	Jan11	Jul11	Jan12	Jul12	Dec12
KW	43852	Kuwait Data Center co.	27%	23%	30%	33%	**36%**	**20%**	**24%**	**18%**	**9%**
KW	9155	QualityNet	28%	20%	25%	26%	42%	31%	24%	29%	40%
KW	21050	Fast W.L.L.	20%	20%	19%	19%	24%	16%	16%	11%	11%
KW	6412	KEMS	22%	26%	23%	21%	20%	27%	25%	28%	25%
KW	3225	Gulfnet Kuwait	13%	17%	16%	15%	18%	16%	13%	15%	20%
KW	29357	WATANIYA TELECOM	9%	9%	9%	18%	17%	14%	19%	15%	14%
KW	42961	MTC GPRS	--	--	--	--	15%	28%	**28%**	**39%**	**42%**
LB	**42020**	**Liban Telecom**	**45%**	**66%**	**64%**	**63%**	**68%**	**69%**	**88%**	**86%**	**92%**
LB	42003	OGERO Telecom	23%	42%	42%	46%	54%	50%	53%	50%	39%
LB	20535	InSat GmbH	2%	2%	3%	6%	--%	--%	--%	--%	--%
LB	39010	TerraNet sal	17%	17%	18%	16%	13%	12%	13%	12%	19%
LB	8261	Archway	--	--	12%	14%	--%	--%	--%	--%	--%
LB	24634	Cyberia	12%	13%	13%	11%	9%	--%	10%	10%	7%
OM	**8529**	**OmanTel**	**100%**	**100%**	**100%**	**99%**	**100%**	**100%**	**84%**	**80%**	**52%**
OM	28885	OmanTel NAP	100%	100%	100%	86%	88%	85%	66%	61%	52%
OM	50010	Omani Qatari	--	--	--	13%	12%	15%	34%	39%	48%
QA	**8781**	**Qatar Telecom**	**75%**	**98%**	**99%**	**99%**	**99%**	**99%**	**99%**	**99%**	**96%**
QA	29384	Qatar Foundation	15%	15%	15%	12%	11%	13%	11%	9%	11%
SA	**39386**	**STC**	**75%**	**65%**	**67%**	**72%**	**67%**	**66%**	**60%**	**55%**	**45%**
SA	25019	SaudiNet	26%	31%	31%	48%	49%	51%	48%	44%	29%
SA	35819	Mobily/Bayanat	6%	18%	15%	12%	20%	23%	28%	36%	48%
SA	34400	Etisalat	7%	10%	11%	8%	14%	17%	21%	28%	34%
SA	47794	Atheeb (Batelco)	---%	2%	5%	7%	5%	4%	5%	4%	4%
SY	**29386**	**Syrian Telecom**	**52%**	**66%**	**84%**	**99%**	**99%**	**99%**	**100%**	**100%**	**100%**
SY	24814	SCS	44%	33%	27%	28%	19%	--%	--%	--%	--%

Percentage of domestic market on-net with leading providers. Incumbents often have more than 75% of the domestic market on-net. Percentages that add to more than 100% signify multihoming (consumer networks on-net with multiple providers).

Special Focus: UAE Internet Exchange Growth

As 2012 comes to a close, the Gulf Region still awaits the arrival of a carrier-neutral, content-friendly Internet exchange point. Until some IXP can attract a critical mass of regional access providers and international content providers, the region's consumers will continue to retrieve most of their Internet content from Western Europe and North America, creating long latencies and inconsistent performance for applications such as streaming voice and video.

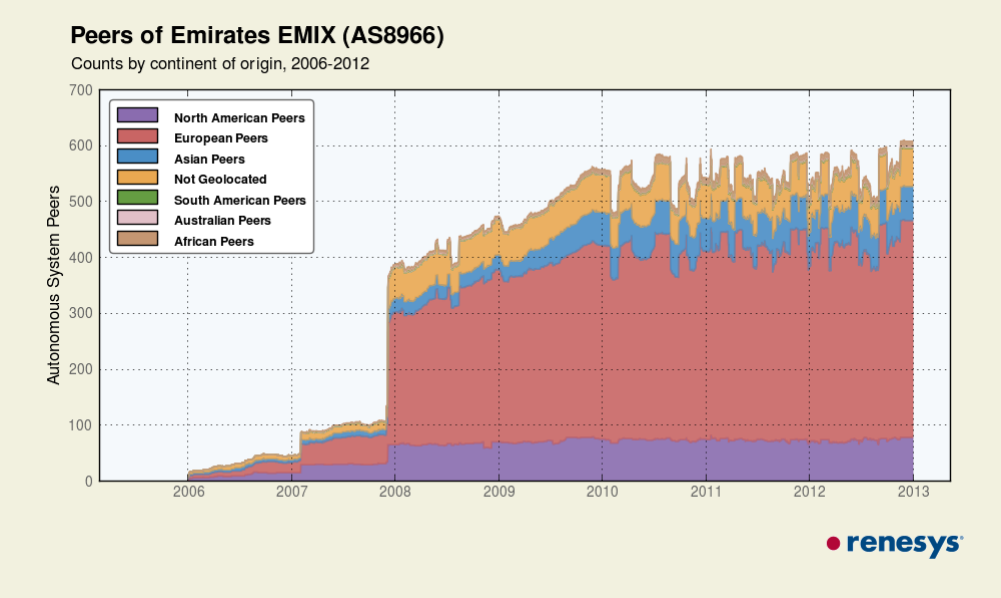
The growth of the UAE-IX, operated by du (AS15802) in partnership with DE-CIX, may begin to change this picture in 2013. It may be useful to review the history of the BGP autonomous system adjacencies observed for the two key UAE providers: du (AS15802) and Etisalat (AS8966).

In addition to their limited number of direct transit customers within the region, both du and Etisalat maintain peering adjacencies (non-transit interconnections for the exclusive exchange of customer data, not general Internet access) with a large number of ASNs outside the region, and a limited number within the region.

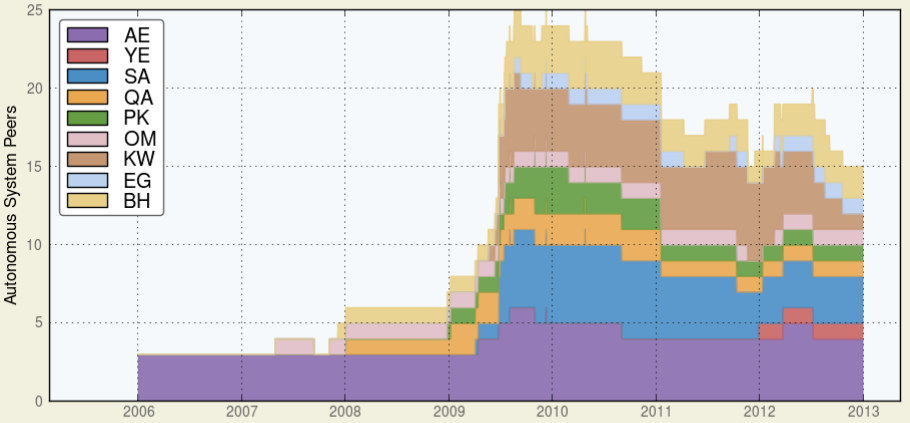
Etisalat's Growth Has Slowed Since 2010

Etisalat's AS8966, the older member of the UAE duopoly, has been establishing peering connectivity with (mostly) European peers since before 2006.

That growth process has slowed since 2010, topping out at roughly 600 peers observed in the BGP tables on any given day.



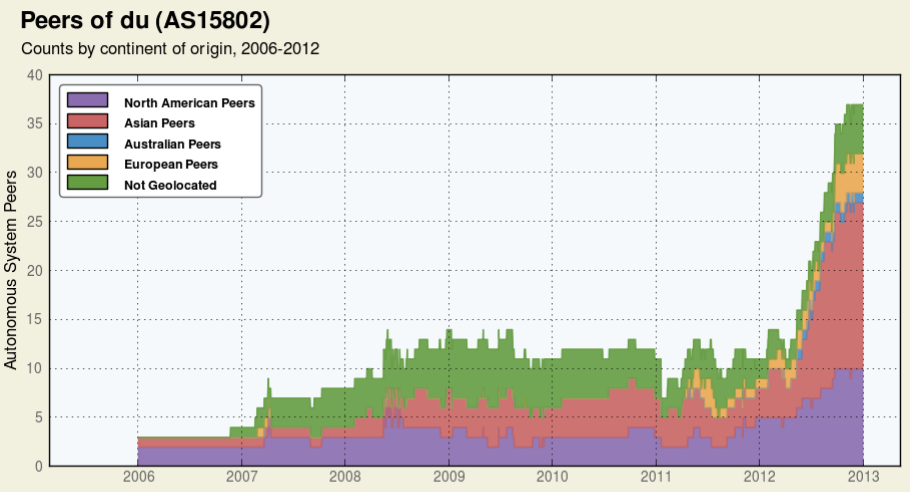
Looking at the in-region BGP adjacencies alone, which include transit relationships with customers such as Batelco, Etisalat has actually seen an overall 30% decline in observed adjacencies outside the UAE since mid-2009.



This may reflect a corresponding increase in the number of competing alternative providers in regional markets such as Bahrain and Kuwait, due to the growth of alternative terrestrial and submarine cable options.

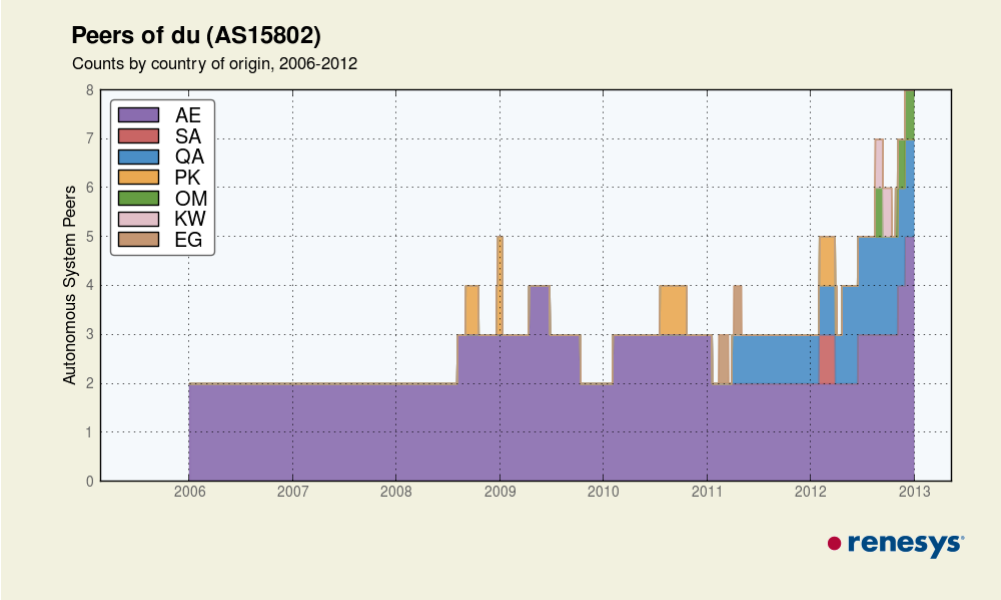
Expansion of Du

For du, by comparison, adjacency growth rates have been strong in 2012, especially among Asian peers (which includes the local region, but also Indonesia, Malaysia, Thailand, and Taiwan), as a result of their new presence at Equinix Singapore.



Overall observed adjacency counts for AS15802 have tripled in the space of 18 months, even though numbers of peer sessions are still only 5% of Etisalat's.

Du's observed in-region peerings are still very limited, in the single digits. Adjacencies with regional providers seem to appear and disappear after short periods of time. While du is acquiring new BGP adjacencies within the UAE, as of yet there is little sign of new relationships with regional providers.



Du's new Datamena brand (http://www.datamena.com) promises carrier-neutral transit and content services, in partnership with Equinix and DE-CIX. If the new platform can attain momentum, it should be visible in du's BGP peer adjacency growth throughout 2013, particularly within the region.

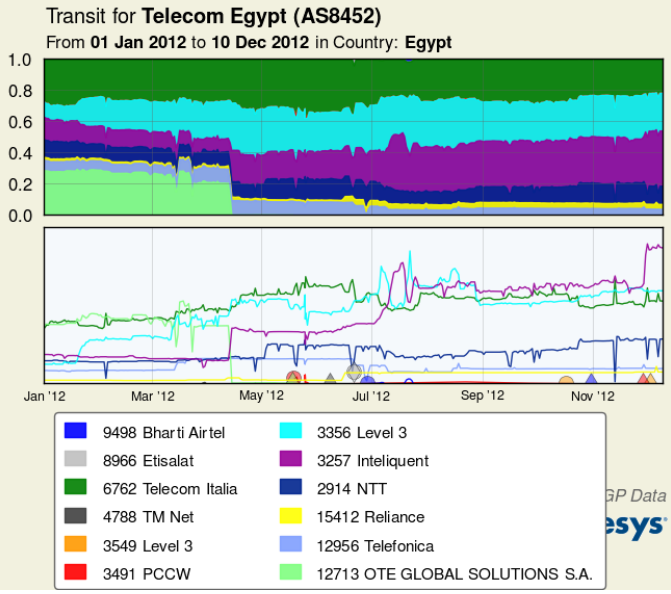
Regional Summaries

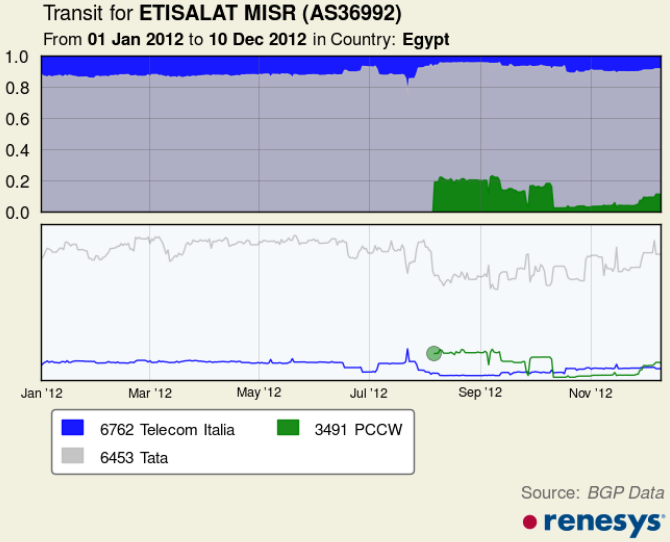
Egypt

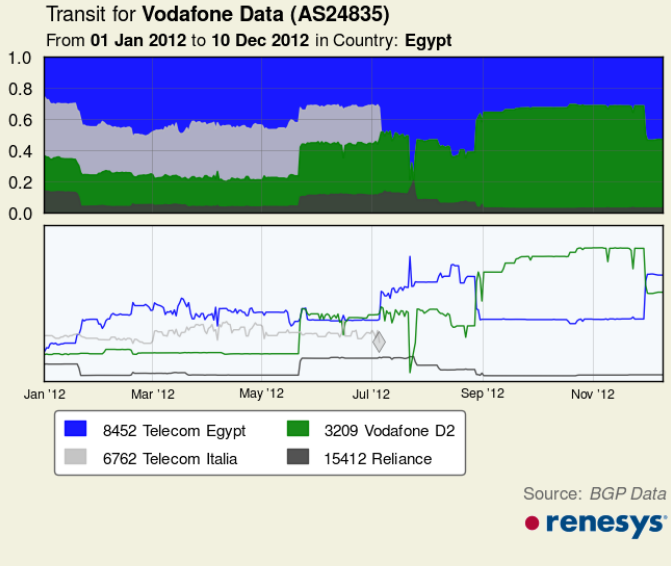
Telecom Egypt continues to strengthen its position relative to competitors, and now has 56% of the domestic Internet on-net (up 20% in 18 months).

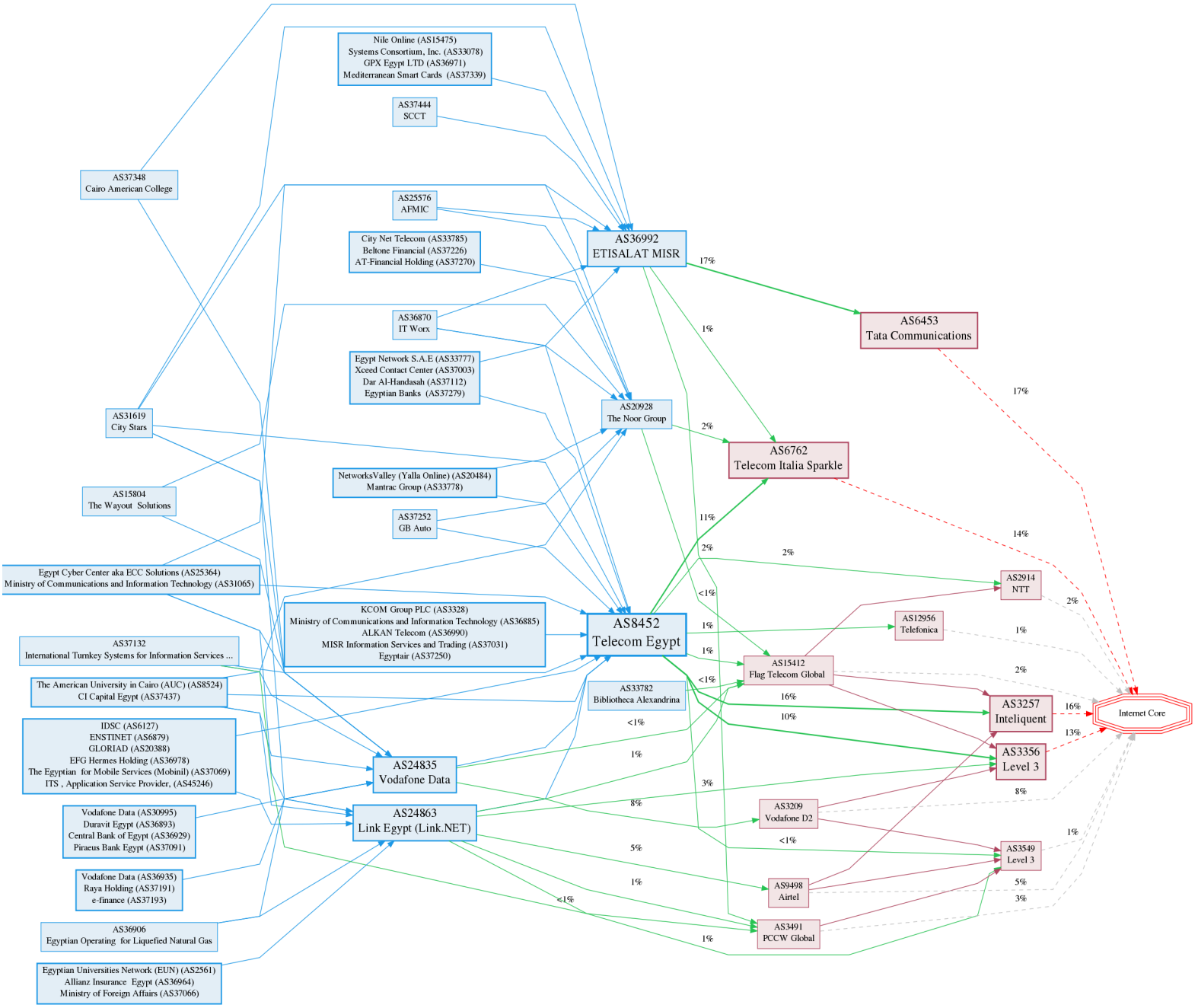
Transit from Telecom Italia, Level3, and (increasingly) Tinet/Inteliquent form the backbone of Telecom Egypt's transit strategy.

Increases in the TE customer base appear to have come at the expense of operators Etisalat Misr, Link Egypt/Mobinil, and Raya Telecom, each of which has seen declines in its national on-net percentage in the last 6 months of 2012.









Schematic view of Egyptian Internet, 1 Dec 2012. International providers are in red; Egyptian domestic providers in blue, with provider-customer relationships indicated by arrows. Arrow weights suggest rough percentage of national routes preferred by global providers utilizing the corresponding inbound ASN relationship.

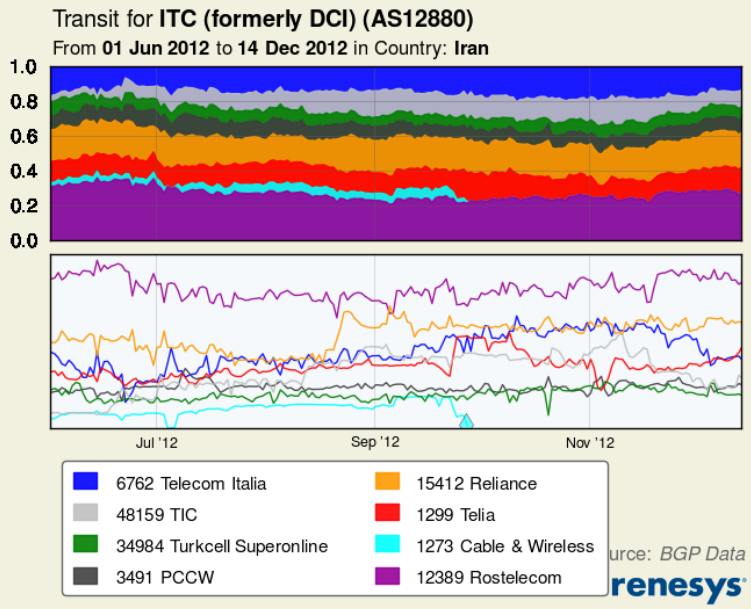
Iran

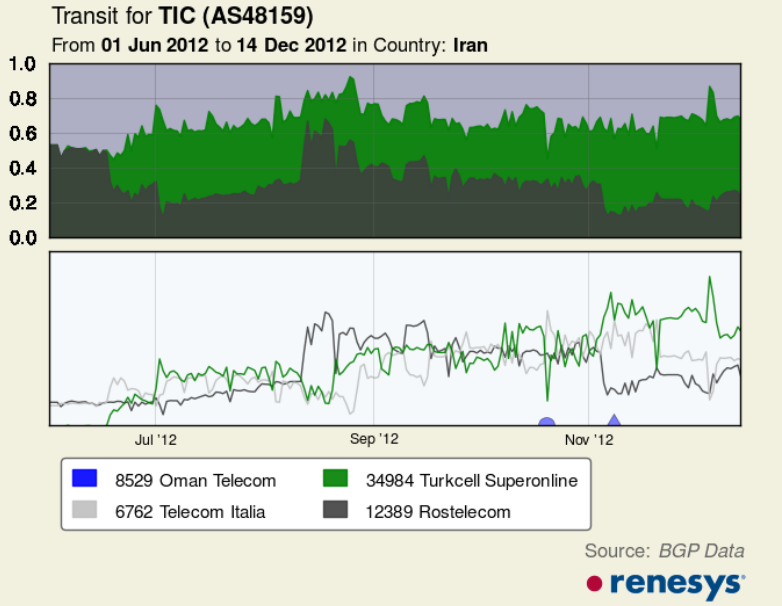
Iran's national provider, DCI (AS12880), has created a second autonomous system, AS48159.

Together, the two autonomous systems control most of the international Internet traffic to Iran, but have very different Internet transit arrangements.

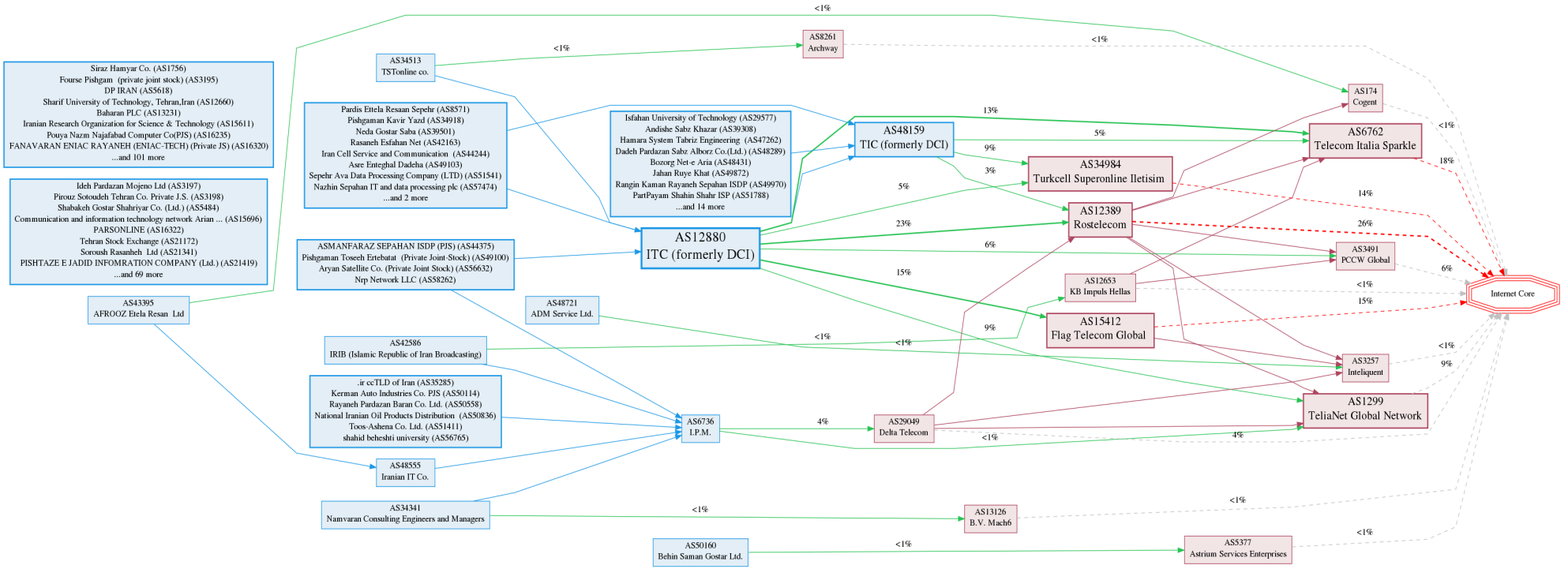
AS12880 continues to take advantage of global carriers' transit through the UAE (including Telecom Italia, PCCW, Telia, and Flag). A northern route through Azerbaijan provides substantial additional transit through Russia's Rostelecom, and a northwestern path provides a second terrestrial path for traffic through Turkey's Superonline.

The new ASN, AS48159, uses a strict subset of these: Telecom Italia, Superonline, and Rostelecom. For a brief period in November, transit was also visible through Omantel, indicating that the new EPEG submarine cable connection to Oman is nearing operational status.



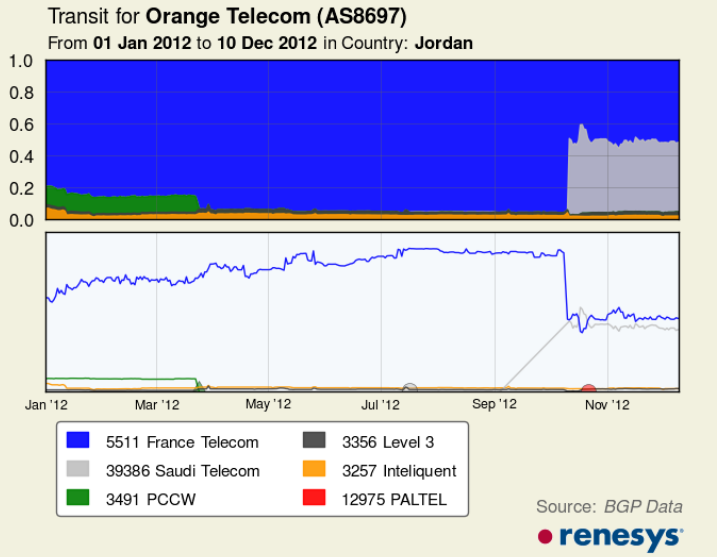


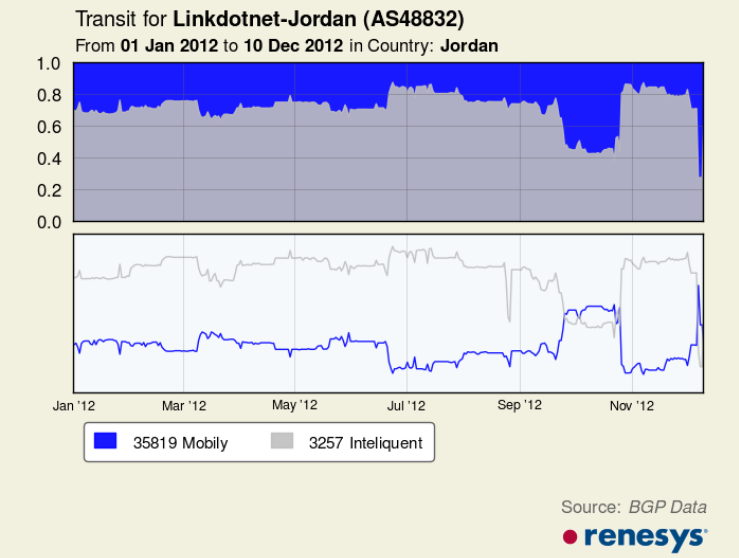
Schematic view of Iranian Internet, 1 Dec 2012. International providers are in red; Iranian domestic providers in blue, with provider-customer relationships indicated by arrows. Arrow weights suggest rough percentage of national routes preferred by global providers utilizing the corresponding inbound ASN relationship.

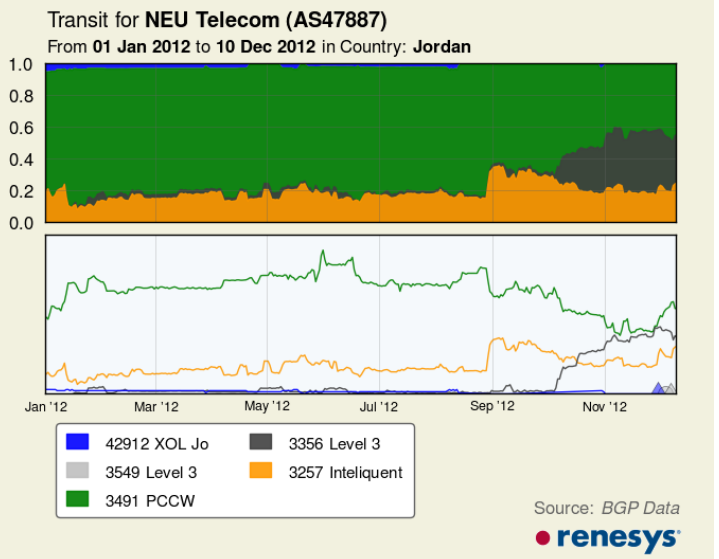


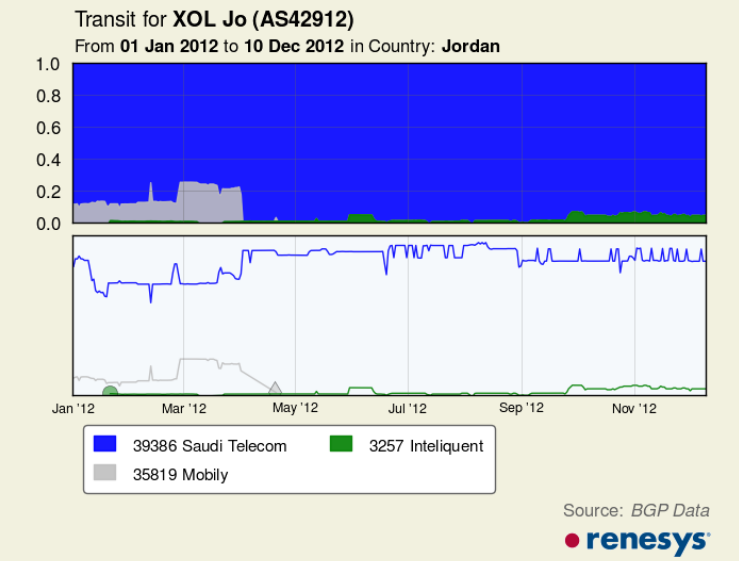
Jordan

Competitors in the Jordanian ecosystem have two choices: submarine connectivity at Aqaba to Level3, Inteliquent, PCCW, and France Telecom, or terrestrial connectivity to Saudi Telecom and Mobily. Incumbent Orange Jordan (AS8697) was one of the last to adopt Saudi transit, in October 2012. Damamax (formerly Neu, AS47887) appears to be the last significant holdout against this trend.

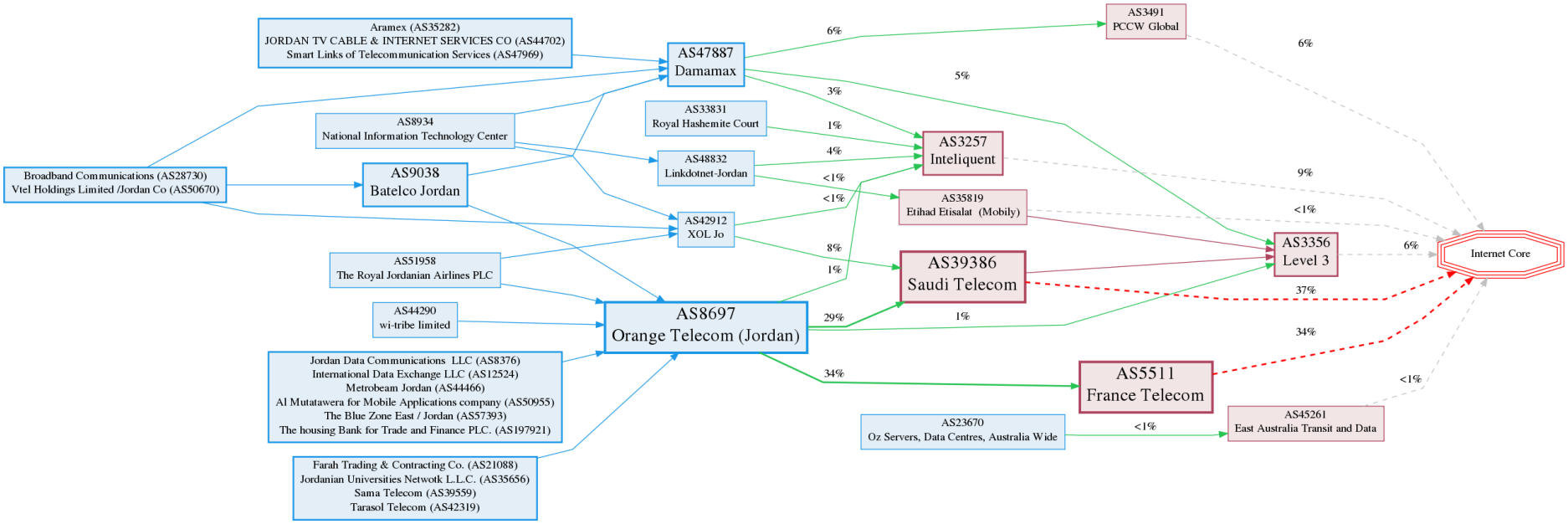








Schematic view of Jordanian Internet, 1 Dec 2012. International providers are in red; Jordanian domestic providers in blue, with provider-customer relationships indicated by arrows. Arrow weights suggest rough percentage of national routes preferred by global providers utilizing the corresponding inbound ASN relationship.



Lebanon

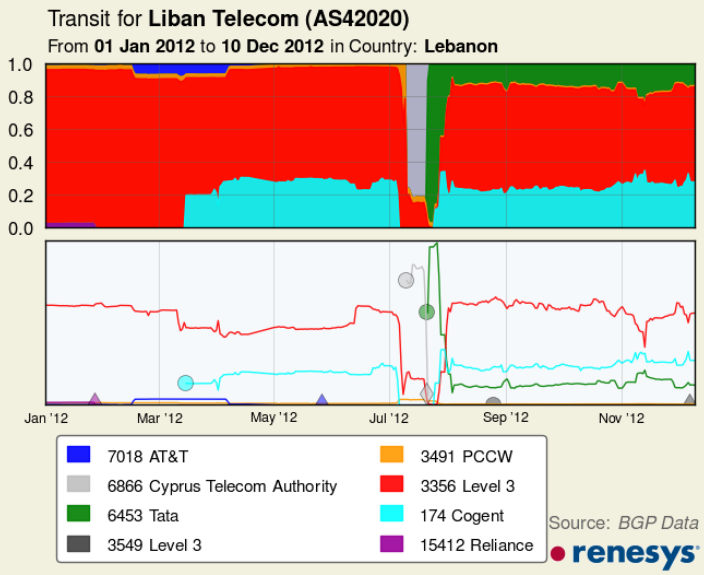
More than a year after landing, the IMEWE cable finally entered service in Lebanon in 2012. One can see new transit alternatives appearing in the Lebanese telecommunications landscape, but only for incumbent Liban Telecom (AS42020).

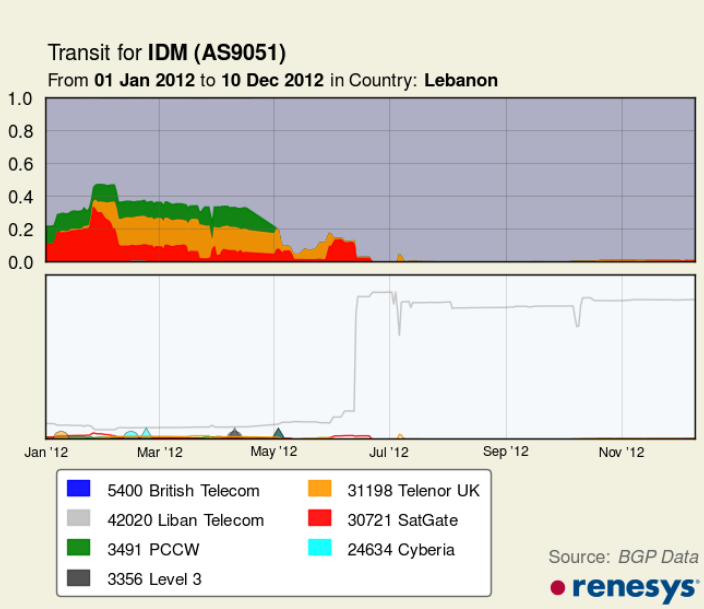
AT&T service appears in February, and disappears in March. Cogent service begins in March. Tata service began in July, after a cataclysmic problem with IMEWE took the entire country off the Internet for a day. Only through emergency transit through Cyprus were communications restored.

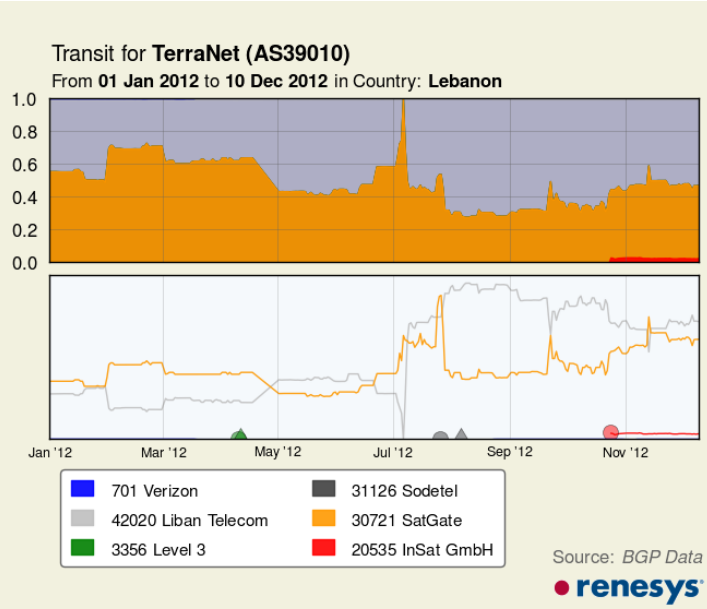
Other providers are limited in their direct access to IMEWE. IDM (AS9051) was able to turn off its transit through satellite providers Telenor UK, PCCW, and SatGate, even as they massively increased their reliance on the incumbent to provide 100% of their transit.

In a potential sign of continuing difficulty, TerraNet (AS39010) continues to route nearly half of its prefix space through satellite provider SatGate, and actually added a new satellite provider (InSat Gmbh) in October 2012.

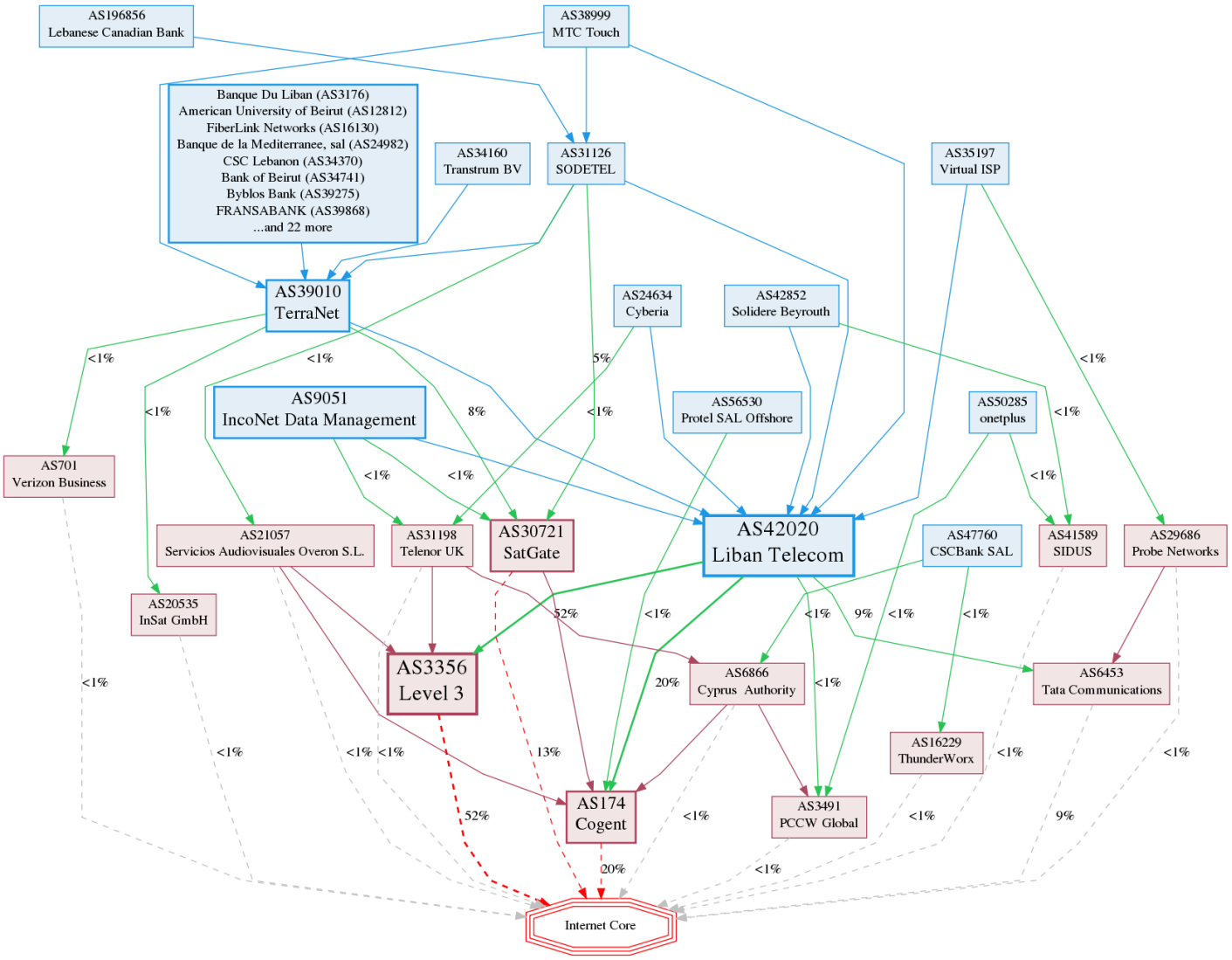
As recently as 2009, Liban Telecom had 45% of Lebanon on-net; at the close of 2012, that has increased to 92%, and will likely continue to climb as operators submit to customers' demands for submarine cable bandwidth.







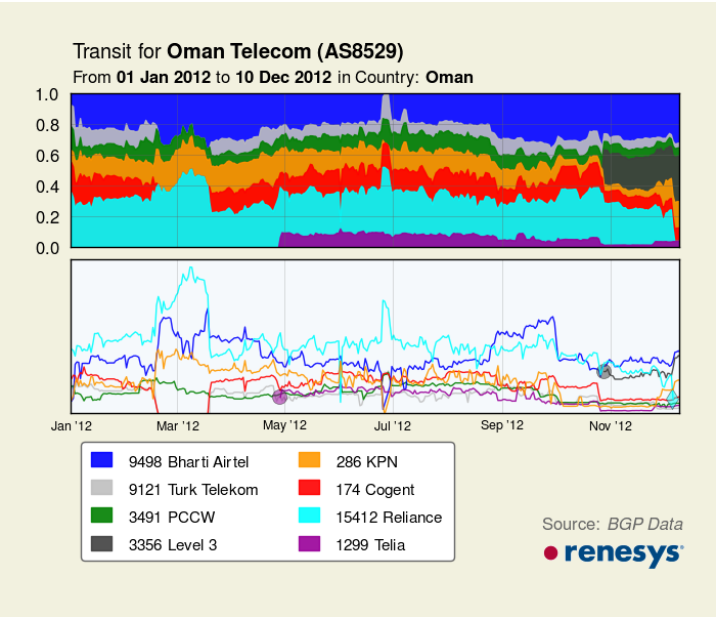
Schematic view of Lebanese Internet, 1 Dec 2012. International providers are in red; Lebanese domestic providers in blue, with provider-customer relationships indicated by arrows. Arrow weights suggest rough percentage of national routes preferred by global providers utilizing the corresponding inbound ASN relationship.

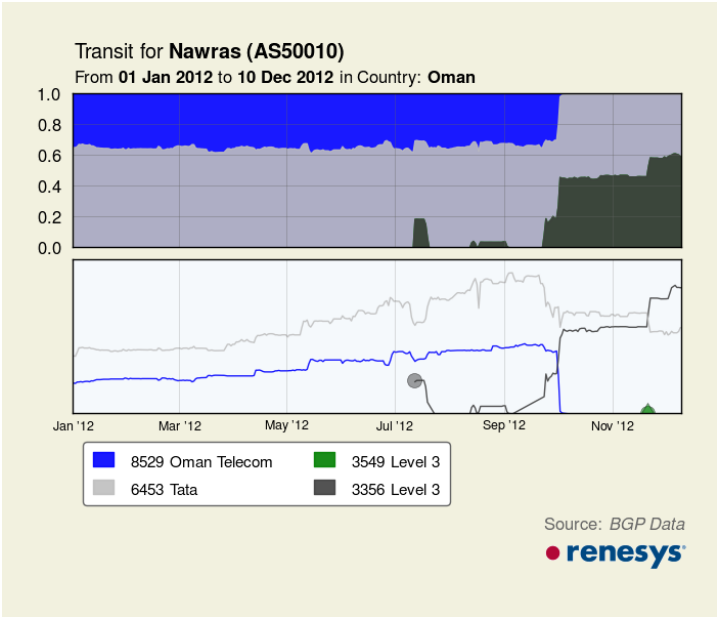


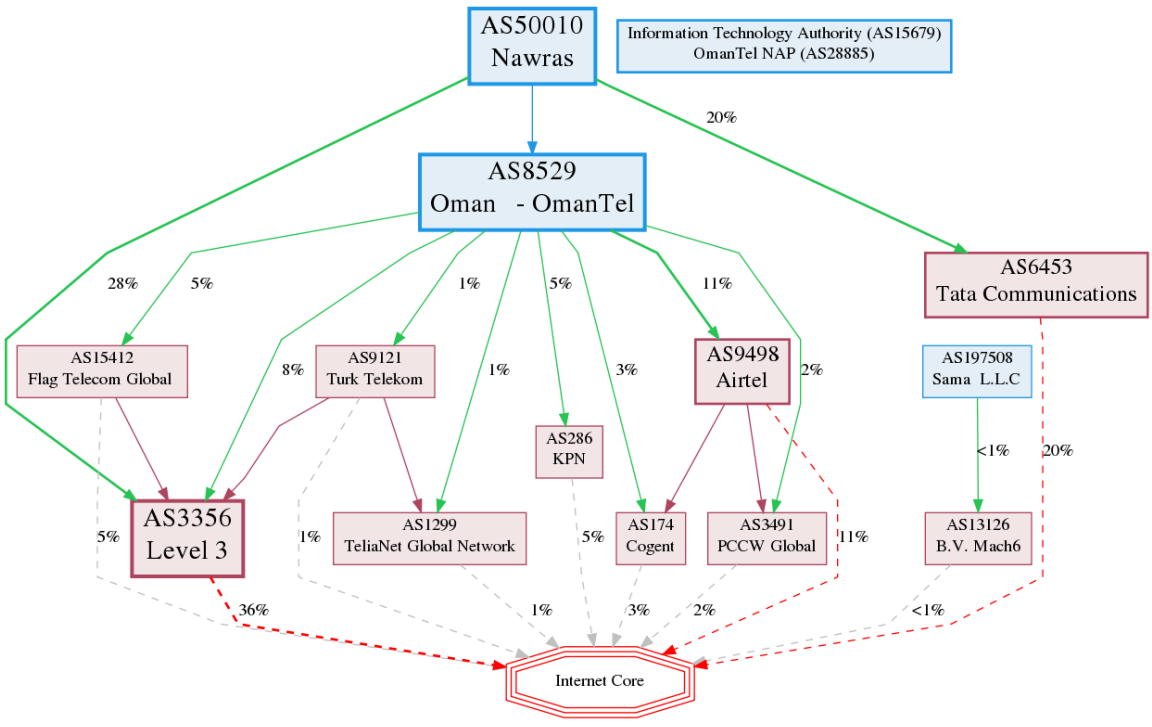
Oman

With emerging direct transit through Level3+Tata, and having dropped all but token transit through incumbent Oman Telecom (AS8529), competitor Nawras emerged as a truly independent operator in the 4th quarter of 2012.

Whether this matures into a UAE-style duopoly, and whether Oman manages to create an Internet exchange to rival Dubai's EMIX, will depend in large part on whether the EPEG cable to Europe through Iran emerges as an attractive alternative for regional providers.





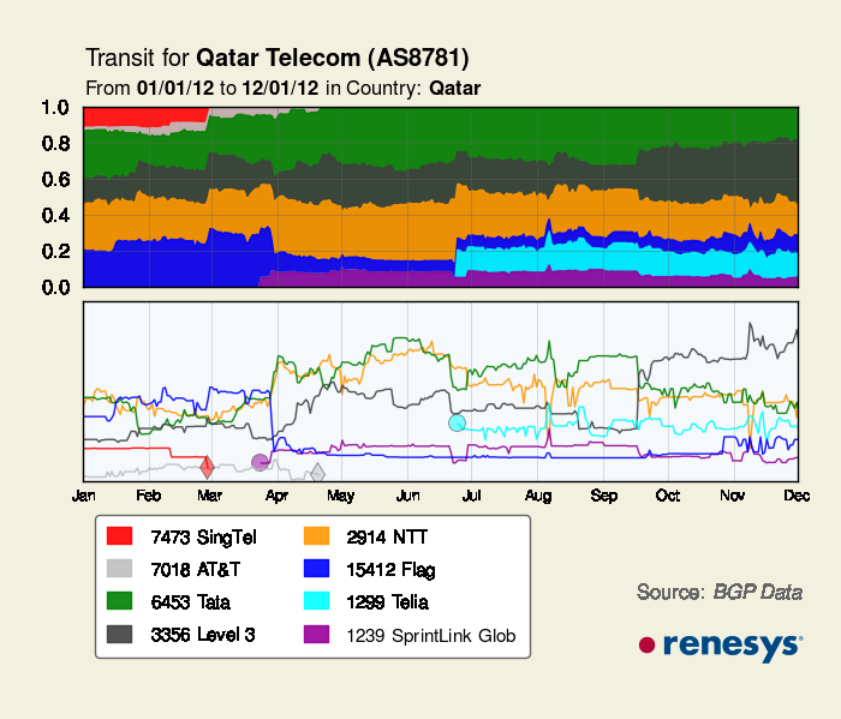


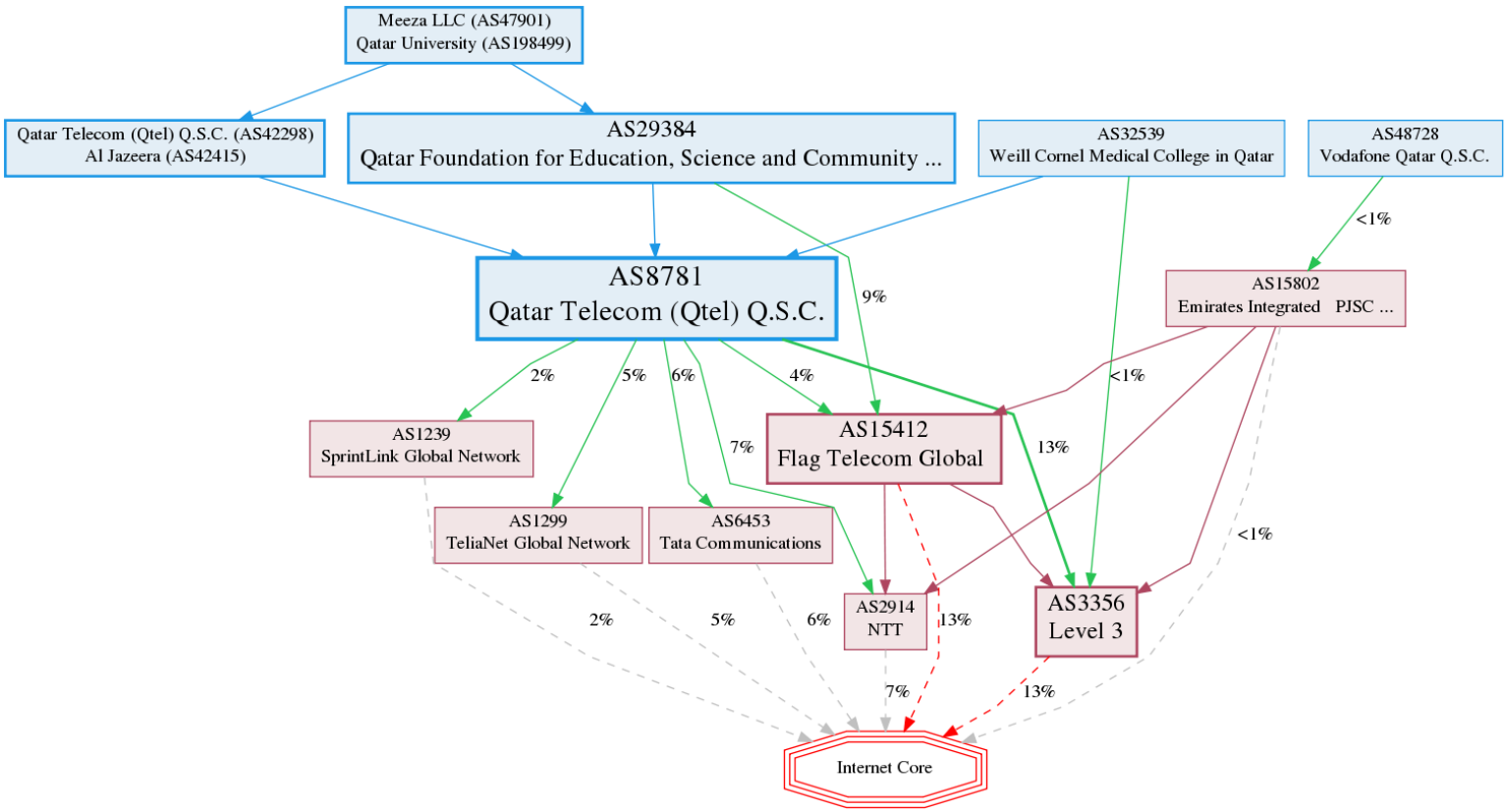
Qatar

Incumbent Qatar Telecom continues to maintain 96% of the domestic Internet on-net.

QTel has a broad range of international transit providers, adding Telia to the mix in June 2012.

Vodafone Qatar, the only provider without service from QTel, still represents less than one percent of Qatar's on-net space.



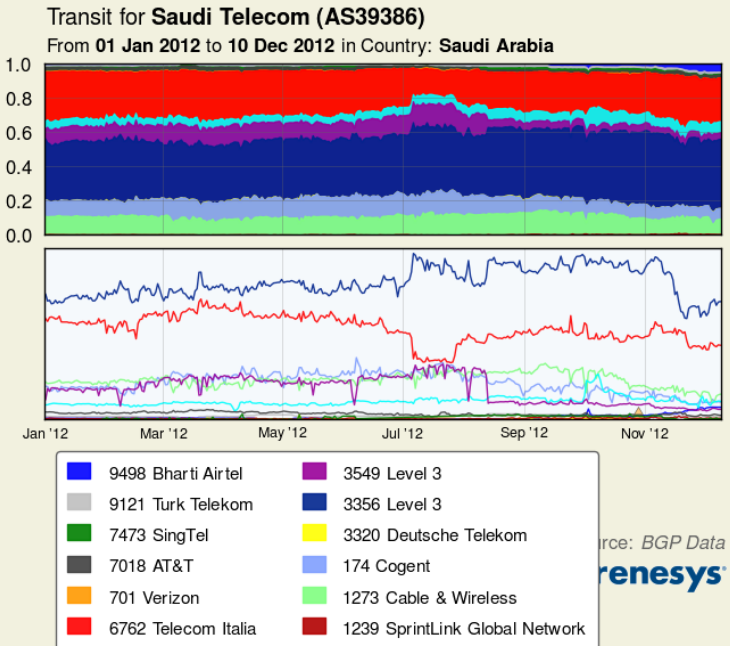


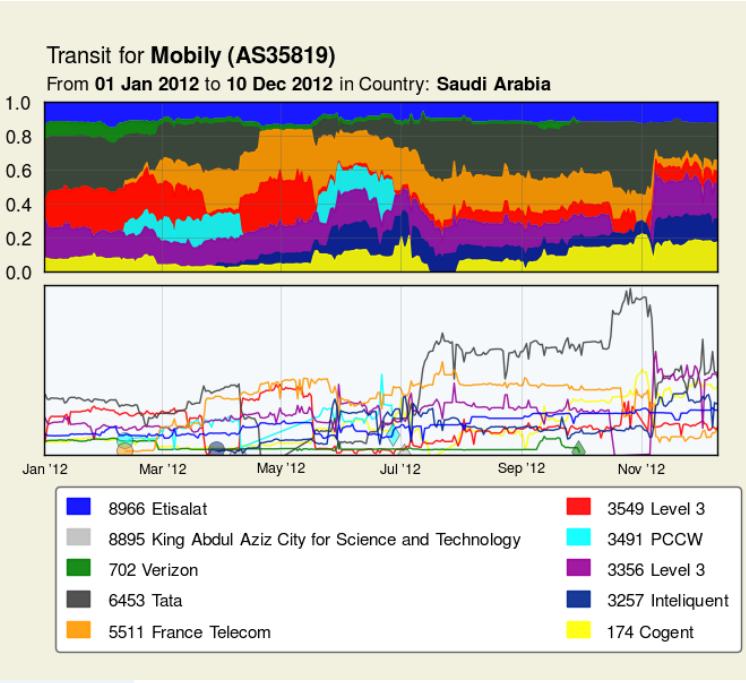
Saudi Arabia

In October 2012, Mobily (AS35819) took the lead in the Renesys Market Intelligence Retail ranking for Saudi Arabia, moving ahead of the incumbent (Saudinet, AS25019) for the first time.

By year's end, Mobily actually had a larger percentage of Saudi Arabia on-net (48%) than STC's AS39386 (45%).

This trend away from incumbent concentration brings Saudi Arabia more in line with Kuwait and Bahrain. With Oman on a similar trajectory, the natural question is whether similar multi-provider rebalancing can eventually be expected in Qatar and the UAE.



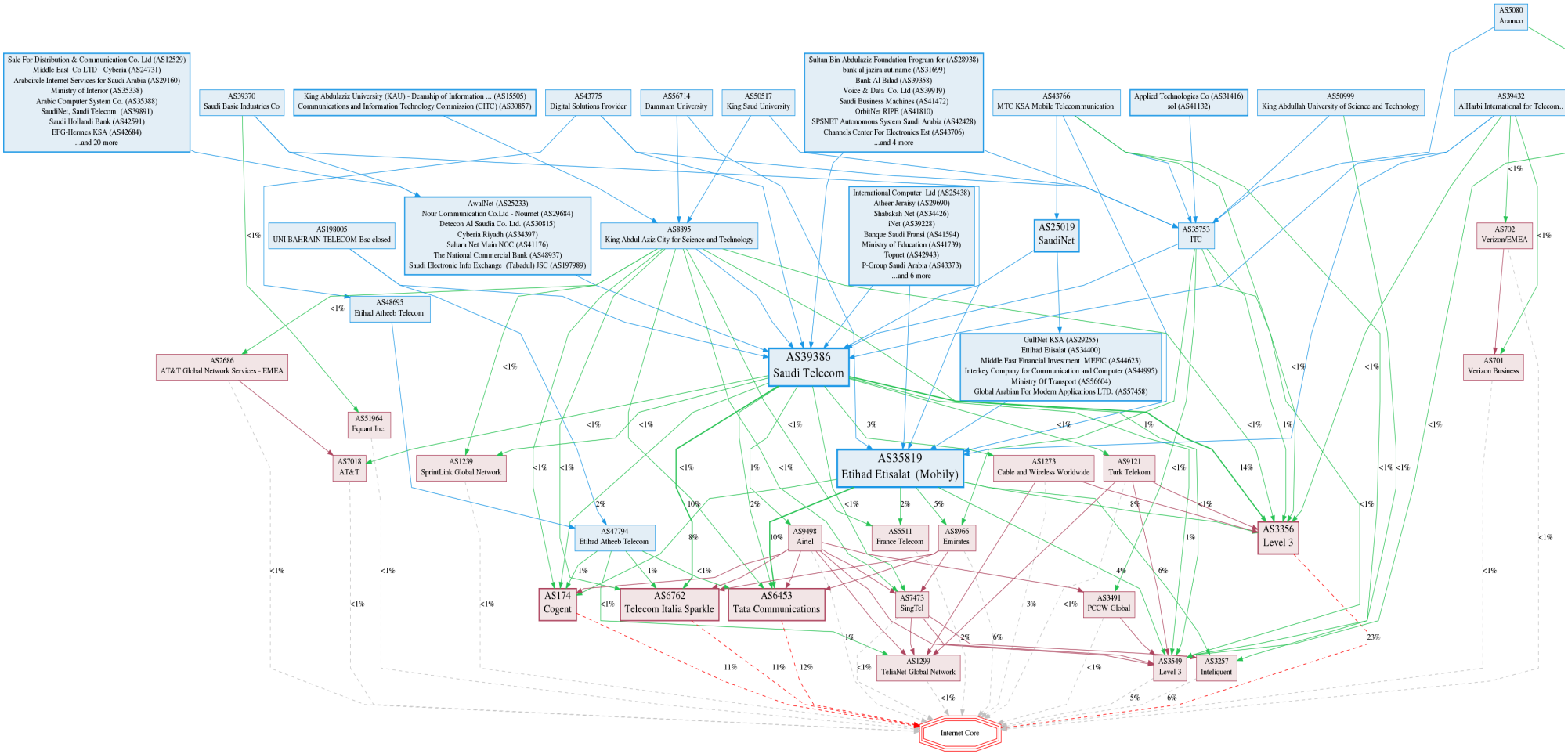


Saudi Arabia IPv4 Internet Index Ratings

IPv4 Customer Base: Retail — Saudi Arabia

1	Etihad Etisalat Company (Mobily)
2	Ettihad Etisalat
3	SaudiNet
4	ITC
5	Etihad Atheeb Telecom Company
6	Saudi Telecom
7	AwalNet
8	King Abdul Aziz City for Science and Technology
9	Cyberia Riyadh
10	Middle East Internet Co LTD - Cyberia

Schematic view of Saudi Arabian Internet, 1 Dec 2012. International providers are in red; Saudi domestic providers in blue, with provider-customer relationships indicated by arrows. Arrow weights suggest rough percentage of national routes preferred by global providers utilizing the corresponding inbound ASN relationship.



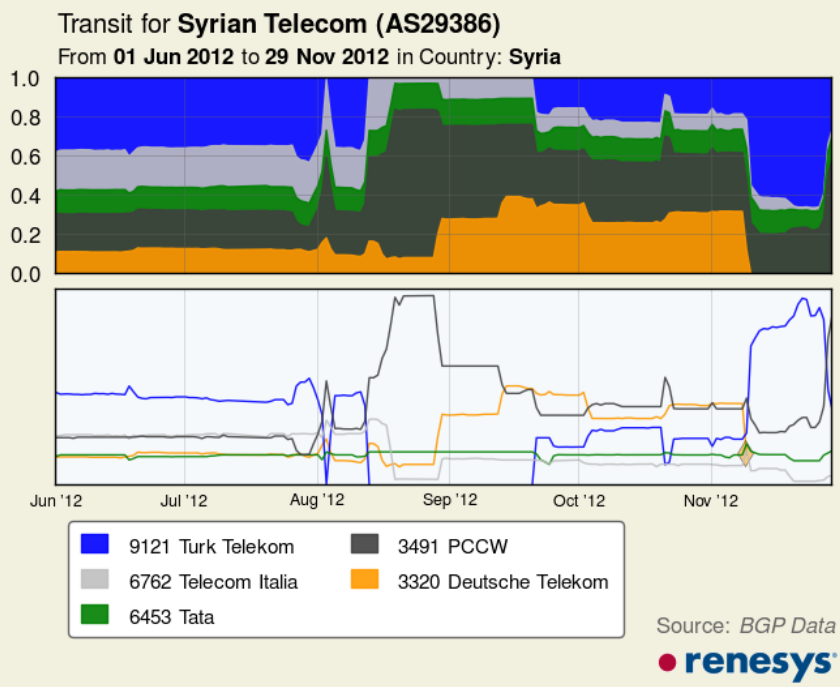
Syria

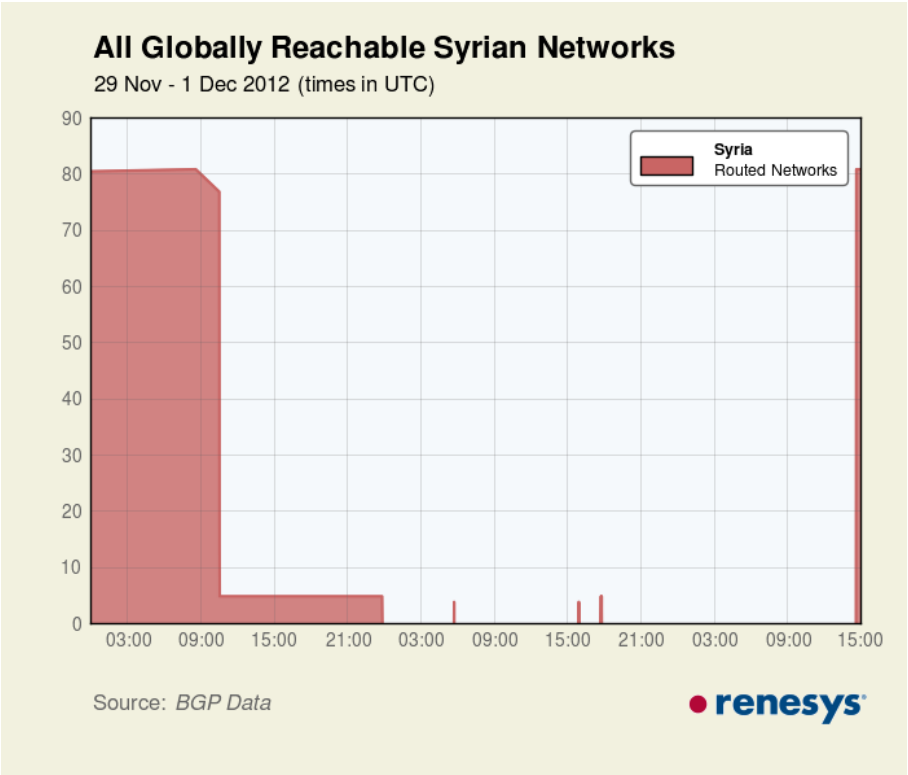
Syria's Internet diversity remains very limited; 100% of the country achieves Internet transit through STE (AS29386).

Transit arrives via limited submarine cable to Cyprus (Telecom Italia, Tata, PCCW) and a terrestrial link to Turkey (Turk Telekom).

In November, the country lost Deutsche Telekom as a transit provider.

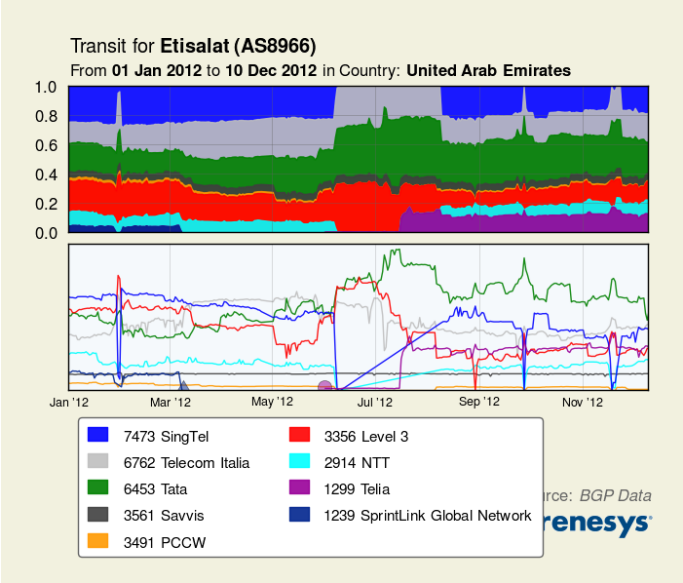
The country continues to be subject to nationwide Internet outages of varying duration. The most significant took place at the end of November 2012, and lasted for more than two days.

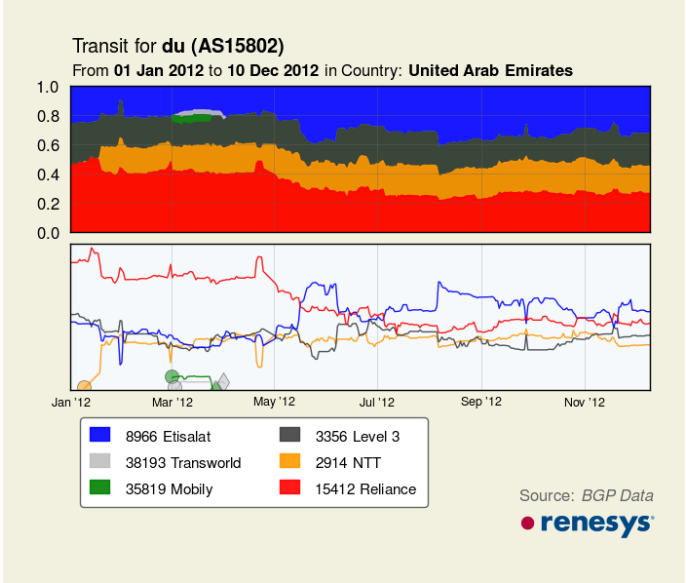


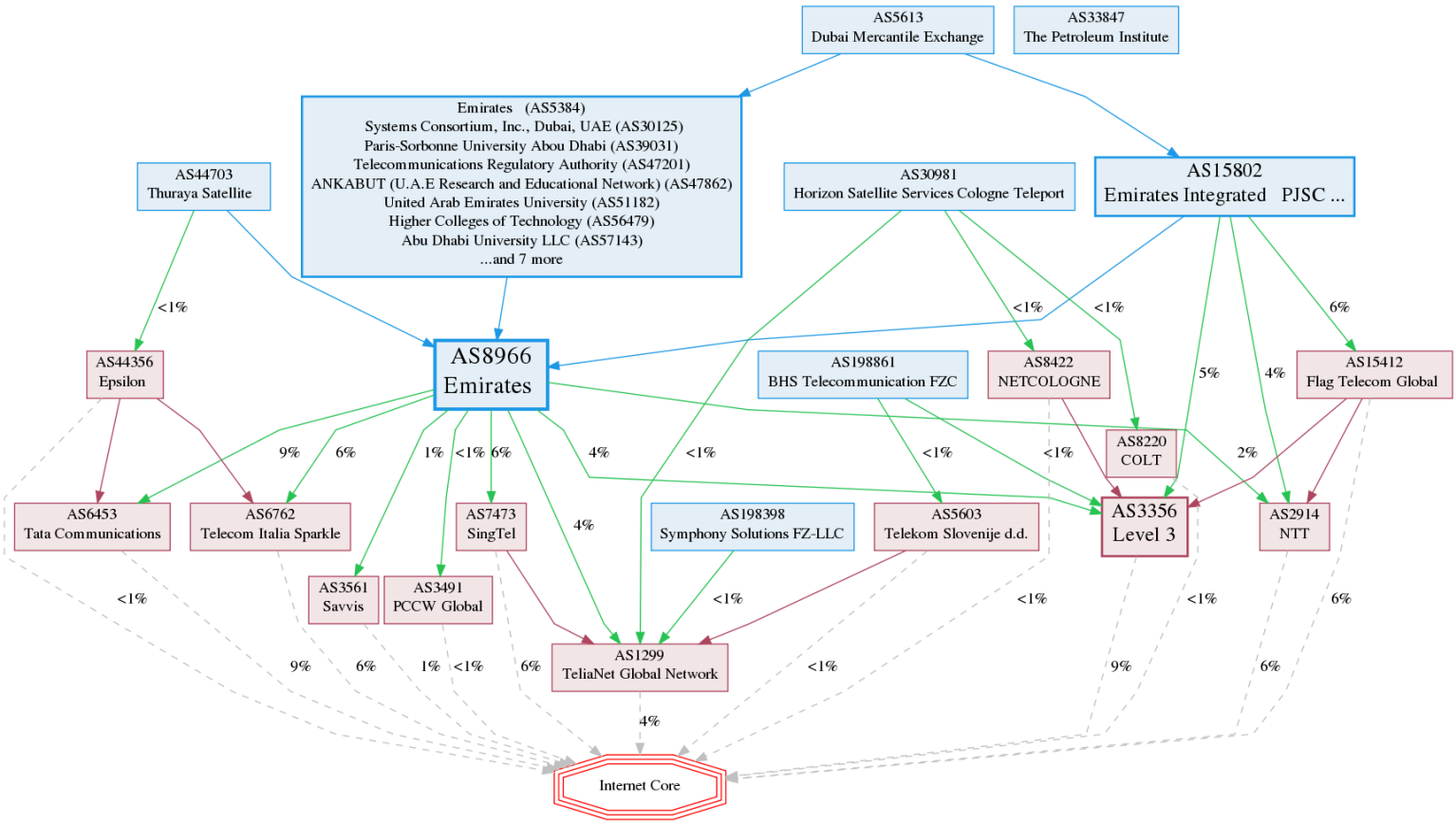


United Arab Emirates

Little seems to change in the UAE Internet ecosystem, despite the growing excitement about the UAE-IX. In 2012, the Du-Etisalat duopoly looks much as it did in 2011 from a transit perspective.



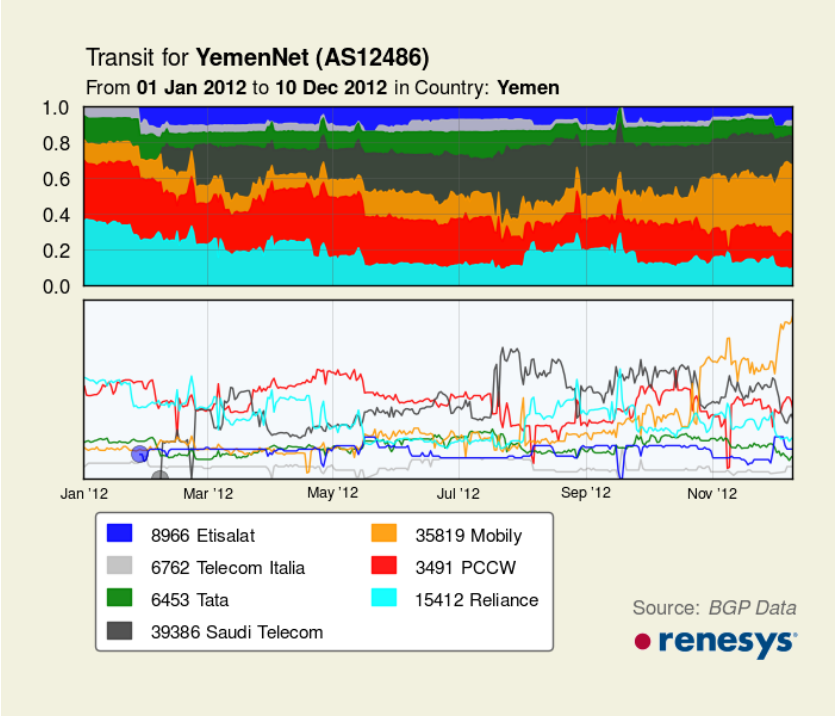


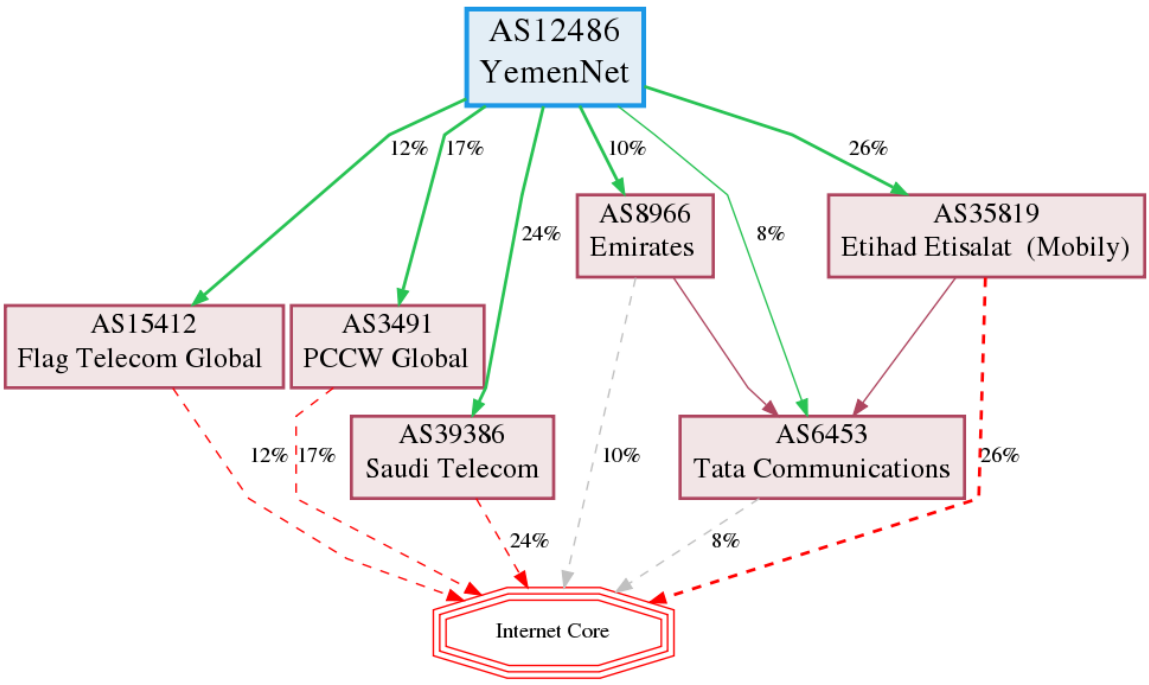


Yemen

Yemen has the same level of on-net concentration in the incumbent as Syria (100%), but has access to a significantly broader range of transit providers thanks to submarine cable landings and terrestrial connectivity with Saudi Arabia.

Of note in 2012: the increase in the 4th quarter in Yemeni transit from Mobily (AS35819), at the expense of Saudi Telecom, FLAG, and Tata.





IPv6 Growth in the Middle East

The following 54 providers in the region each originate at least one IPv6 prefix. IPv6 growth continues to underperform expectations worldwide, representing less than half a percent of the IPv4 traffic measured at major Internet exchanges. The scarcity of IPv4 address space has led to the emergence of alternative cash-based markets, and may pose growth constraints on regional providers unless the worldwide IPv6 transition begins to meet with more success.

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

Appendix A. Internet Routing Terminology

Internet routing has developed its own terminology over time, which may not be familiar to the nonexpert. This section provides context for some of the terms used in this report.

Prefix (or "network"): a sequence of IP addresses that an enterprise may use to identify machines that it attaches to the Internet (computers, routers, etc.)

- *Example: 77.92.160.0/19, which is a contiguous block of 8 million IP addresses belonging to Rawabi Telecommunications and Software.*

Border Gateway Protocol (BGP): the software protocol used to establish Internet connections between different organizations.

Autonomous System: An organization that has applied for an Autonomous System Number (ASN), in order to be allowed to advertise its own prefixes in the global routing table.

- *Example: Batelco (ASN 5416), or the BIX (ASN 35019).*

Border Router: networking equipment deployed at the edge of an organization's network, in order to establish connections to other organizations by exchanging BGP messages with them.

Advertise (or "Announce") a Prefix: An organization that wants other people to be able to reach its prefixes must **announce** them to its transit providers and peers. It does this by configuring its border routers to send BGP messages describing networks it knows how to reach, and listen for BGP messages that announce other people's networks.

Path to a prefix, ASPath: each BGP announcement contains an **autonomous system path:** a sequence of one or more autonomous systems who passed on the announcement, representing the "best path" to the announced prefix.

- *Example: a BGP announcement containing the ASPath **"7473 8966 35019 39273 30882"** indicates that the best path to the prefix goes from Singtel (AS7473), to Emirates Telecom (AS8966), to the Bahrain Internet Exchange (AS35019), to Lightspeed Telecom (AS39273), and finally on to Benefit Company (AS30882), in that order.*

"Having a Route": when a router hears another router announce a path to a prefix, it enters it into its routing table, and is then said to "have a route" to that prefix. If the new route is an improvement over its existing route, it will re-announce that improved route to all of its other neighbors. Amazingly, a new or improved route to any prefix generally propagates to all of the routers worldwide through re-

announcement within 15 seconds.

Transit, Transit Provider: When an autonomous system signs a contract to carry another enterprise's traffic to and from the global Internet, it is serving as a Transit Provider (i.e., "selling transit" to the other party).

- *Example: FLAG (AS15412) and Tata (AS6453) both sell transit to Batelco.*

Singlehomed, Multihomed: if an autonomous system has only one transit provider, they are said to be singlehomed. If they have more than one transit provider, they are multihomed. Multihoming significantly reduces the risk of having Internet instability and outages, because if one provider has a problem, traffic can transparently fail over to the other provider.

- *Example: Lightspeed is singlehomed to FLAG (AS15412). 2Connect is multihomed to the BIX (AS35019) and Tata (AS6453).*

Peering: when two autonomous systems agree to exchange traffic between their customers, instead of each having to pay a transit provider to carry that traffic between them, they are said to be peering. If no money changes hands, it's **settlement-free peering**. Adding to the potential confusion, the term "peer" can also be used generically to indicate a BGP provider adjacency, which can represent either a transit relationship, a paid peering relationship, or a settlement-free peering relationship.

Reachable, Unreachable (or "Outaged'): If a router has a route to a given prefix, that prefix is **Reachable** from its perspective; if it no longer has a route, the prefix is **Unreachable**. When a network prefix becomes unreachable (that is, it is no longer being announced to any transit provider), it is no longer connected to the Internet.

Global Routing Table: the ideal routing table consisting of all the known "best paths" to all of the prefixes on earth, from all of the border routers on earth. Renesys builds an approximation of this ideal global picture by connecting to hundreds of organizations' border routers and synthesizing a continuous map of their routes at one-second granularity.

Appendix B. Bahrain Autonomous System Ranking

The Renesys Market Intelligence service ranks autonomous systems according to the number and size of the address blocks whose traffic they carry into a given geographic region. The December 2012 Customer Base rankings for Bahrain's domestic providers are reproduced below. International providers such as Tata, Saudi Telecom and Qatar Telecom have been removed from the ranking.

The "Self" column indicates how many IPv4 prefixes are originated by the given autonomous system number (ASN) in the global routing table. "Customer" indicates how many additional IPv4 prefixes are transited by the given ASN on behalf of its ASN customers. Not all providers offer transit services to ASN customers (for example, Batelco has never transited downstream customer prefixes on behalf of a customer ASN).

Network prefixes come in various sizes, from large (17-bit prefixes advertised by 2Connect and Zain Bahrain, each containing 32,768 IP addresses) to very small (24-bit prefixes advertised by many providers, each containing just 256 IP addresses). Rank is computed based on total size of routed space, not the count of transited network prefixes alone.

Rank	Provider	ASN	Self	Customer	Total
1	Zain Bahrain	31452	32	0	32
2	Batelco	5416	168	0	168
3	VIVA Bahrain	51375	39	3	42
4	Menatelecom	39015	5	32	37
5	2Connect	35313	2	0	2
6	LightSpeed	39273	5	5	10
7	BIX	35019	5	7	12
8	BCN	41110	1	0	1
8	RTS	42931	1	0	1
9	Etisalcom Bahrain	35457	17	0	17
10	Life Telecom	3.288	2	0	2
11	Nuetel	35568	6	0	6
12	GCC/NGN	44075	1	0	1
13	Equant	51964	1	0	1
13	Northstar	35546	1	0	1
14	Gateway Gulf	44876	4	0	4
15	Central Informatics	48019	3	0	3
16	Benefit Company	30882	1	0	1
17	Kalaam Telecom	35443	1	0	1
17	iCol Plus	44167	1	0	1
18	Viacloud	35729	2	0	2

Renesys Market Intelligence Ranking, 1 Dec 2012. 'Self' and 'Customer' indicate counts of IPv4 prefixes transited directly or on behalf of customers, respectively, within the Kingdom of Bahrain.