renesys®
The Internet Intelligence Authority

Middle Eastern Regional Internet Trends

December 2010

Contents

Executive Summary

The Bahrain Telecommunications Regulatory Authority has asked Renesys to examine recent trends in IP interconnection for Bahrain and its neighbors in the Gulf region. The goal of the 2010-2011 study will be to fairly and objectively characterize the evolution of the region's primary Internet service providers, their patterns of interconnection, and their response to infrastructure incidents such as submarine cable cuts.

At the close of 2010, the Middle East's national Internet ecosystems contained nearly 11,000 distinct IPv4 networks, out of roughly 380,000 on Earth. Renesys continually monitors the paths traffic takes to reach every worldwide network, and actively verifies the performance of those paths using multipoint latency measurement.

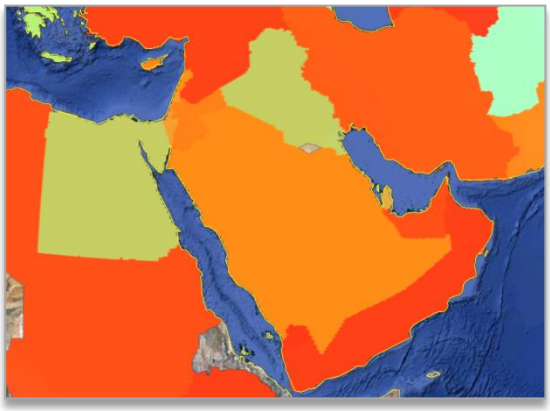
Together, these datasets permit the objective study of interconnection and Internet transit diversity, integrating regional network observations that have been collected continuously over a period of years.

Key findings include:

- The largest domestic providers of the region tend to have a higher than average on-net market share, suggesting restricted competition.
- Bahrain is a notable exception to this trend, and leads the region in lowering the percentage of the domestic market seen on-net with the largest domestic providers.
- As 2010 comes to a close, Bahraini providers are taking advantage of more diverse international transit than ever before.
- Bahraini providers still have fewer available choices for international transit than others in the region. Two new submarine cable landings should improve this picture in 2011, and the region will have additional terrestrial connectivity options as well.
- The Bahrain Internet Exchange, once the default alternative provider in the Kingdom, is losing market share as with the arrival of more international transit diversity.
- Batelco's lack of multihomed customers artificially constrains their on-net share of the domestic market, and potentially their growth.
- The April 2010 shunt fault on the Sea-Me-We-4 cable off of Alexandria showed that major cable failures are survivable, if nations pursue a strategy of achieving significant international transit diversity.
- The IPv6 Internet is growing very slowly in the region, despite the looming threat of IPv4 address space exhaustion. A prolonged and potentially painful multi-year transition period is inevitable, and may pose special challenges for regional regulators.

Key Findings

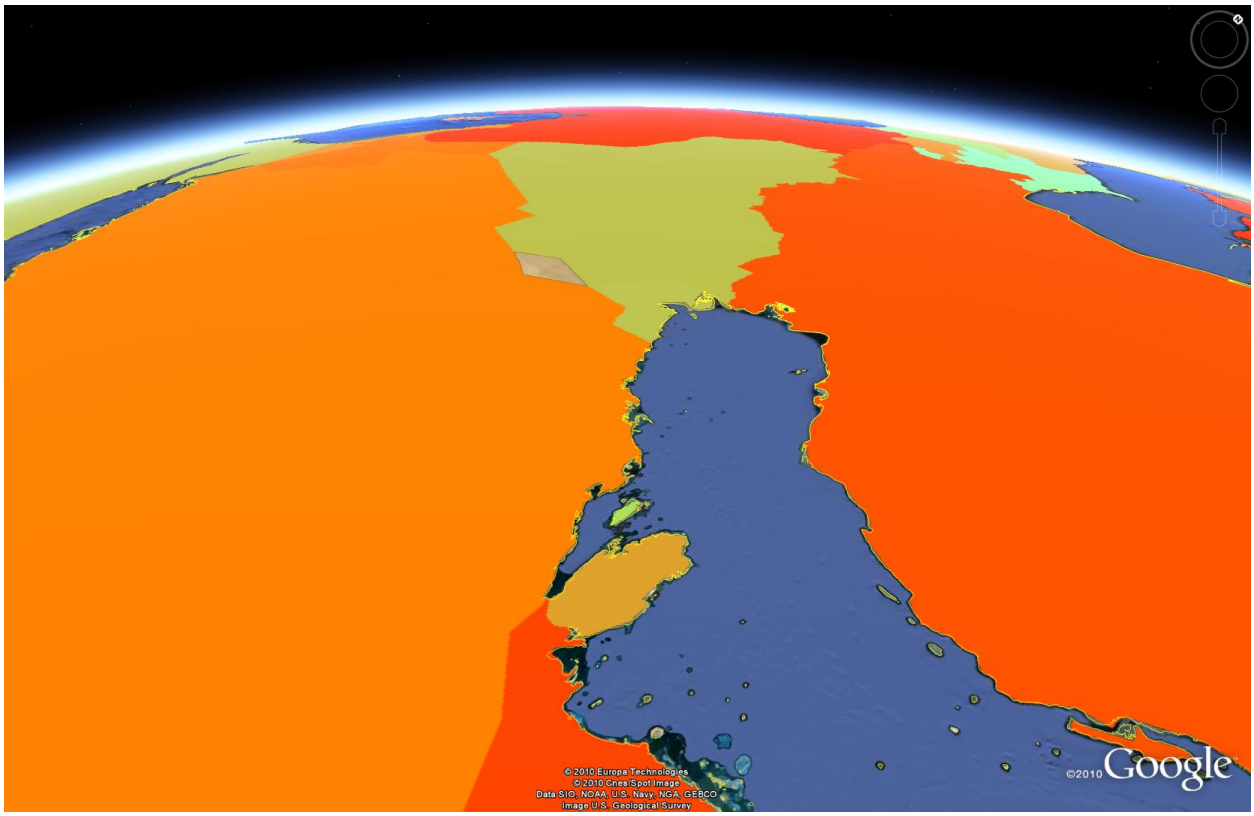
The largest domestic providers of the region tend to have a higher than average on-net market share, suggesting restricted competition. However, Bahrain is a notable exception to this trend.

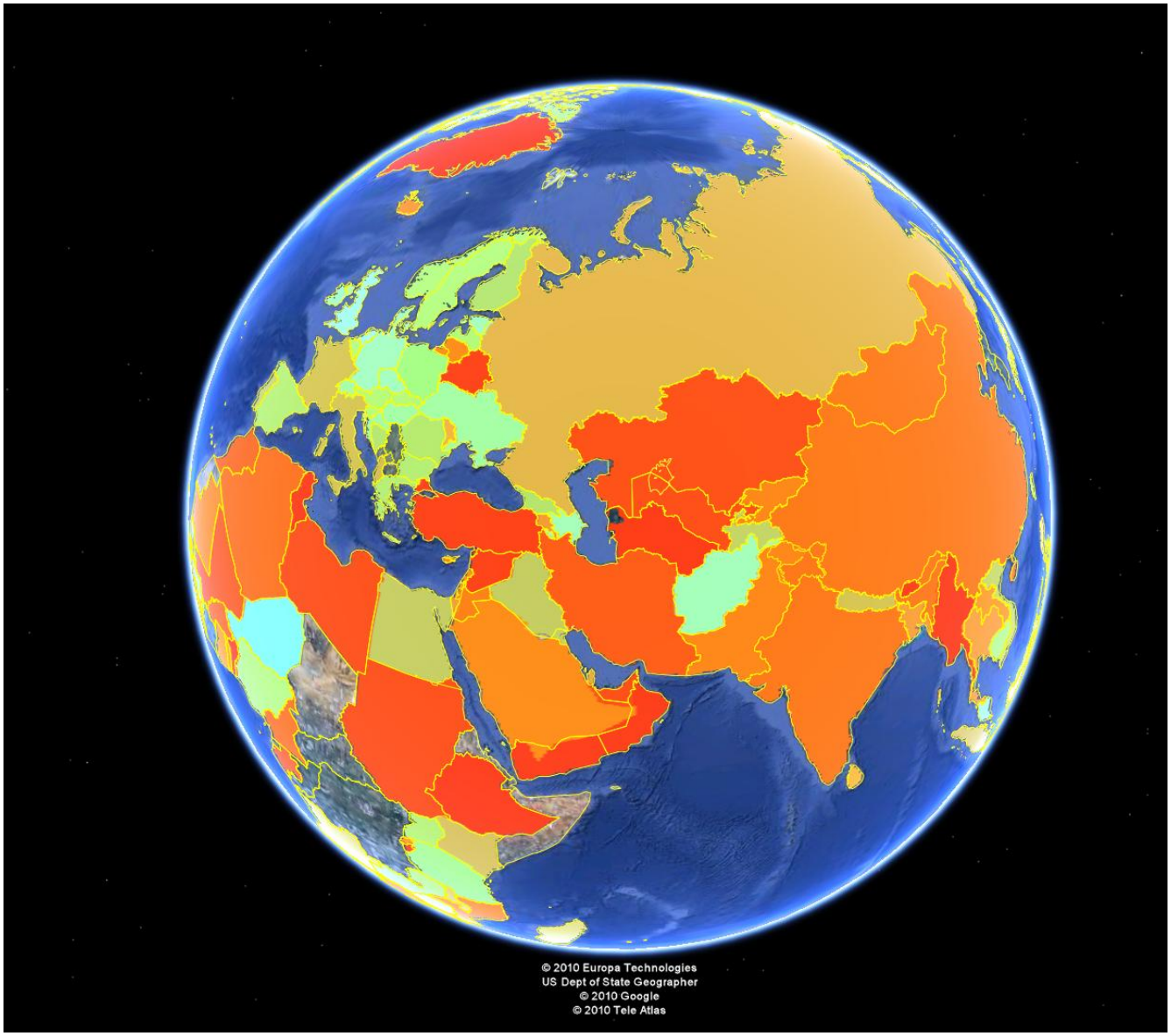


"On-net" percentages for largest domestic providers. Orange indicates 50%+ of the domestic market on-net with a single provider, red 90%+. Bahrain is light green, at 28%.

The average "largest domestic provider" on Earth sells to **36%** of their own national market, as evidenced by published routes to domestic customers. Lower-than-average on-net percentages for largest providers are common in highly competitive markets such as the USA (9%), Great Britain (11%), Germany (14%), and Canada (27%), where a deep field of competitors reduces the likelihood that any single largest domestic provider will serve a dominant percentage of the national market.

Within the Gulf region, the weighted average is **71%** on net with a single provider, roughly twice the worldwide average.





Bahrain (28%), Kuwait (35%), Iraq (38%), and Egypt (38%) score in line with worldwide averages. In these countries, multiple independent service providers compete to offer access to international transit, so that no single provider gains what could be considered a dominant share of the domestic IP transit market "on net."

Saudi Arabia (69%) and Jordan (76%) are higher than average, but clearly have at least some active competitors gaining measurable IP market share. **Lebanon (65%)** has a high percentage of satellite Internet providers, each of which takes away potential market share from a strong incumbent.

Oman, Qatar, Yemen, Syria, Iran, and the United Arab Emirates all have more than 90% of their domestic market on-net with a single domestic provider. Few realistic alternatives exist for international IP transit, other than that mediated by the largest domestic provider.

As 2010 comes to a close, Bahraini providers are taking advantage of more diverse international transit than ever before.

In March 2010, Saudi Telecom launched its Viva mobile service in Bahrain, utilizing dark fiber leased from GCCIA. Backup transit was provided over Flag FALCON via the Bahrain landing station. Bahraini providers Menatelecom, Kalaam, RTS, Etisalcom Bahrain, and GCCNGN/Rawabi quickly moved to acquire international transit via STC, and today, STC has an estimated 21% of the Bahraini market on-net.

October 2010 saw a surge in Bahraini utilization of the Flag FALCON cable, with leading competitive providers Menatelecom and Zain Bahrain both showing evidence of substantial Flag transit for the first time. Flag's on-net percentage of the domestic market has risen from 26% to 45% over the course of the year, with Tata's on-net percentage falling from 93% to 82%, and Emirates' from 35% to 28%.

Bahraini providers still have fewer available choices for international transit than others in the region.

Bahraini providers still do not have access to the full array of international service providers that are available in other countries at consortium-based cable landings. As 2010 closes, Bahraini providers have four choices for international transit: Tata, Flag, Emirates, or STC. By contrast, the largest providers in the UAE, Saudi Arabia, and Egypt typically have access to six, eight, or even ten international carriers, and use them all simultaneously for transit, letting them compete for every packet sent and received. In Bahrain, Tata and GBI both plan new submarine cable landings in 2011, which should increase the range of direct International transit available to domestic providers.

Additional terrestrial connectivity options for the region are likely to materialize in 2011.

The Gulf region has always lacked a terrestrial alternative to failure-prone submarine cables for European and Asian connectivity. Turkish, Russian, Iraqi, Azeri, and even Iranian carriers are stepping into the gap, hoping to provide attractive terrestrial routes for the region's IP traffic. The JADI-link (Jeddah, Amman, Damascus, Istanbul) is theoretically complete and likely to be the first online, although it has not yet made a visible impact in the routing tables. Saudi-Iraqi and Jordanian-Iraqi routes are likely to follow, connecting the region to transcontinental Russian transit.

The Bahrain Internet Exchange, once the default alternative provider in the Kingdom, is losing market share as with the arrival of more international transit diversity.

LightSpeed Communications, who became a Flag customer in 2009, added the BIX as a backup provider in March, thereby reducing the likelihood of suffering a single-carrier outage. Because the BIX resells a 50-50 mix of Tata and Emirates traffic, it represents a very reasonable diversification strategy for any Bahraini company that uses a lot of Flag transit.

On the other hand, with the market entry of STC, and the expanded presence of Flag, other companies may see opportunities to replace BIX transit with direct international capacity. Menatelecom dropped BIX transit at the start of August 2010, having added Saudi Telecom as a third provider 60 days earlier. Kalaam and RTS followed suit in October and November. Unless the BIX can reverse this trend, its historical role as the Kingdom's default alternative service provider may be in doubt, and national transit diversity may suffer.

Batelco's lack of multihomed customers artificially constrains their on-net share of the domestic market, and potentially their growth.

Of all the incumbent providers in the region, only Batelco continues to have no autonomous system customers downstream – that is, no customers that can have *multiple service providers*. Bahraini companies whose primary current provider is Tata, or the BIX, or STC, would presumably welcome the change to lower their risks by acquiring Batelco as a backup provider, given its Flag and Tata transit, Emirates peering, and physical diversity. Without a multihomed customer strategy, however, there's a risk that Batelco's relative on-net share of the Bahraini market will continue to shrink as the domestic market grows and diversifies around it.

The April 2010 failure of SMW4 showed that major cable failures are survivable, if nations pursue a strategy of significant international transit diversity.

Unplanned Internet infrastructure failures are the unintentional testing mechanism that reveals whether a country's Internet ecosystem is sufficiently diverse. In 2010, the shunt fault encountered by SMW4 off of Alexandria, Egypt was the primary event of this type. Across the region, providers shifted European transit to alternative providers on alternative cables. In Bahrain, customers who were heavily dependent on Tata saw packet delays to Europe increase by hundreds of milliseconds, as traffic re-routed around the planet. The event was a reminder that international transit diversity is the best insurance against regional outages.

The IPv6 Internet is growing very slowly in the region, despite the looming threat of IPv4 address space exhaustion. A prolonged and potentially painful multi-year transition period is inevitable.

Today, only about 40 IPv6 networks from the Gulf region appear in the global routing table, and only a handful of domestic and international providers offer any kind of IPv6 connectivity.

As IPv4 allocations are exhausted, telecommunications regulators throughout the region may rapidly find themselves overseeing a lucrative (and increasingly desperate) market for IPv4 address space, in which new market entrants can be shut out by existing providers for lack of adequate IPv4 addressing resources. Affected parties should begin to consider whether a country's existing IPv4 allocations might constitute a finite national resource, like radio spectrum, that is potentially subject to regulatory oversight.

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.

This report focuses on two particular kinds of measurements: **on-net market share estimates** and **route selection percentages.**

On-net market share is an estimate of the percentage of a given market that is, directly or indirectly, the customer of a given provider. Renesys computes the provider's customer base score (a proprietary model designed for comparative provider rankings, that incorporates a contribution from each network prefix originated or transited by any of the provider's downstream customers). That customer base score is then divided by the total customer base score for the market as a whole (all network prefixes believed to geolocate there) to create the on-net percentage.

Route selection percentages incorporate additional information: the percentage of Renesys observation points that believe that the given provider is the "best" (selected) route to a given prefix at any moment. This yields an estimate of instantaneous share for any provider within any market, which may fluctuate second by second as the customers in that market change their routing preferences among the providers with whom they have transit contracts.

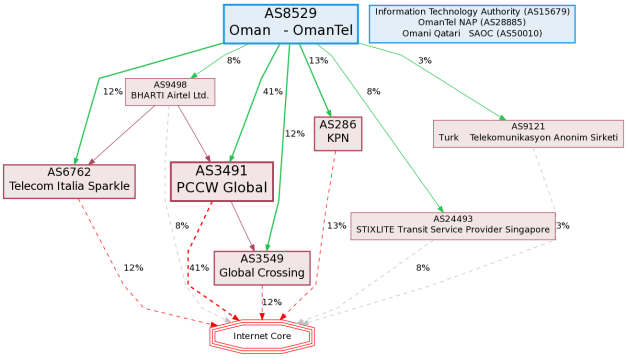
One can think of the on-net market size as a natural upper bound for the route selection percentage; the on-net market share is the percentage of a market that the provider could provide transit to, *if it were always selected as the best route by all its customers*.

Note that route selection percentages sum to 100%, while on-net percentages generally sum to greater than 100%. To see why, consider a simplified scenario in which a country is served by two international carriers, and every customer in the country has direct transit contracts with both of them. Each of the two carriers would have 100% of the country on-net. But at any moment, all else being equal, they would each be expected to have a route selection percentage of 50%.

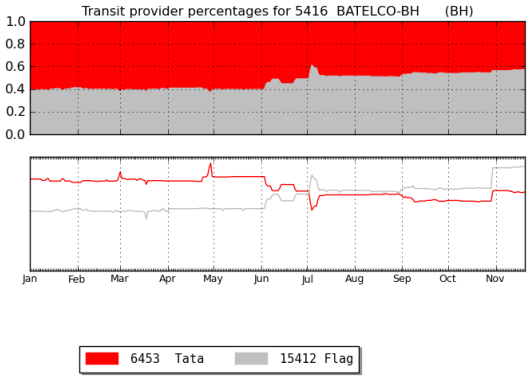
Starting on page 53, **on-net tables** show the on-net percentage of each international and domestic service provider within a given national market, as that percentage has evolved over a period of years. As a reminder, these are *upper bounds for route selection*, and will often sum to more than 100%, in situations where downstream customers have multiple provider choices.

This report contains three primary kinds of visual displays.

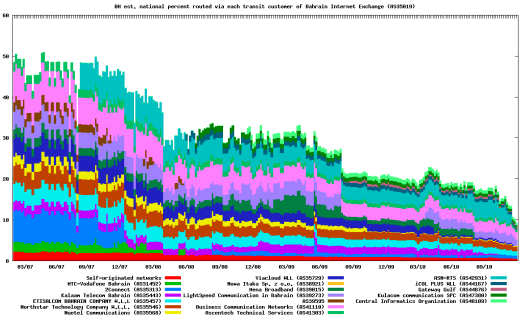
Market graphs show the primary domestic and international providers for a country, along with their interconnection weights. Domestic providers are light blue; international providers are light red. Arrows indicate customer-provider relationships, and the percentage numbers on each arrow indicate the percentage of the national market that is estimated to be "on net" in that relationship. In other words, if that relationship were to disappear (because a cable was cut, or because a contract were not renewed), the label indicates the percentage of the national market that could potentially be affected by routing instability or outage.



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 over some lookback period (in this report, 2010).



Customer transit plots look at a provider's downstream customers instead, estimating the contribution each one makes to the provider's total national traffic . In this report, customer transit plots are normalized by national market size, to give additional information about the growth or decline of a given provider within the domestic market, based on the sum of inputs from each of its direct customers.



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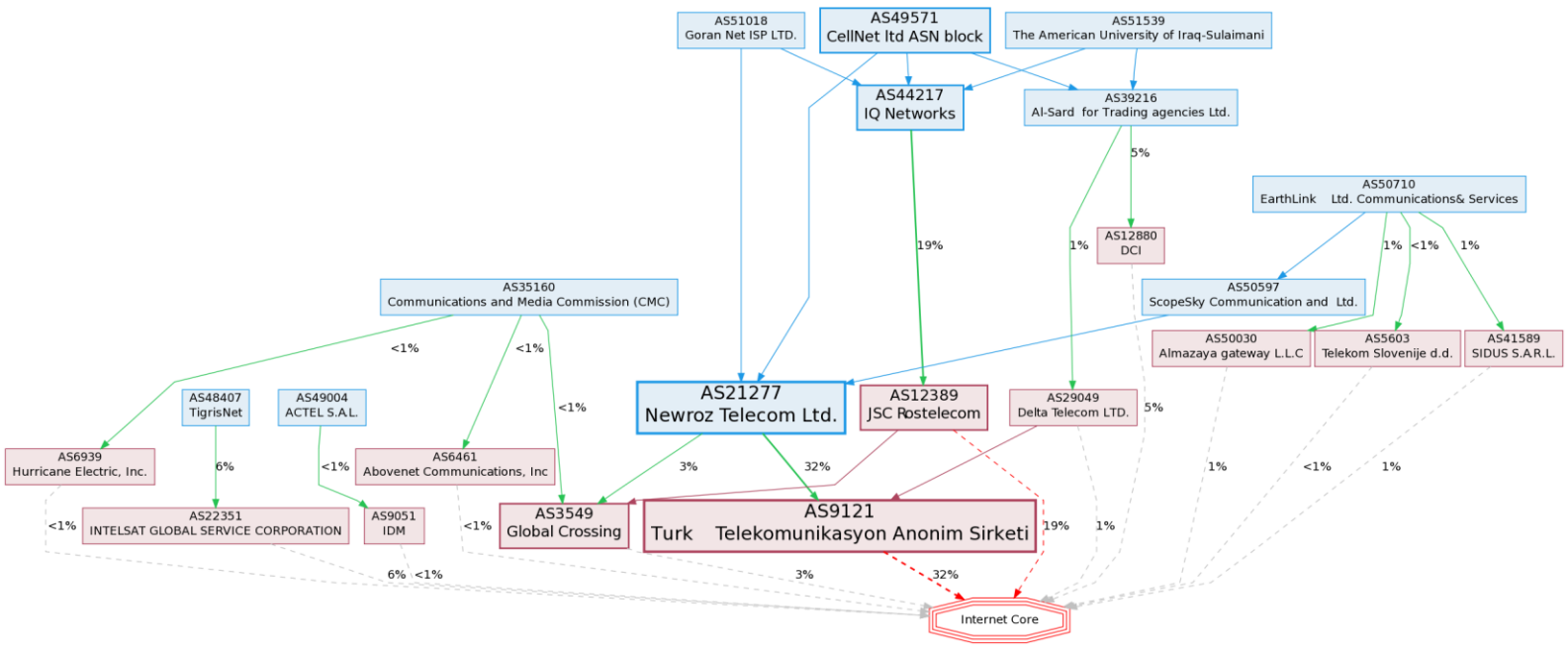
Country Summaries

The countries of the Middle East vary widely in their approach to Internet economics. Some, like the Kingdom of Bahrain, show continuing trends towards increased competition and Internet transit diversification. Others have been slower to diversify, leaving a single domestic incumbent in control of market-dominant portions of the national Internet ecosystem. In all cases, geography is strongly determinative of international transit diversity. Countries with access to multiple consortium-based submarine cable landings have an abundance of international transit alternatives, which may or may not be made available to a broad set of competing domestic providers.

The sections that follow provide capsule summaries of the leading domestic providers of each country in the region, summarizing their interconnections with international providers graphically. Additional plots illustrate the international transit available to each provider, and show how that transit blend has changed throughout 2010.

Iraq

The smallest Internet economy in the region, and the 109th largest worldwide, is Iraq's. The Internet economy of Iraq is once again growing, with new investment evident and new connections to neighboring countries appearing almost monthly. The US military's portion of Iraq's national Internet continues to drop, as the domestic market expands. While most visible autonomous-system level activity currently takes place in the northern provinces of Iraqi Kurdistan, one can also see evidence for growth and interconnection in the Baghdad area.

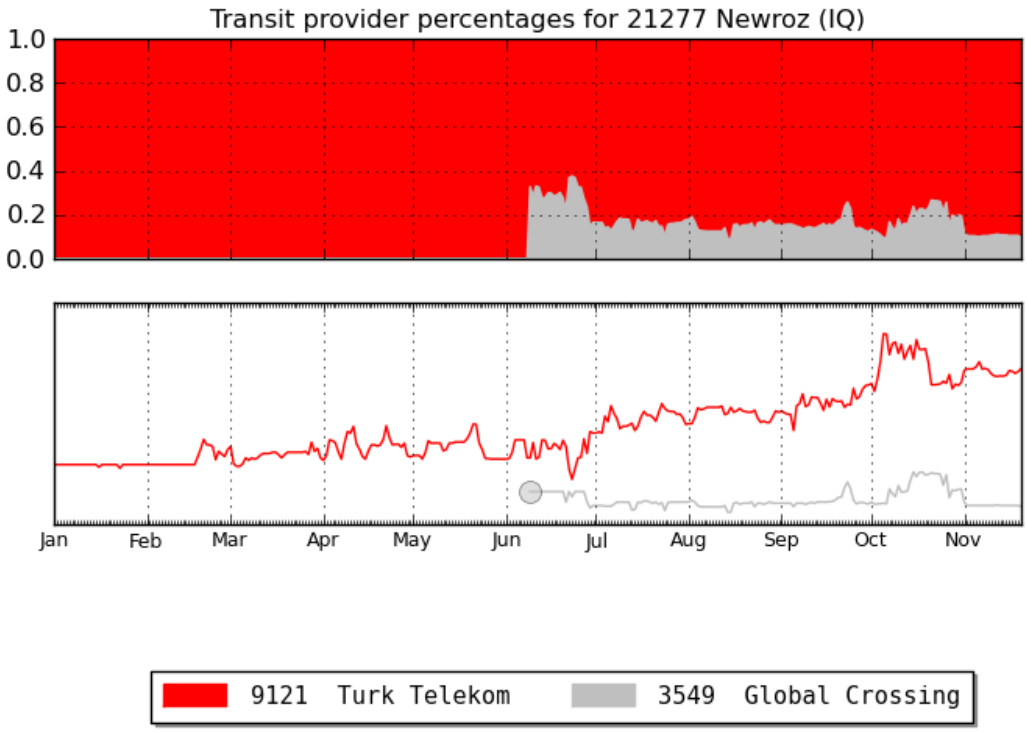


Looking forward, new cable landings at Basra in 2011 will connect Iraqi providers more firmly to the Gulf's regional submarine cable network in the south, and new Turkish, Iranian, Azeri, and Russian connectivity will provide attractive terrestrial paths to Europe and Asia in the north. These paths can provide vital backup connectivity in the event of failures on the submarine cables that serve the Gulf, and will link up with existing Iraqi fiber connectivity to Jordan and Saudi Arabia.

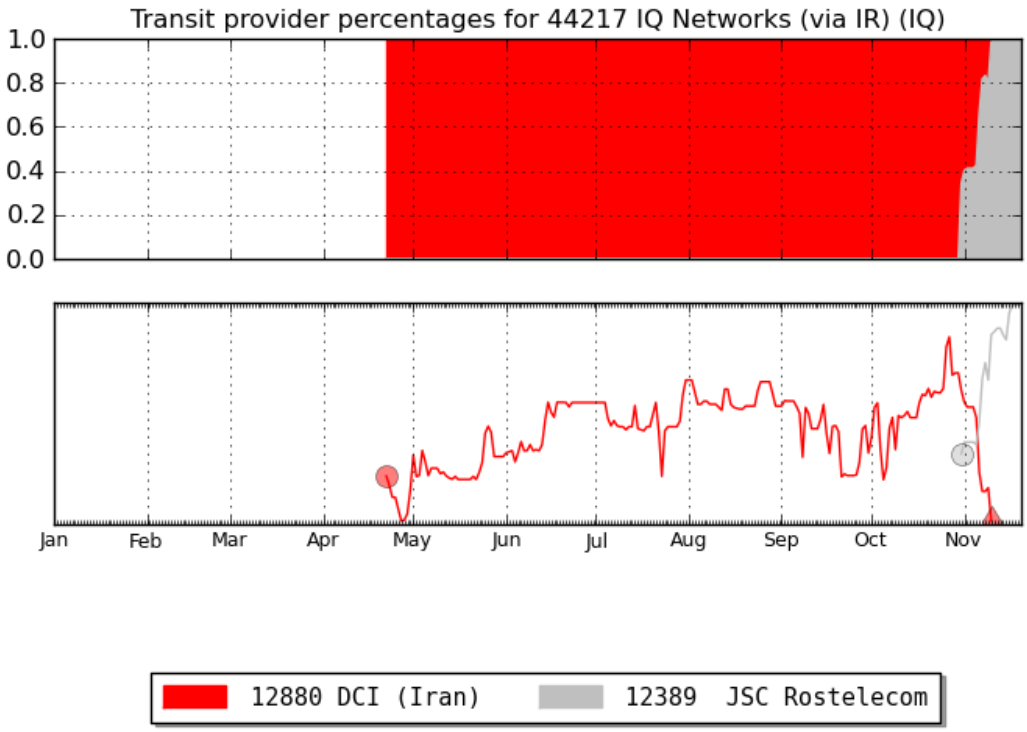
Indeed, if the Iraqi central and provincial governments can address security concerns, and continue reconstructing the nation's fiberoptic backbone and metro networks, Iraq may emerge as a major regional conduit for low-latency IP transit between the Gulf states and Europe. Iraq's incumbent operator, state-owned ITPC, has reaffirmed its stated policy of pursuing privatization and encouraging the growth of a diverse set of domestic Internet transit providers.

Today, nearly all visible ASN-level Internet routing in Iraq takes place over terrestrial paths from Kurdistan to its neighbors in the north.

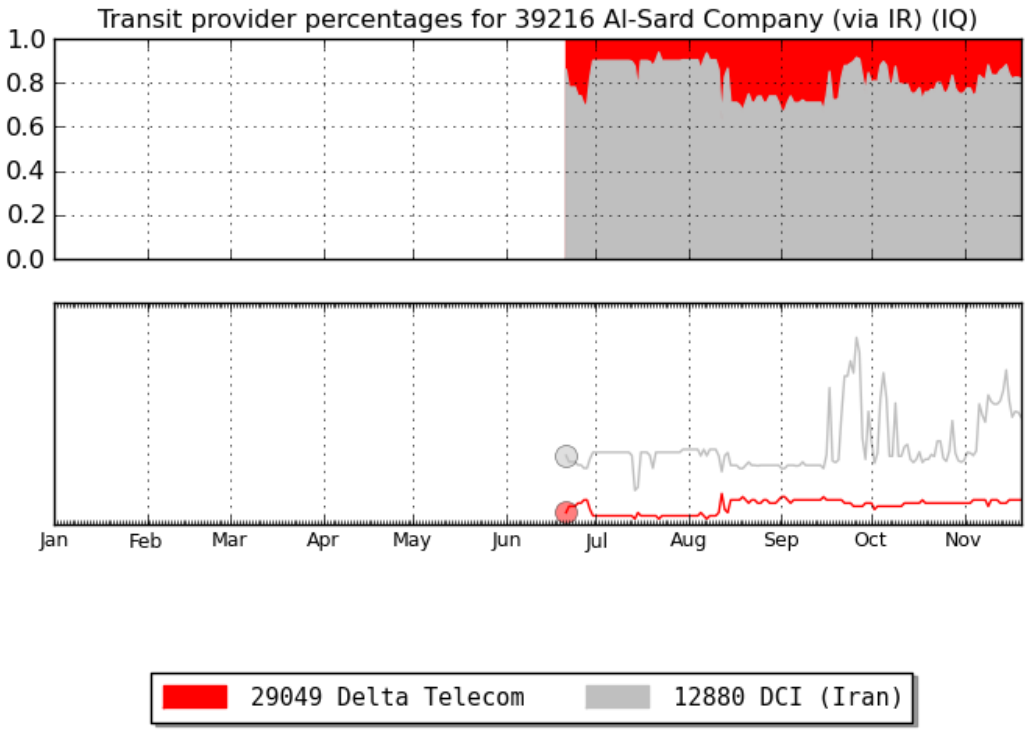
Primary Iraqi transit providers include **Newroz Telecommunications** (AS21277), based in Suleimaniya, which has 3 downstream ASN customers, 39 originated networks, and 18 transited networks. Newroz receives transit from Turk Telekom (80%) and Global Crossing (20%). It has 40% of the country "on-net" – that is, 40% of all Iraqi IP space receives Internet transit (at least partially) through Newroz.



Where Newroz looks west for transit, **IQ networks** (AS44217) looks east. With 4 downstream ASN customers, 6 originated networks, and 19 transited, IQ Networks has 18% of the country on-net, and now receives 100% of its Internet transit from Russian provider Rostelecom (AS12389), utilizing Iranian connectivity through the Azeri Internet Exchange in Baku.



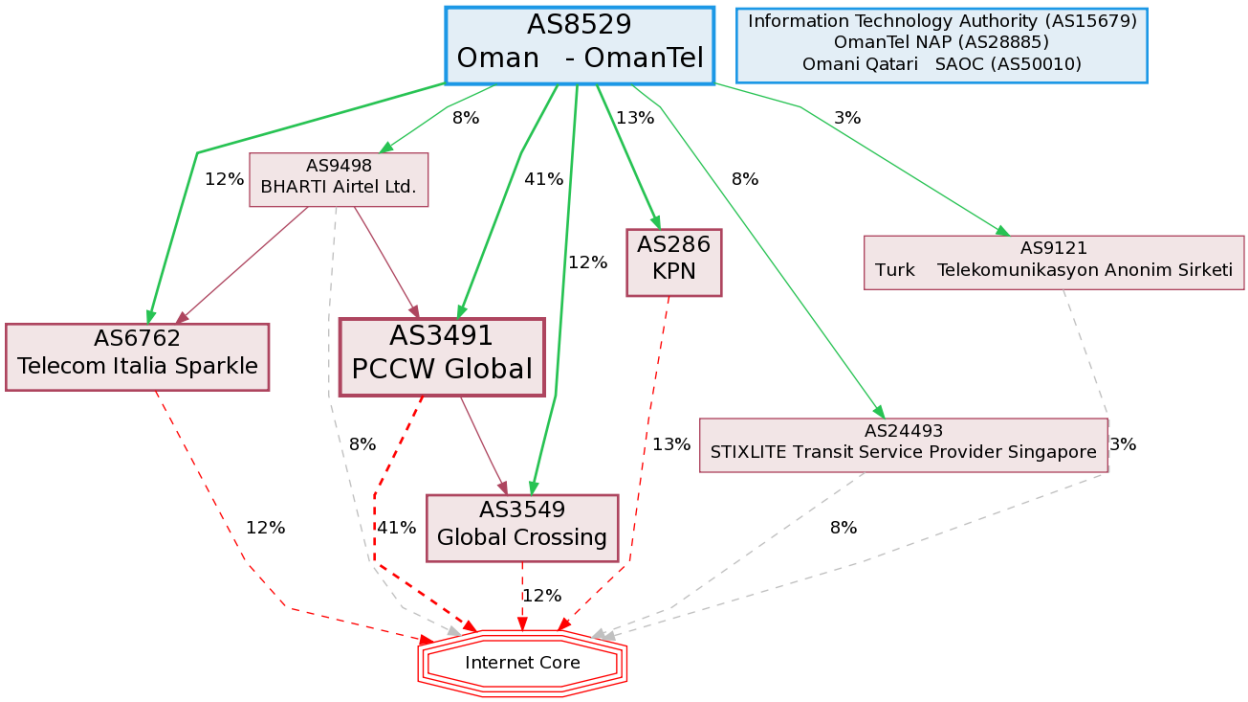
A third Iraqi provider, the **Al-Sard Group** (AS39216), utilizes a blend of Azeri transit (Delta Telecom) and Iranian transit (DCI Iran) along the same physical routes. Several downstream autonomous systems, including Goran Net, CellNet, and the American University at Suleimaniya, derive their transit from some combination of these, while others still utilize VSAT connectivity.



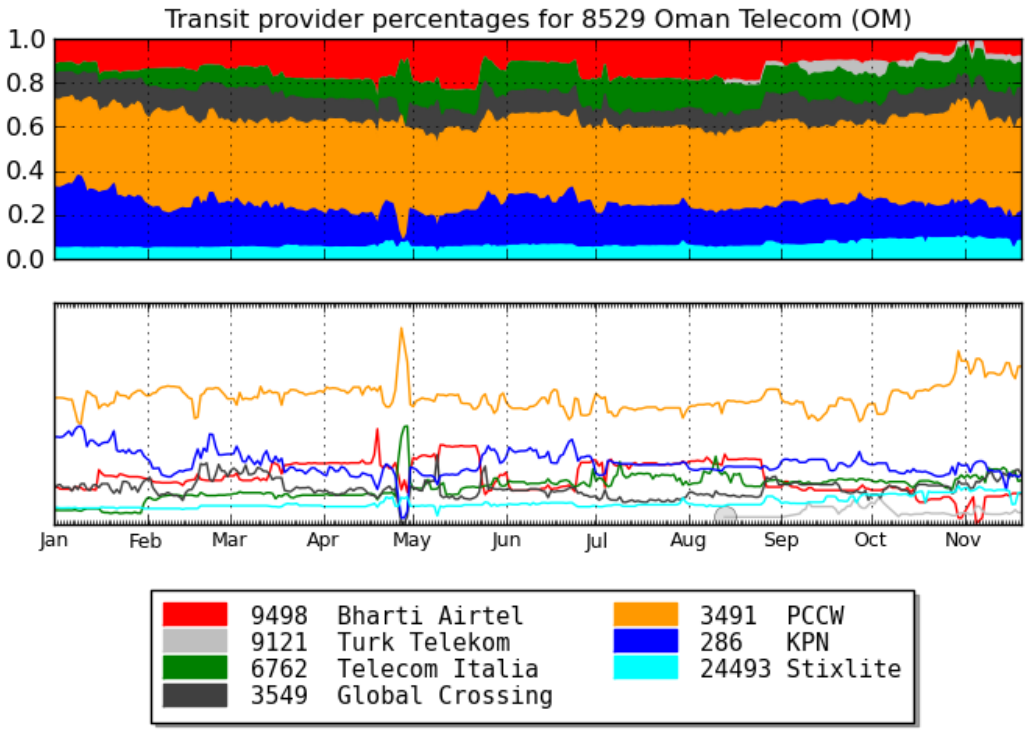
Oman

Oman's Internet ecosystem is slightly larger than Iraq's, ranking 10th regionally and 103rd globally. Its domestic transit diversity is substantially lower, however. **OmanTel** (AS8529) has 100% of the nation's IP space on-net, and transits a total of 106 networks, on behalf of 2 major downstream customers. Very little evidence for fixed-line or mobile IP diversity is evident in the national transit graph.

The OmanTel NAP (AS28885) accounts for a third of the customer base, and Omani Qatari (AS50010) for another two-thirds. Omani Qatari appeared in January 2010, and is transiting large amounts of IP space on behalf of Nawras Mobile Broadband (the country's 2nd mobile licensee).

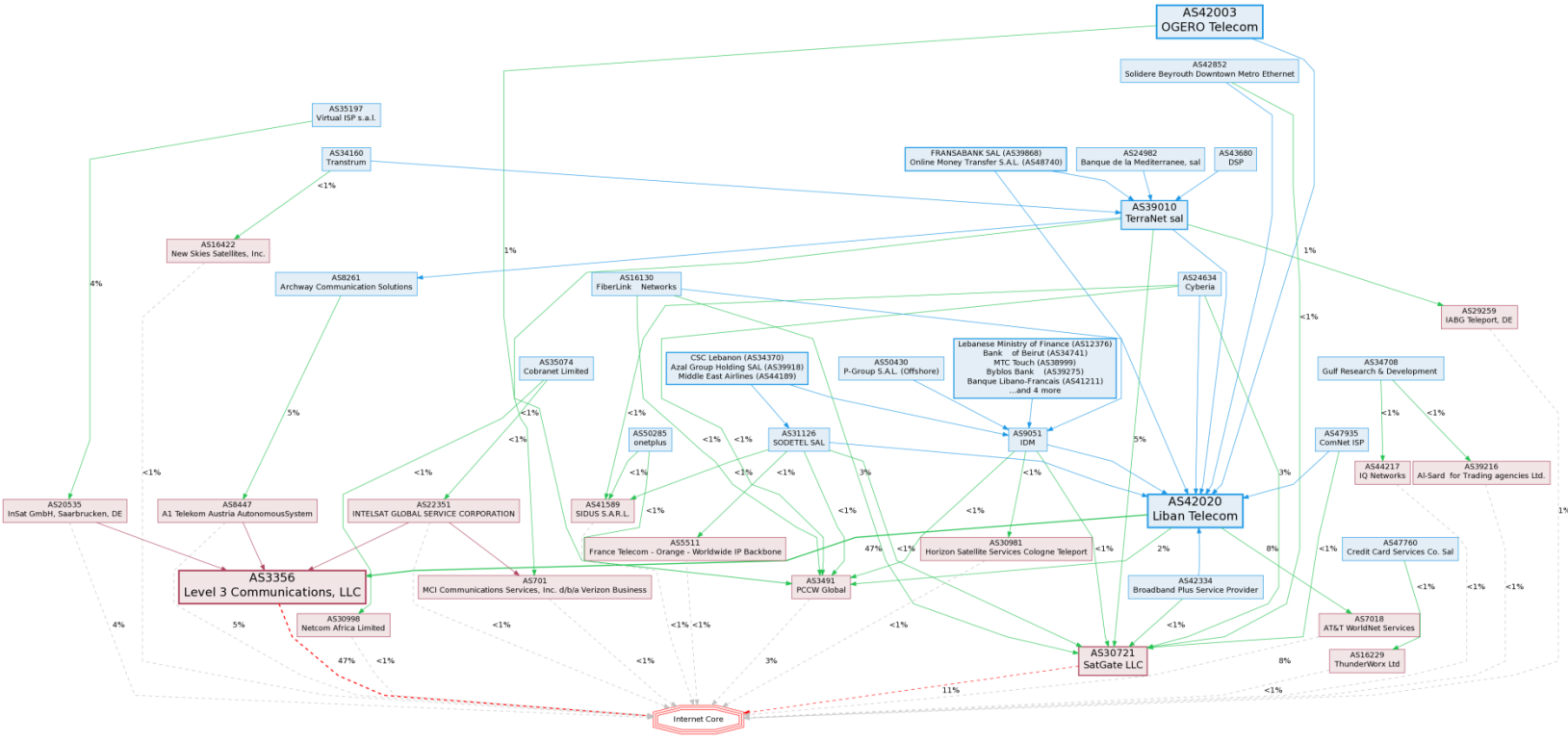


On the other hand, with cable landings from FLAG Falcon and SMW3, Oman can easily draw upon diverse international transit. OmanTel's transit is spread across seven international providers.



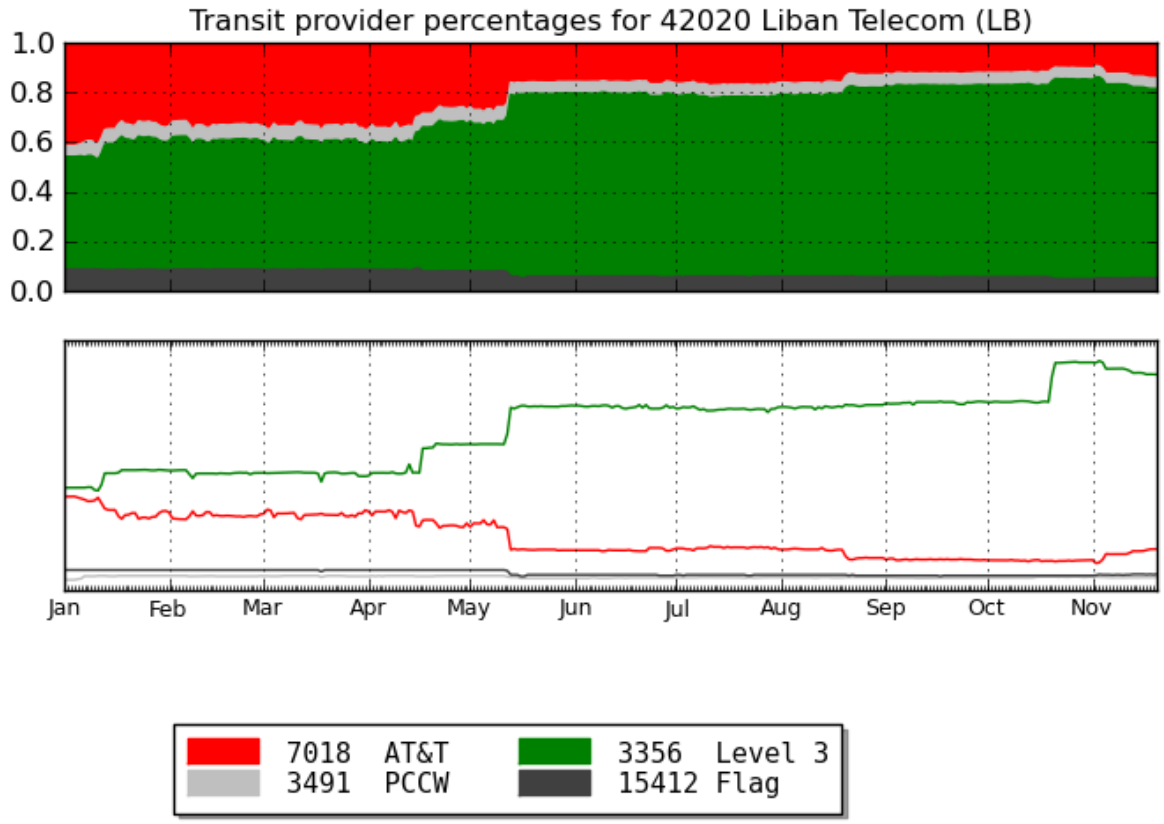
Lebanon

Lebanon's Internet ecosystem (ranked 100th globally) has historically suffered from a lack of international consortium-based submarine cable landings, with connectivity only to Cyprus and Syria. It still has higher-than-expected international transit diversity, largely because enterprises rely on satellite connectivity from a large number of providers. At least 17 different Lebanese service providers have direct international IP connectivity of one form or another.

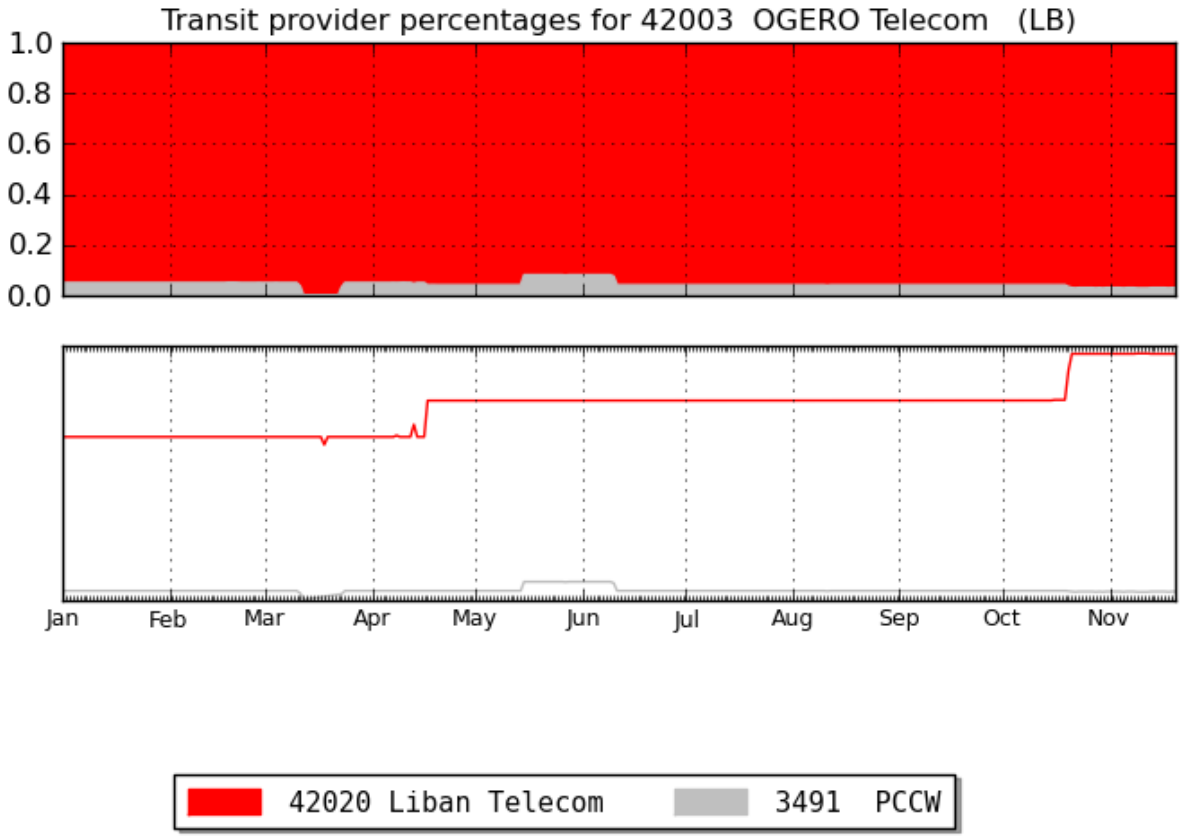


The proposed landing in 2011 of the new IMEWE cable at Trablous will change the entire dynamics of the Lebanese Internet marketplace. For the first time, a wide range of European and Asian carriers will be available to Lebanese operators, and the impacts on transit pricing and carrier diversity are likely to be profound.

For now, the largest provider, **Liban Telecom** (AS42020), has 68% of the nation's IP space on-net. It transits 363 IPv4 networks on behalf of 12 downstream ASN customers. Utilizing Cypriot connectivity, its transit providers include Level3, AT&T, Flag, and PCCW.



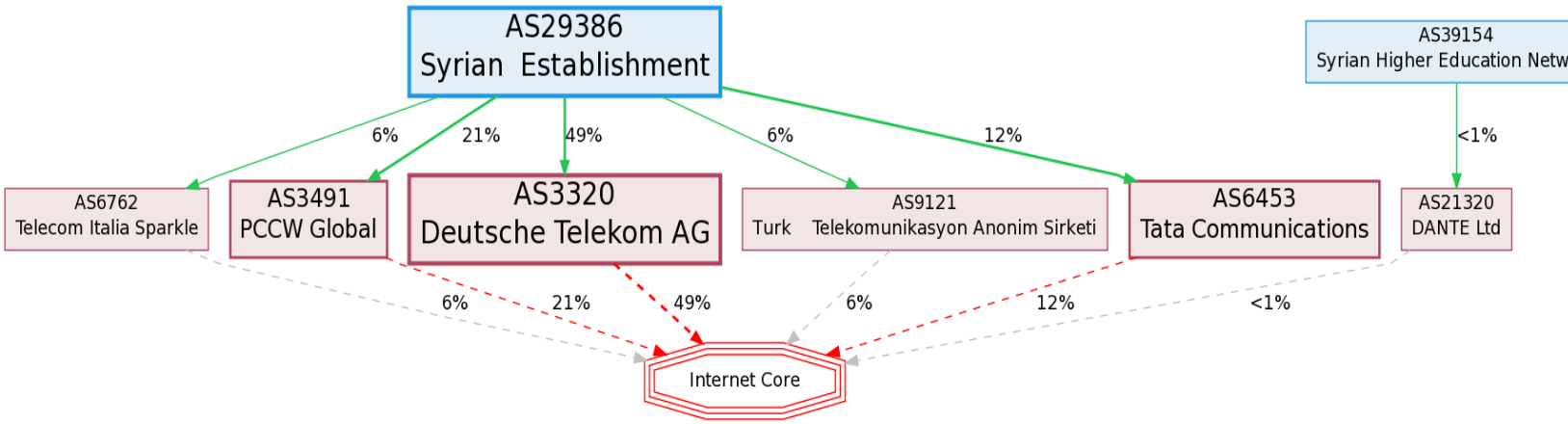
Second-place domestic provider **Ogero Telecom** (AS42003) has no customers downstream, but originates 45 IPv4 networks, representing 51% of the country's IP base. It receives nearly all its transit from the incumbent, as well as a very tiny amount directly from PCCW.

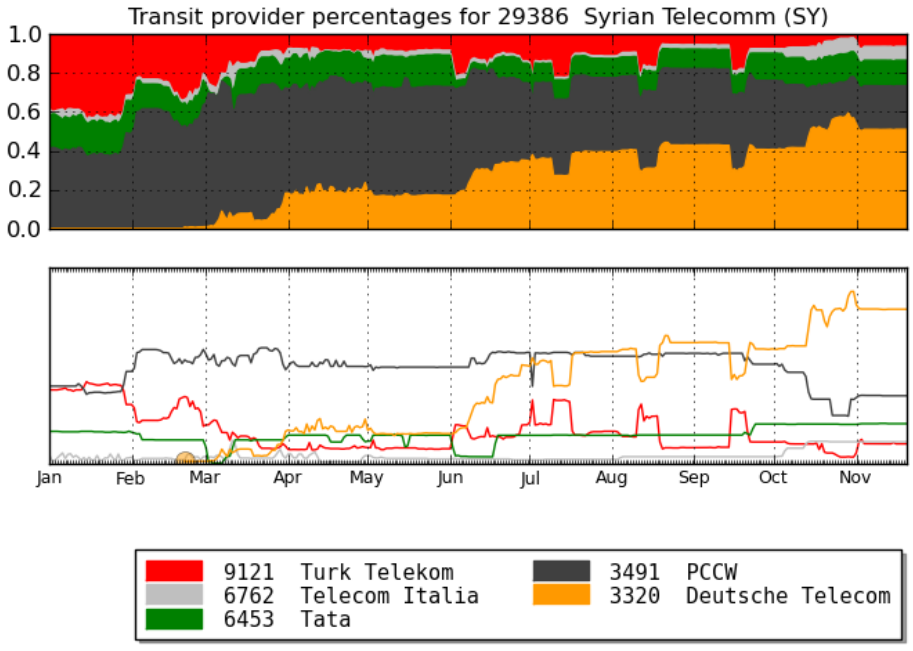


Syria

Ranked 97th globally, Syria's Internet ecosystem is dominated by an incumbent provider, **Syrian Telecom** (AS29386), with 99% of the national market on-net, and no non-incumbent ASNs downstream.

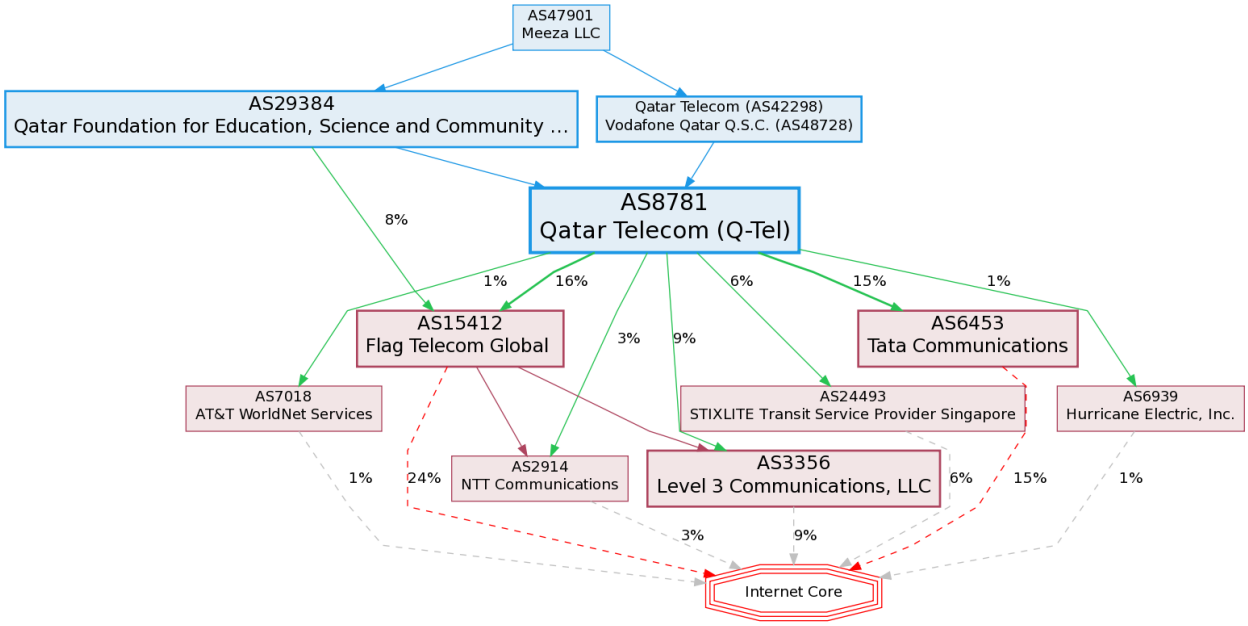
Transit is via submarine cable to Cyprus, and is largely provided by Deutsche Telekom. When the JADI-link project is complete, substantial additional transit should become available through Turk Telekom via terrestrial fiber. Turkish transit appears to have actually shrunk over the course of 2010, in favor of Deutsche Telekom.



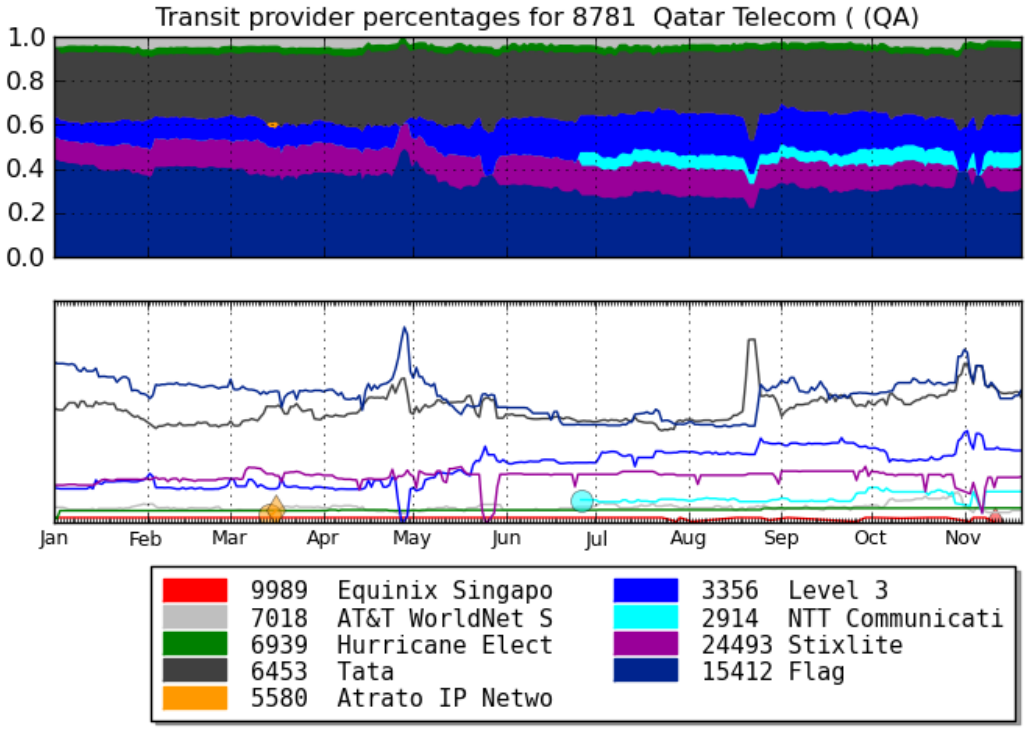


Qatar

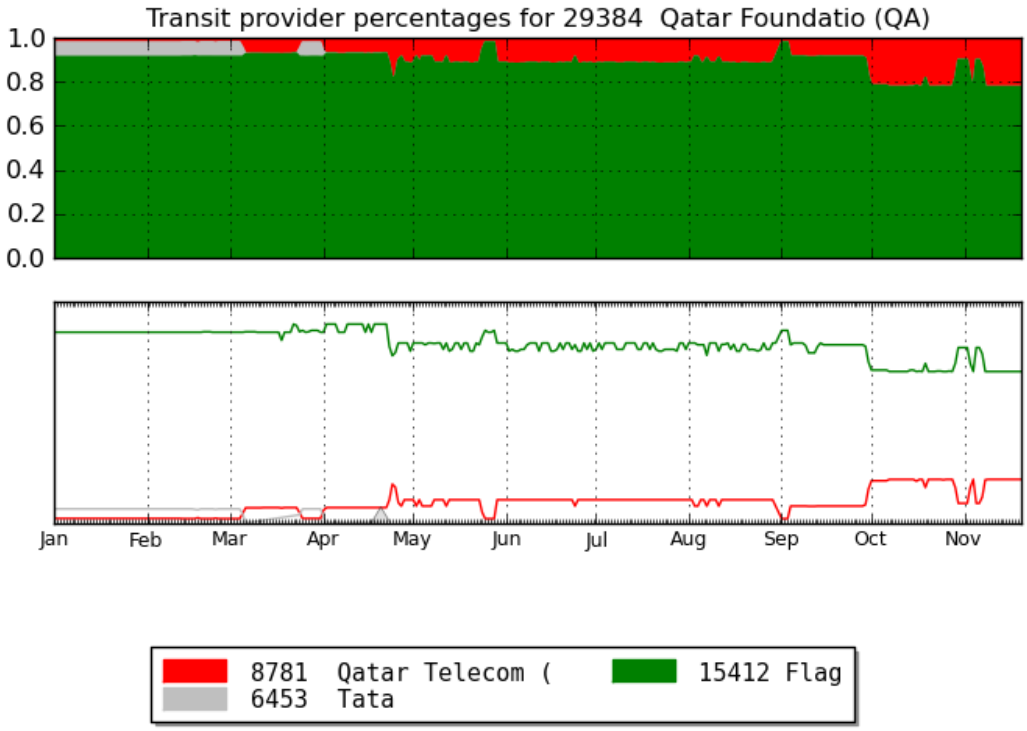
The Qatari Internet ecosystem, like that of Oman, showcases a dominant incumbent with a broad set of international providers, made possible by three fiber connections to the neighboring UAE. Qatar is the 93rd largest Internet ecosystem globally.



Q-Tel (AS8781) is the dominant Qatari provider, with 99% of the national IP space on-net. It serves 9 downstream ASN transit customers, and transits 210 networks on their behalf. Its diverse array of transit providers includes Hurricane Electric, Tata, Flag, NTT, Level3, Stixlite Singapore, and AT&T.



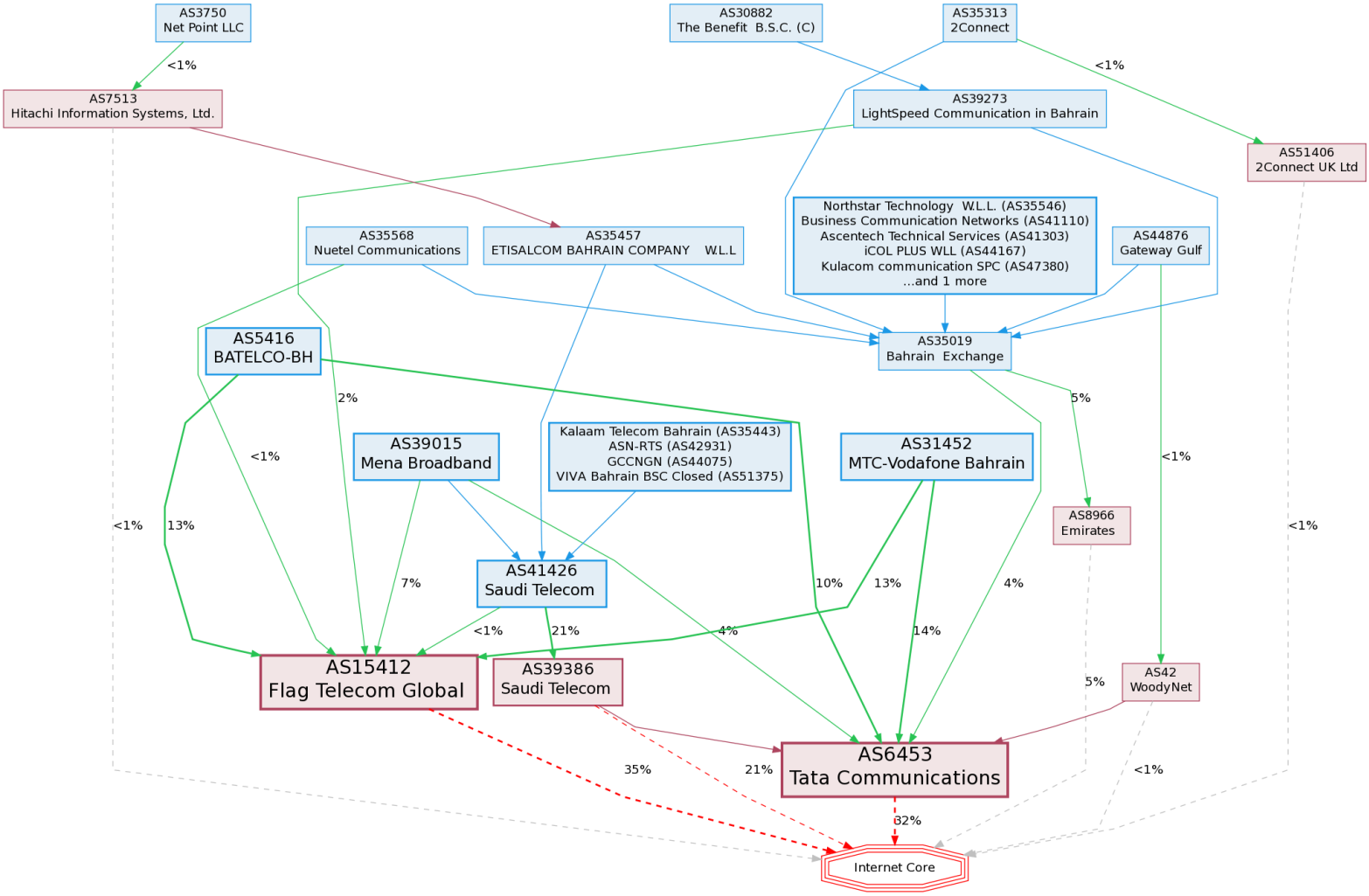
The **Qatar Foundation for Education, Science, and Community** (AS29384) has become something of a service provider in its own right, with one downstream ASN customer, 15 originated networks, and 12% of the national IP space on-net. It has indirect international transit through Q-Tel, but also a direct connection to Flag, and phased out a direct connection to Tata earlier this year.



Bahrain

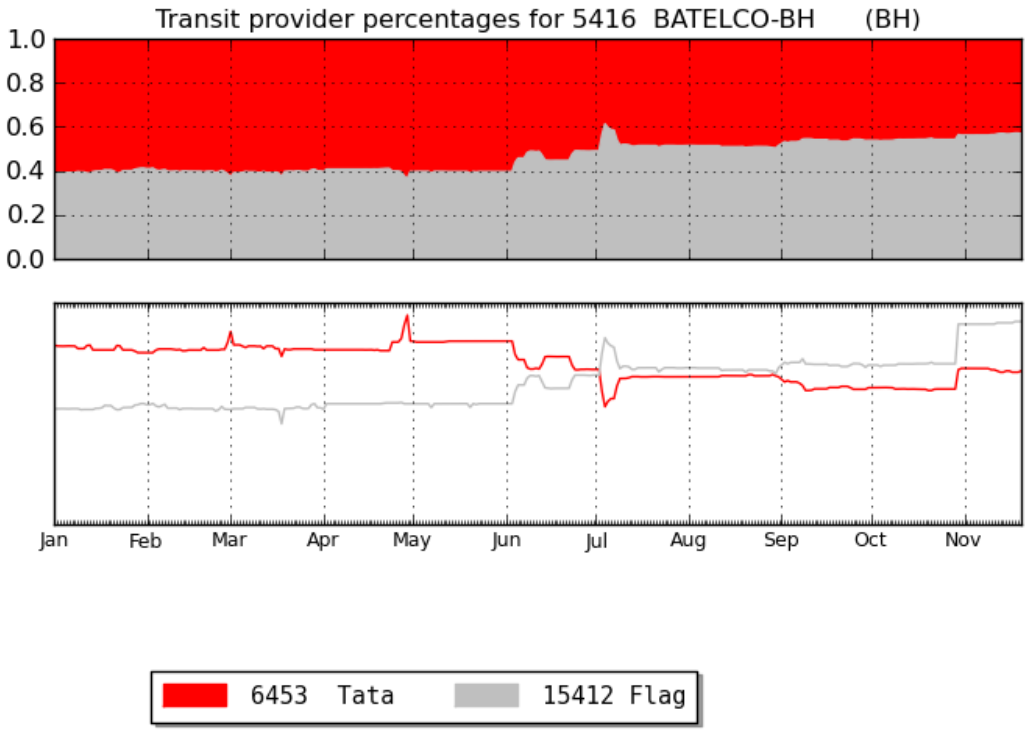
Bahrain's Internet ecosystem is the 92nd largest in the world, despite serving a population of less than one million people. In the context of the other regional Internet ecosystems, Bahrain is notable for its progress towards domestic competition in the IP marketplace, as the estimated on-net shares of the incumbent and competitive providers have come roughly into balance.

The general availability of new international transit providers in the Bahrain market in 2010 (not only Flag, but also Saudi Telecom in connection with the launch of its Viva mobile service) has created significant change. Domestic transit relationships in 2010 have seen significant flux, as ISPs continue to seek reliable, low-cost connectivity to international markets for their customers.

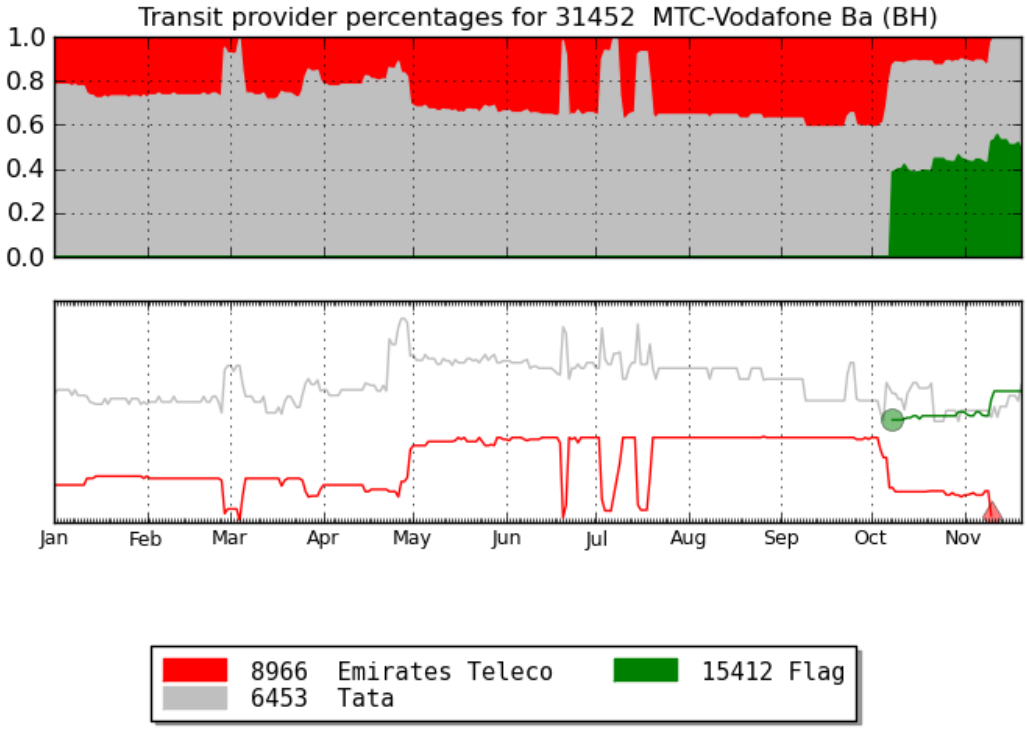


Long-time observers of the Bahrain transit market will note that Zain, Mena, and Etisalcom Bahrain are now substantial consumers of Flag transit, in addition to Nuetel, Lightspeed, and Batelco. Flag's percentage on-net of the Bahraini domestic market now approaches 45% (up from the 26% share it has held in recent years). Tata's on-net share has dropped from 99% (Jan 2009) to 93% (Jan 2010) to just 82% today.

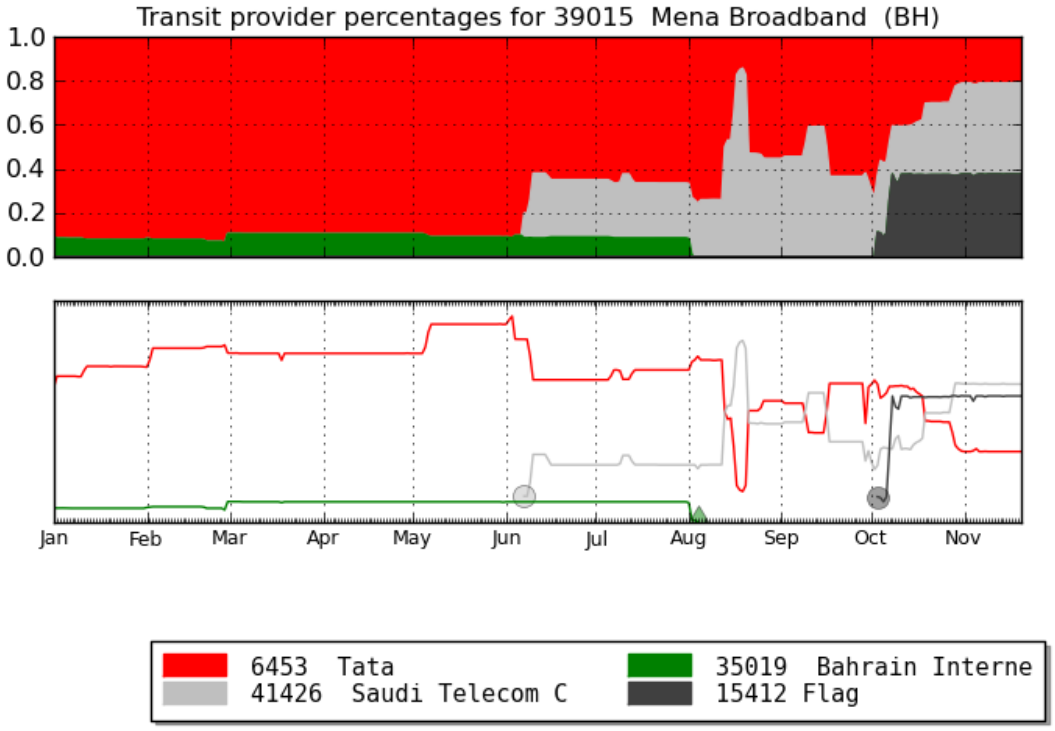
Batelco's continuing lack of downstream ASNs has resulted in the steady erosion of the percentage of the national Internet ecosystem that it can count among its customers. Today, Batelco (AS5416) retains an estimated 26% of the country's Internet ecosystem on-net, representing 143 IPv4 networks. Batelco receives approximately 60% of its transit from Tata, and 40% from Flag; the percentage of Flag transit has drifted gradually upward over the course of 2010 within a 10% band.



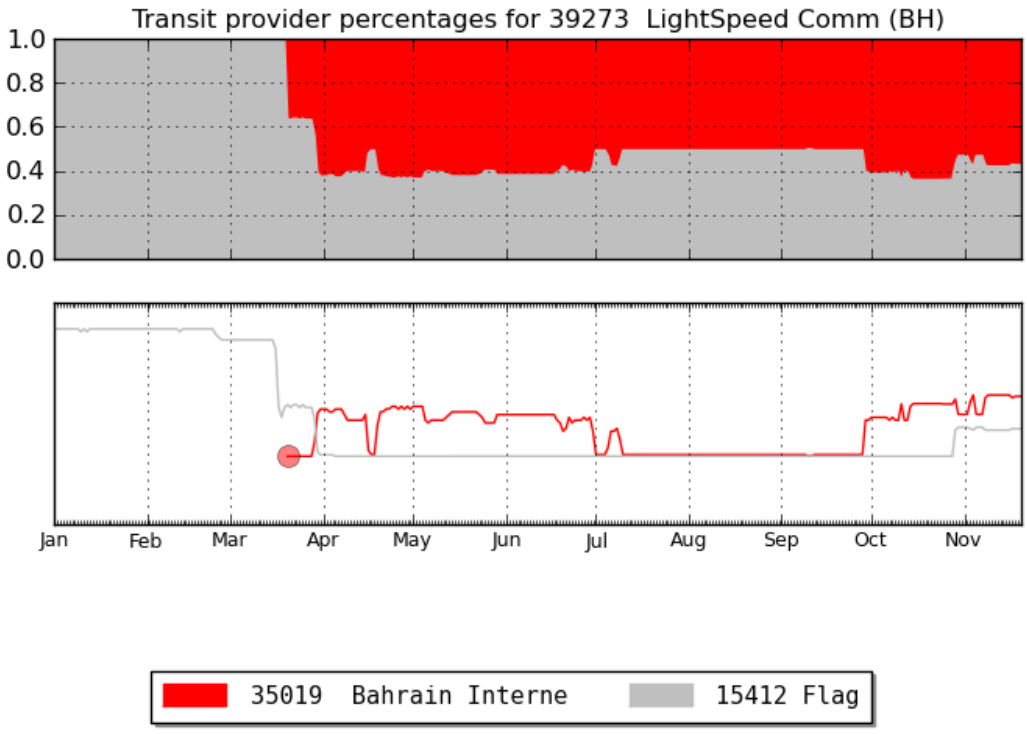
Competing provider **Zain Bahrain** (AS31452) has 28% of the national market on-net, and like Batelco, splits its transit between Flag (45%) and Tata (55%). After achieving access to Flag transit in October, Zain rapidly moved to phase out its Emirates transit and cut its reliance on Tata by approximately half.



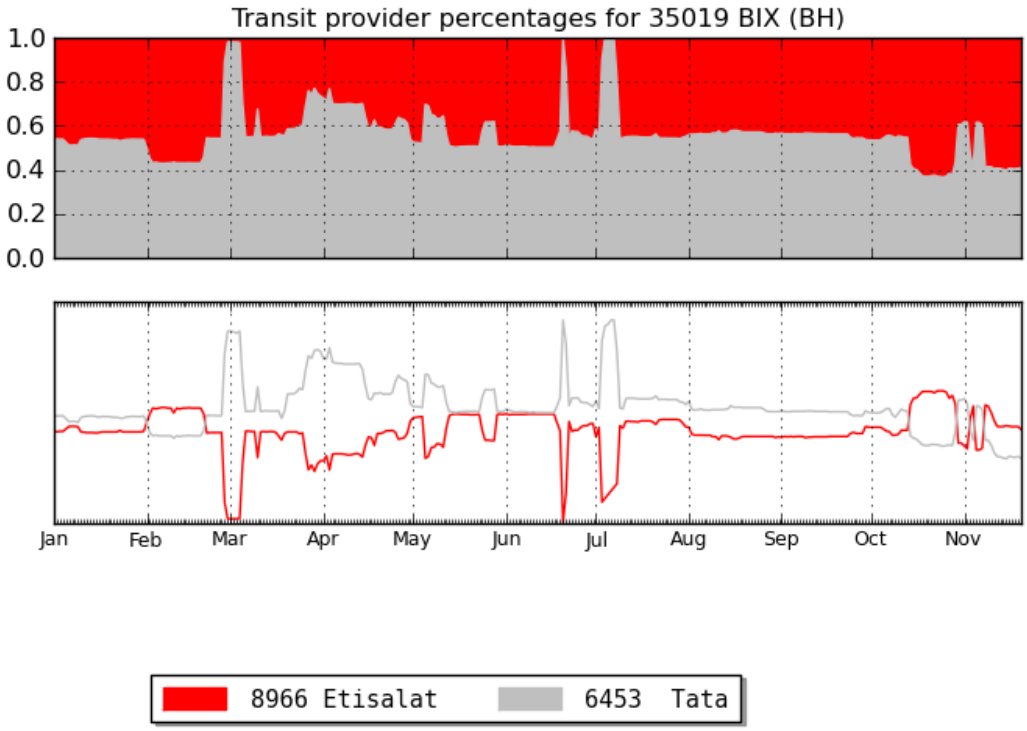
Another competitor, **Menatelecom** (AS39015), has 30 originated networks (22% of Bahrain on-net), and splits its transit between Saudi Telecom (40%), Flag (35%), and Tata (25%). Mena added transit through Saudi Telecom in June, phased out its transit through the Bahrain Internet Exchange in August, and gained access to Flag transit in October, finishing the year with a very different transit spectrum than it started with.



LightSpeed Communications (AS39273) added transit through the Bahrain Internet Exchange in March, restoring some measure of transit diversity (they had been single-homed to Flag since 2009).

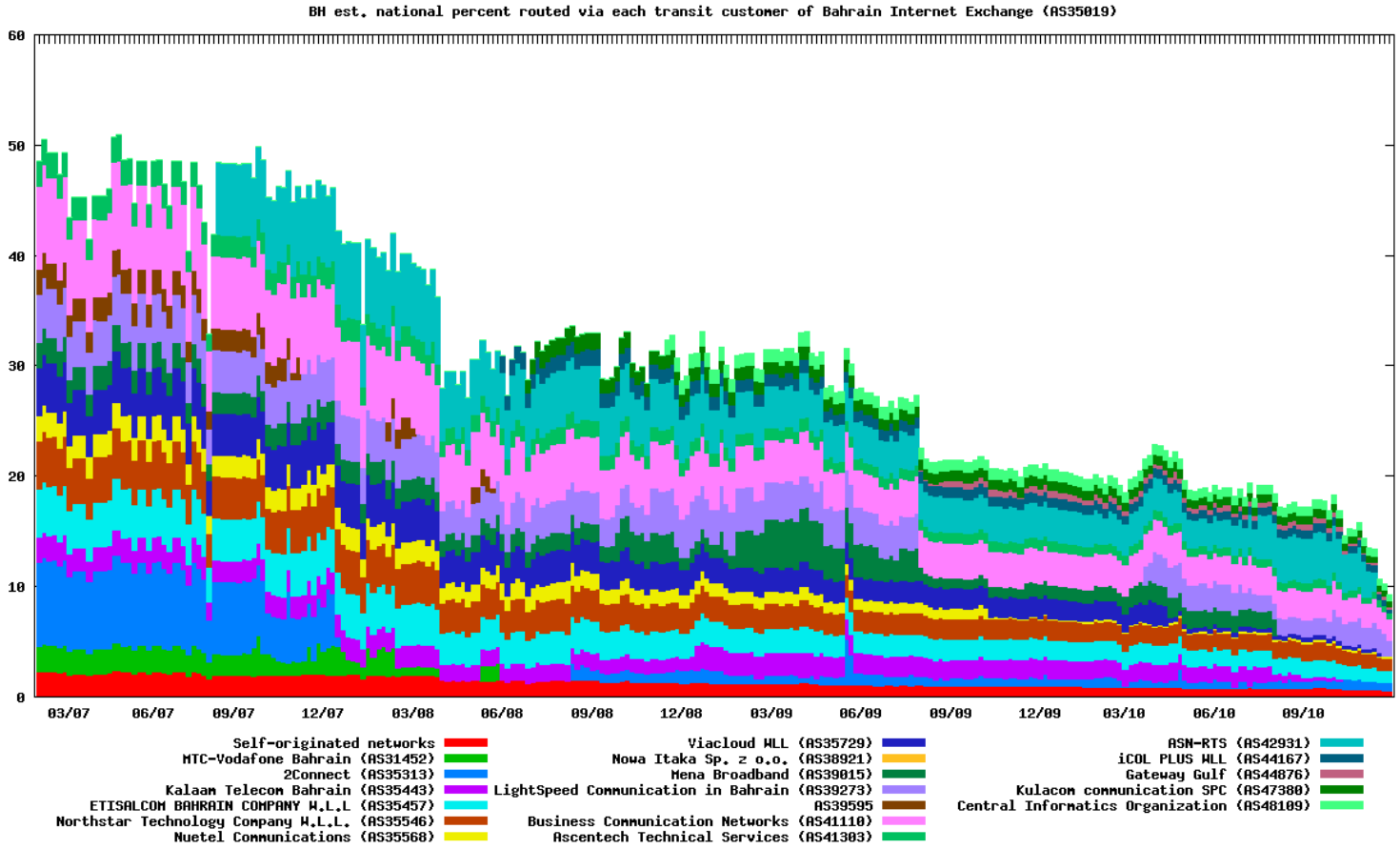


The **Bahrain Internet Exchange** (AS35019) now has 12 ASNs downstream, and approximately 17% of the nation on-net. The BIX continues to retain Tata and Emirates for transit, in the same 50-50 mix utilized in recent years.



In 2010, the BIX had only one significant customer win: LightSpeed communications, returning to the BIX in March after a long absence in order to obtain backup transit and restore dual-homed status.

Offsetting this gain were several key customer losses in the second half of the year, perhaps driven by broader availability of FLAG and STC transit as competitive options. Menatelecom (AS39015) left in August and is now triply-homed to Tata, Flag, and STC. Kalaam (AS35443) left in October, and RTS (AS42931) left in November; both are now singly-homed to STC (a net loss of national transit diversity).



This plot captures the steady decline in total route selection percentage through the BIX over the last 4 years.

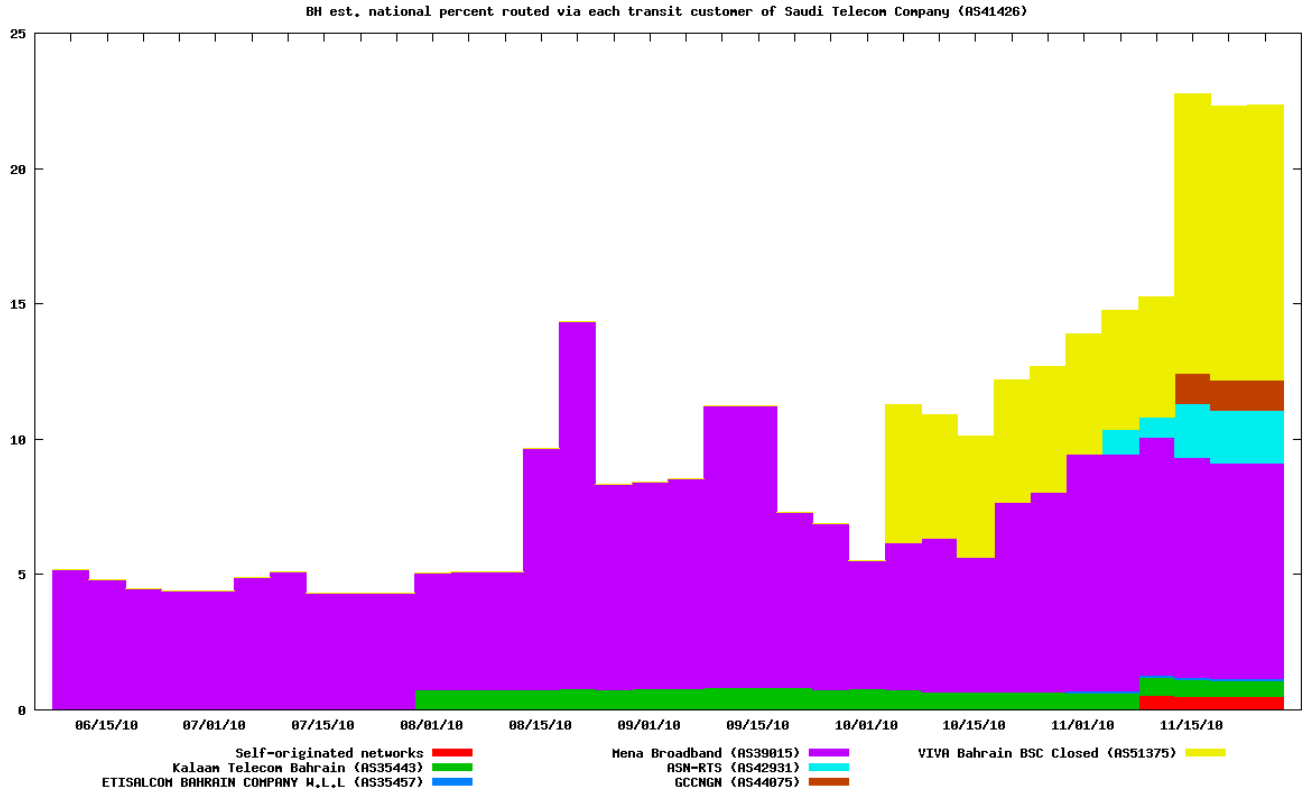
At its peak in early 2007, the BIX could expect to route traffic for nearly 50% of the national IP transit market: everyone but the incumbent.

Since then, the BIX customer base has stayed relatively fixed, with only minor additions and subtractions, and no participation by the incumbent. Meanwhile, the rest of the domestic market has grown steadily. In the closing months of 2010, the BIX has lost customers to alternative providers as access to international direct transit has improved. With 17% of the Kingdom on-net, route selection percentages are now below 10% (with providers treating BIX transit as their backup route, and preferring other, direct routes via STC, Tata, or Flag). If these trends continue, the BIX could easily be reduced to single-digit route selection share by the end of 2011.

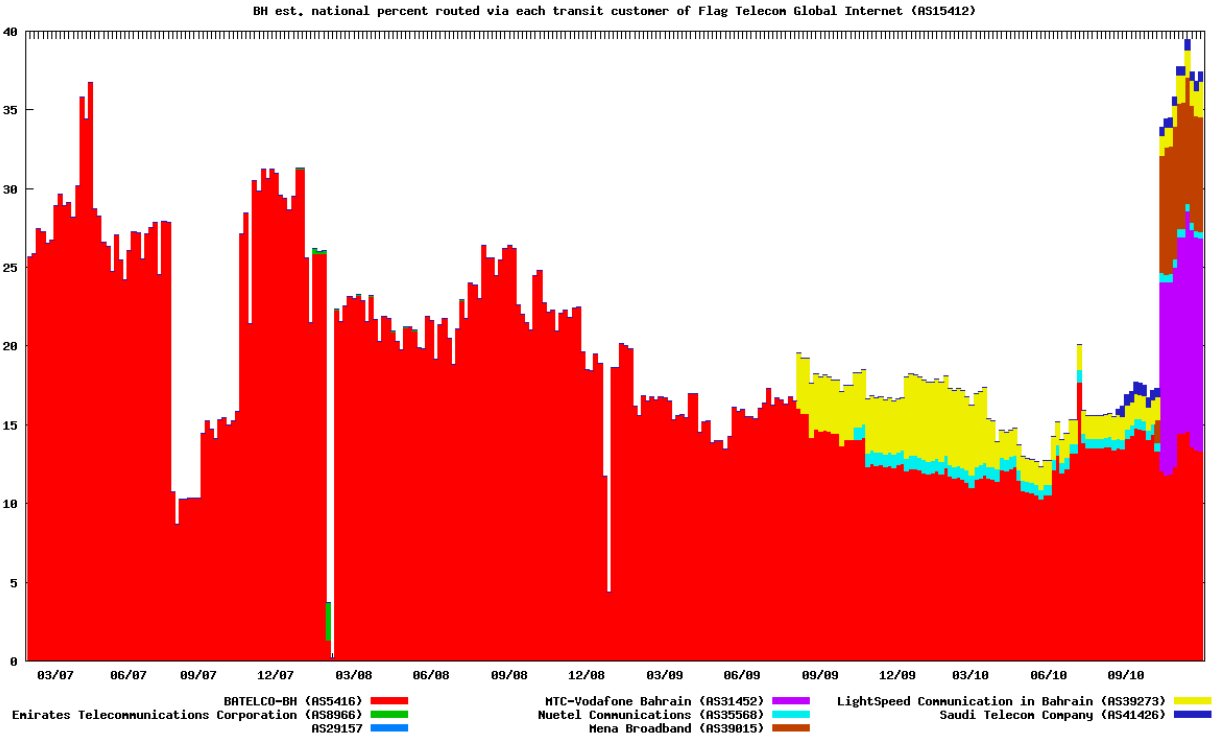
There is an implicit risk in such a scenario: if the so-called 'single-homed' autonomous systems, who buy from a single provider, choose to replace the dual-homed BIX with a single international carrier, then the Kingdom's net transit diversity will decline, and more service-impacting Internet outages may result.

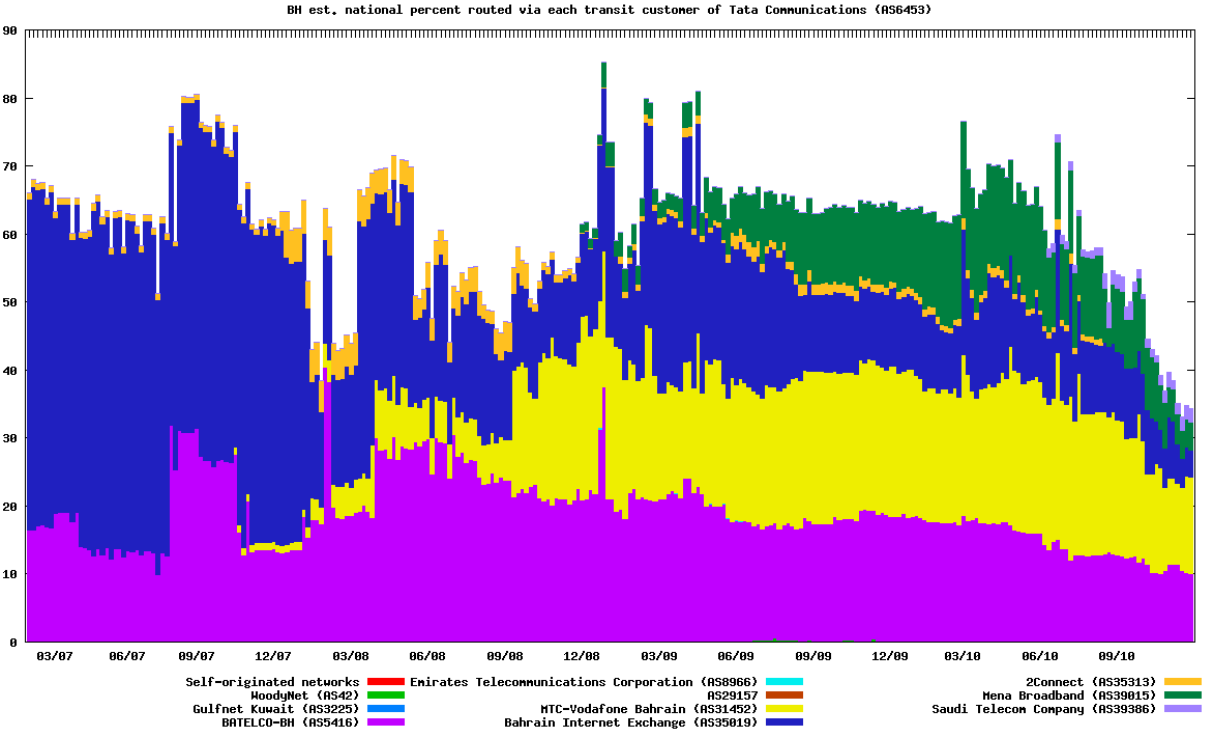
Viva (AS51375) entered the Bahrain mobile market as the Kingdom's third mobile licensee. Owner Saudi Telecom (AS41426) began offering Internet transit to Bahraini companies in June 2010, several months thereafter.

As this plot shows, STC's route selection percentage of the national market has grown steadily with each passing month. At the close of 2010, just over 20% of the Bahrain IP transit market is estimated to route through STC on any given day, despite having neither Batelco nor the BIX as customers.



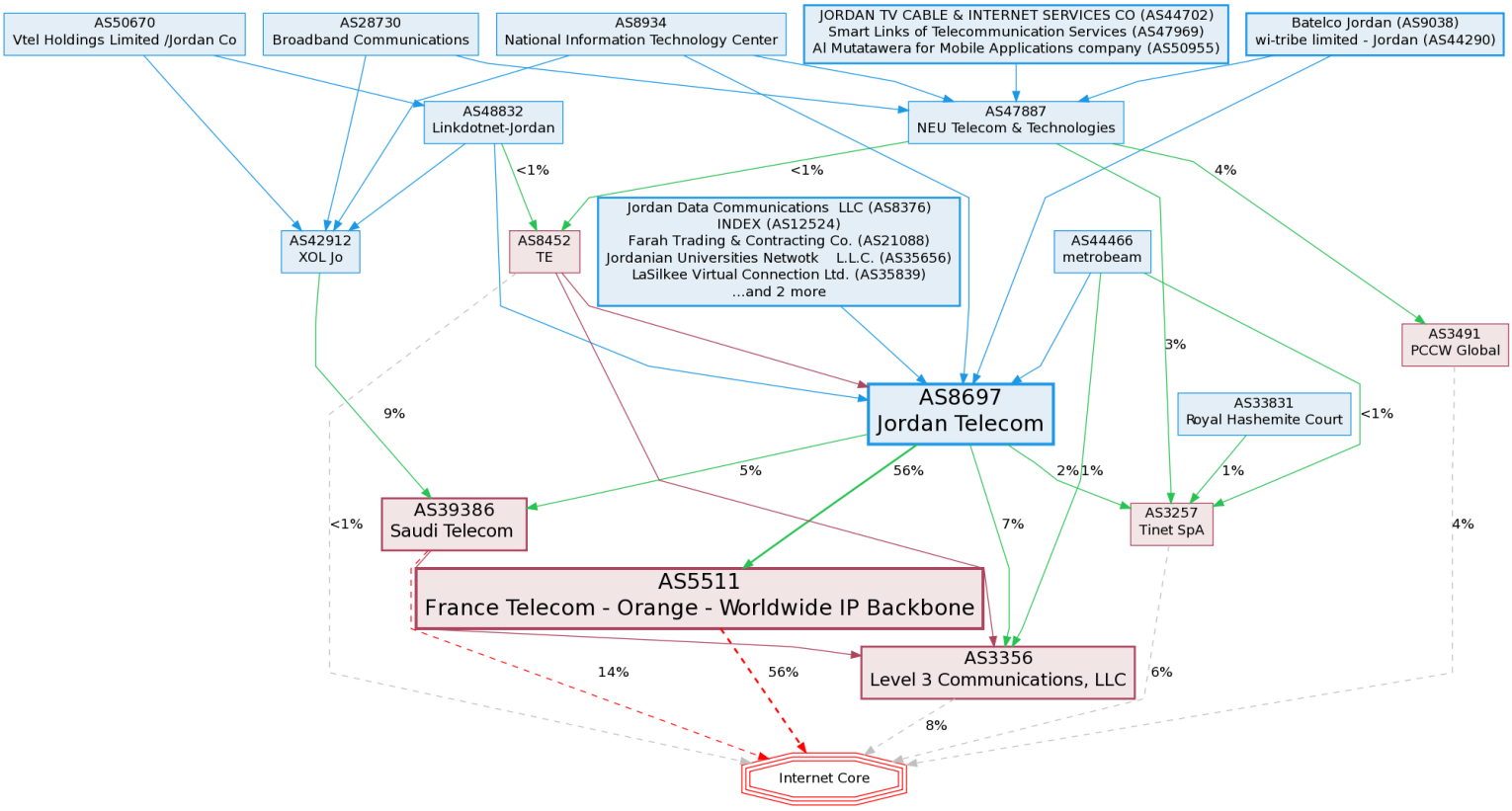
Finally, **Flag** (AS15412**)** also picked up substantial new Bahrain market share at the end of 2010, growing to route nearly 40% of the total transit market within a matter of weeks. **Tata** (AS6453) saw mirror-image declines in their on-net and route-selection percentages, as direct STC and Flag transit became more broadly available to Bahrain's domestic providers.





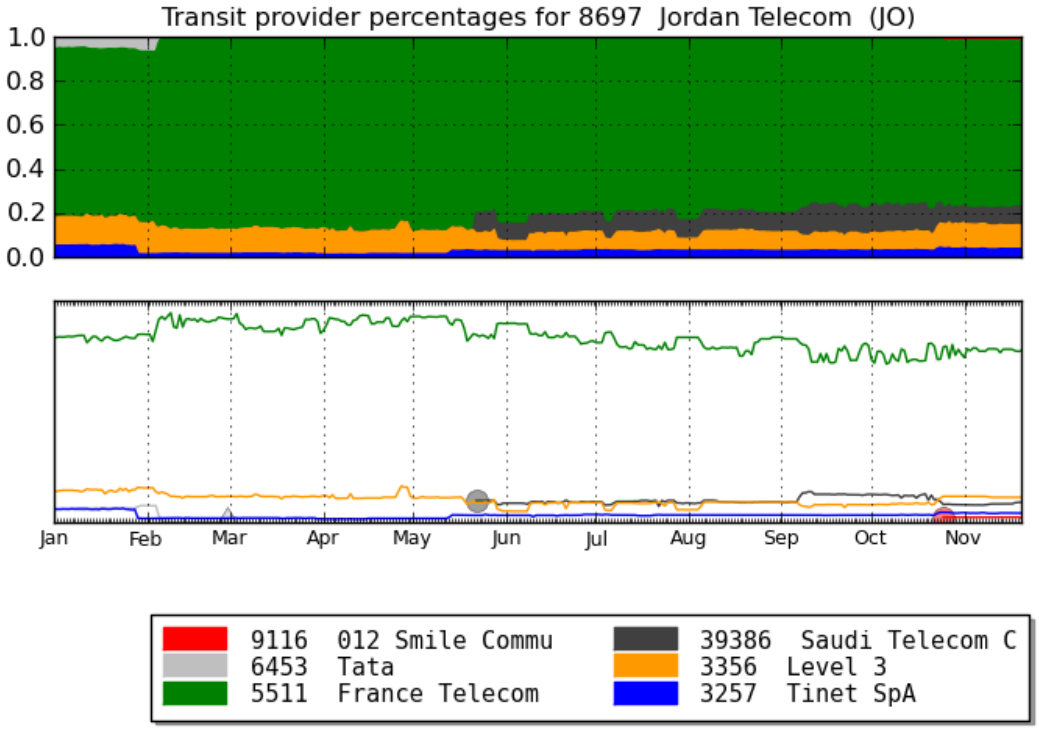
Jordan

Jordan's modern relationship with France Telecom continues to guide the development of its Internet ecosystem (the 90th largest worldwide), with transit from Orange over the Flag FEA cable at Aqaba representing the majority of the country's Internet transit.

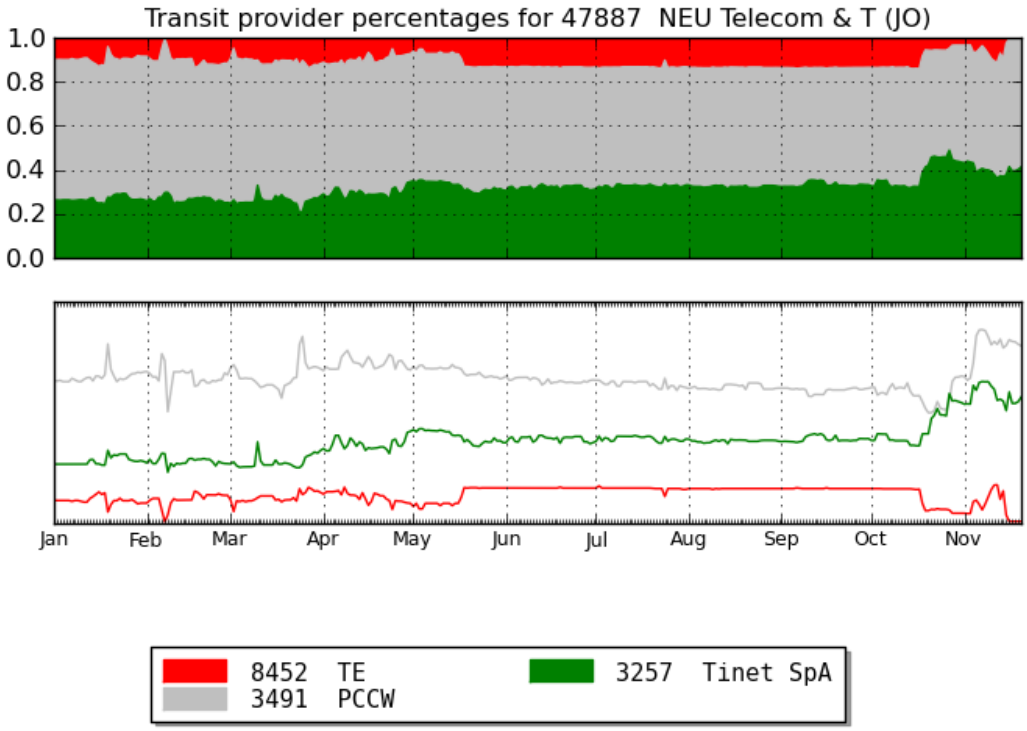


Incumbent **Jordan Telecom** (AS8697), which still has 75% of the national market on-net, serves 13 downstream ASN customers, transits 104 networks on their behalf, and originates 9 IPv4 blocks (plus one IPv6 block) for itself. Besides France Telecom (60%), its transit providers include Level3 (15%), Saudi Telecom (15%), and Tinet (5%).

Critically, Jordan Telecom controls the FLAG landing facility at Aqaba; a second FLAG landing facility, to be managed by competitor Vtel, has been nearing completion for the last year and may improve competing providers' access to international IP bandwidth. When the JADI-Link project reaches fruition, terrestrial connectivity through Syria to Turkey will likely add Turk Telekom (AS9121) as an additional source of Jordanian transit to Europe.

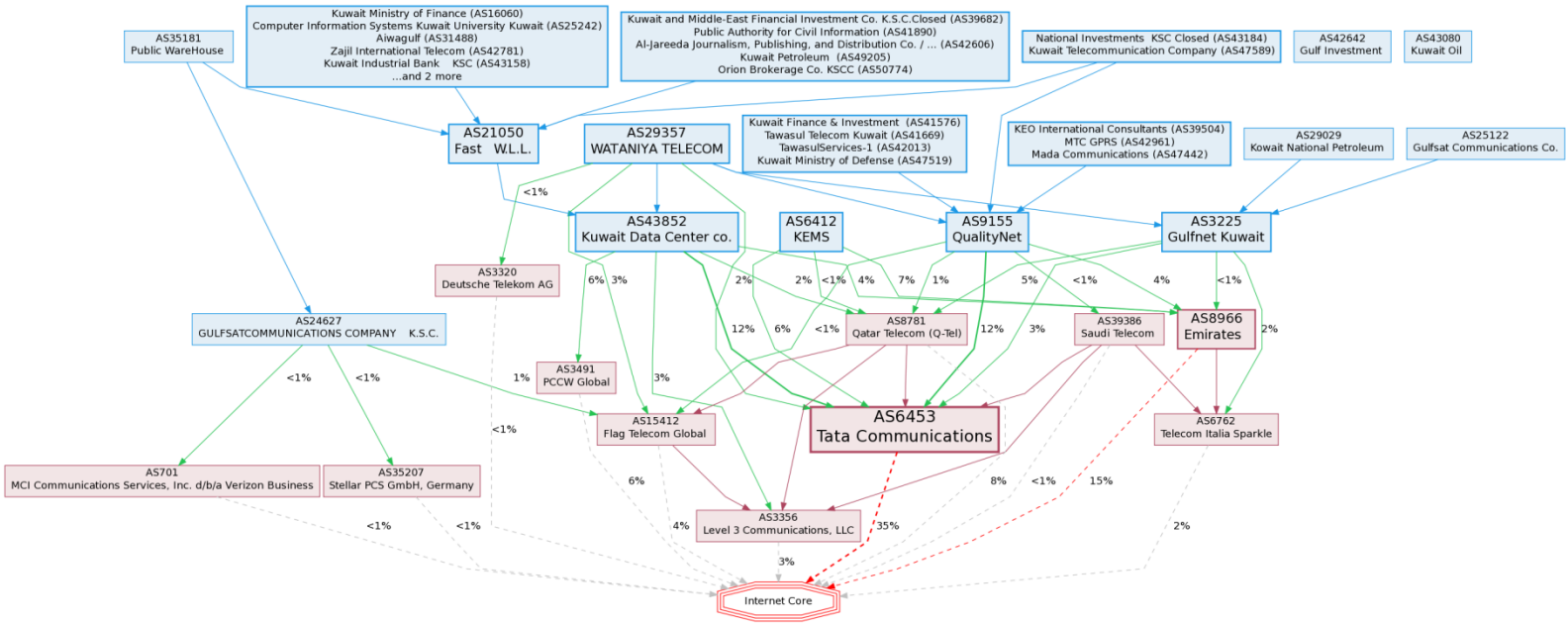


XOL Jordan (AS42912) is a distant second-place competitor, with 14% of the country on-net (4 ASN customers downstream, 6 originated IPv4 networks, 23 transited networks), and a single provider (Saudi Telecom). Another competitor, Neu Telecom (AS47887) comes in just behind XOL, with 8% of the country online (8 ASNs downstream and 43 networks). Neither competitor uses the incumbent for IP connectivity, preferring instead to connect directly with international carriers (Saudi Telecom for XOL, PCCW and TInet for Neu Group).

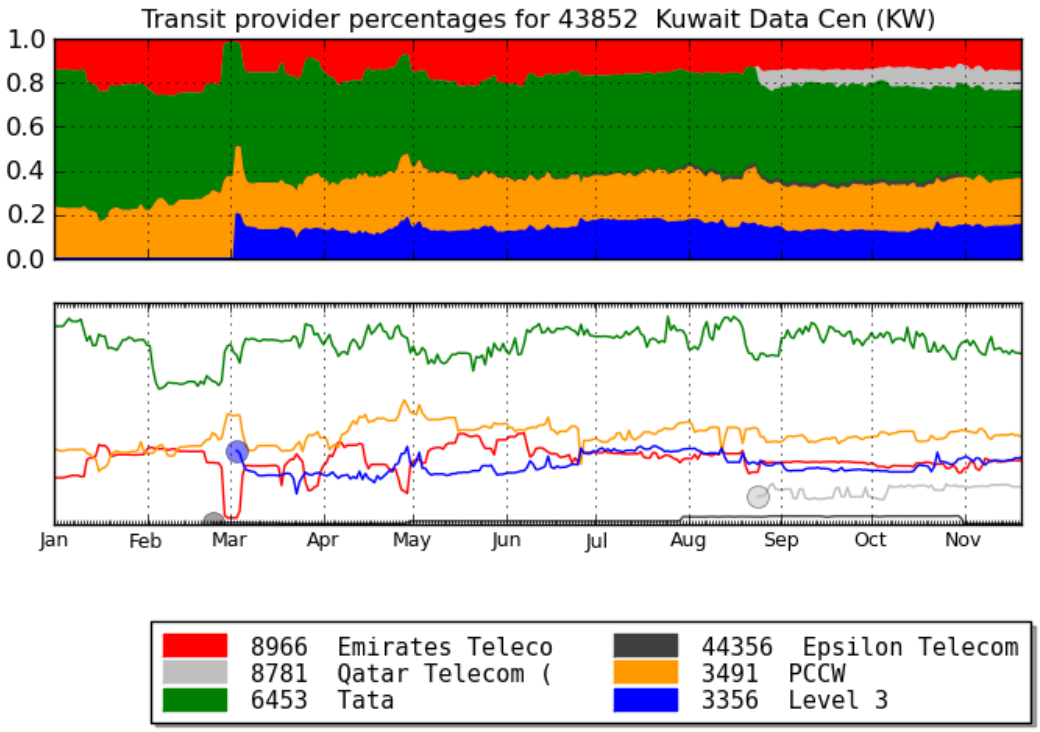


Kuwait

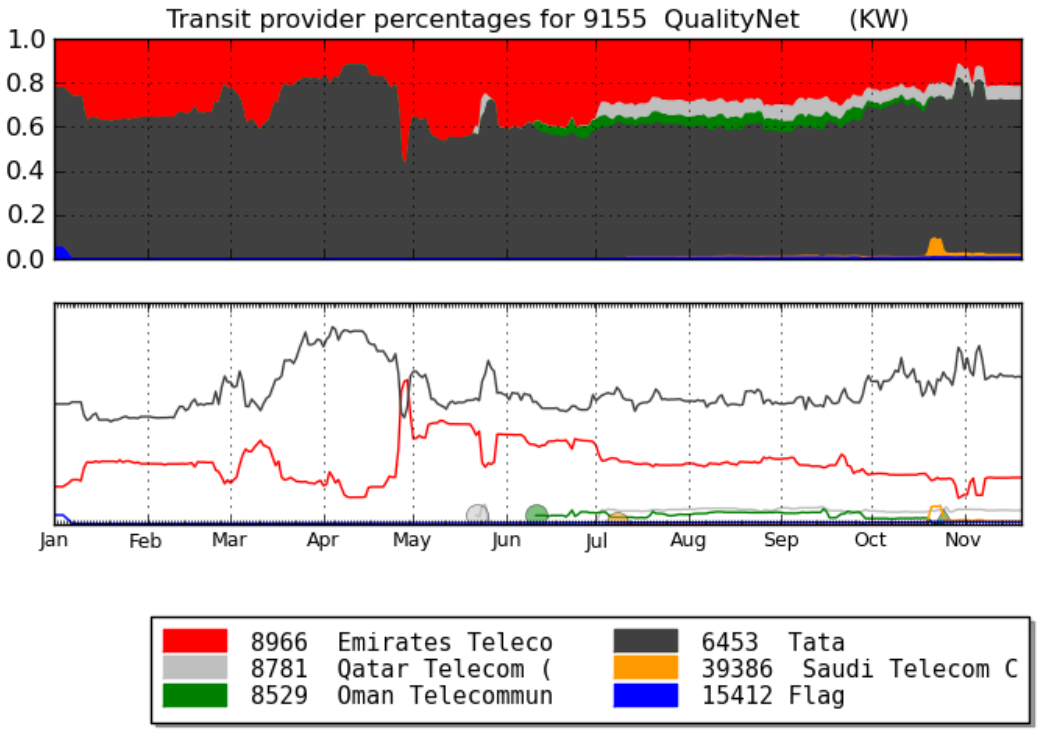
Kuwait's Internet ecosystem is the 63rd largest globally; it is characterized by a fairly large set of competing service providers, none of whom has a dominant share of the domestic market.



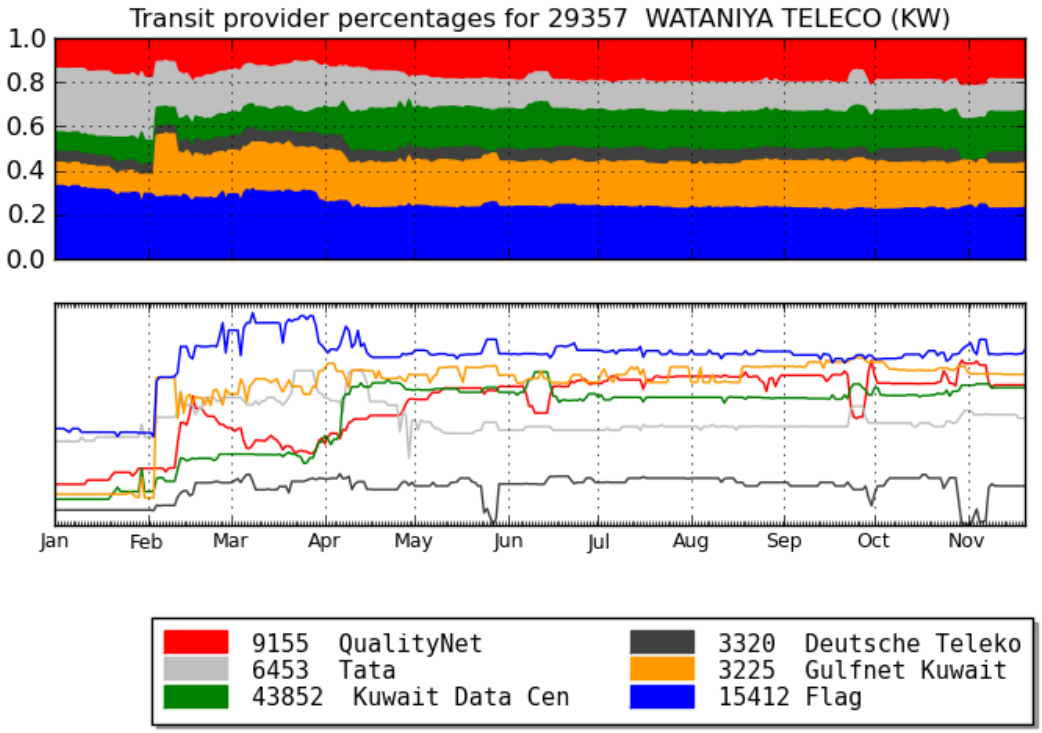
Kuwait Data Center Company (AS43852, with 34% of the domestic market on-net) has 3 ASNs downstream, and 126 networks transited.



QualityNet (AS9155, with 24% of the domestic market on-net) has 11 ASNs downstream, 184 networks originated, and 115 transited.

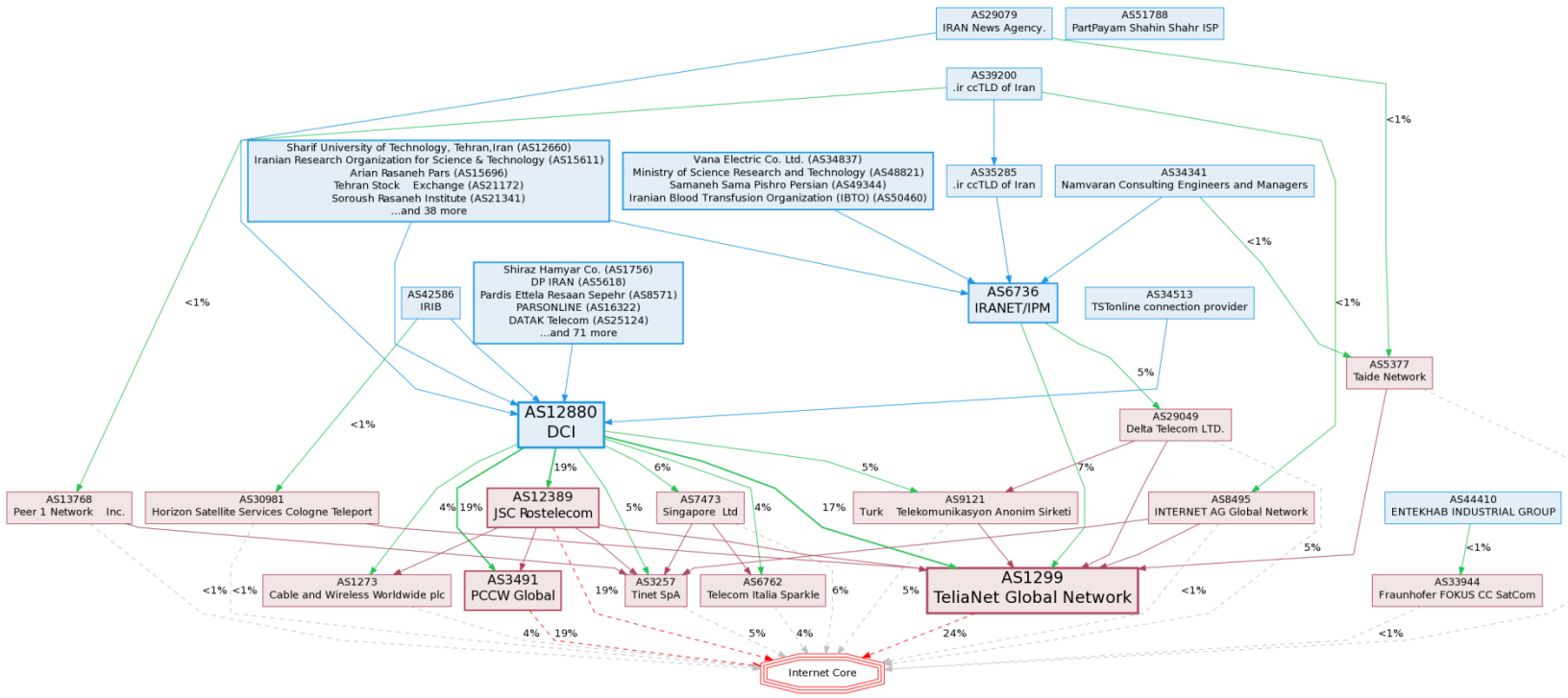


Other Kuwaiti providers with substantial market share include **Gulfnet Kuwait** (AS3225, 19% on-net), **Wataniya** (AS29357, 18%), and **KEMS** (AS6412, 20%). These providers typically get their transit from five or six international and regional providers, including Tata, Level3, PCCW, Emirates, and Q-Tel, and from each other (creating a complex web of ad-hoc bilateral transit and peering arrangements that substitute for a local Internet exchange).

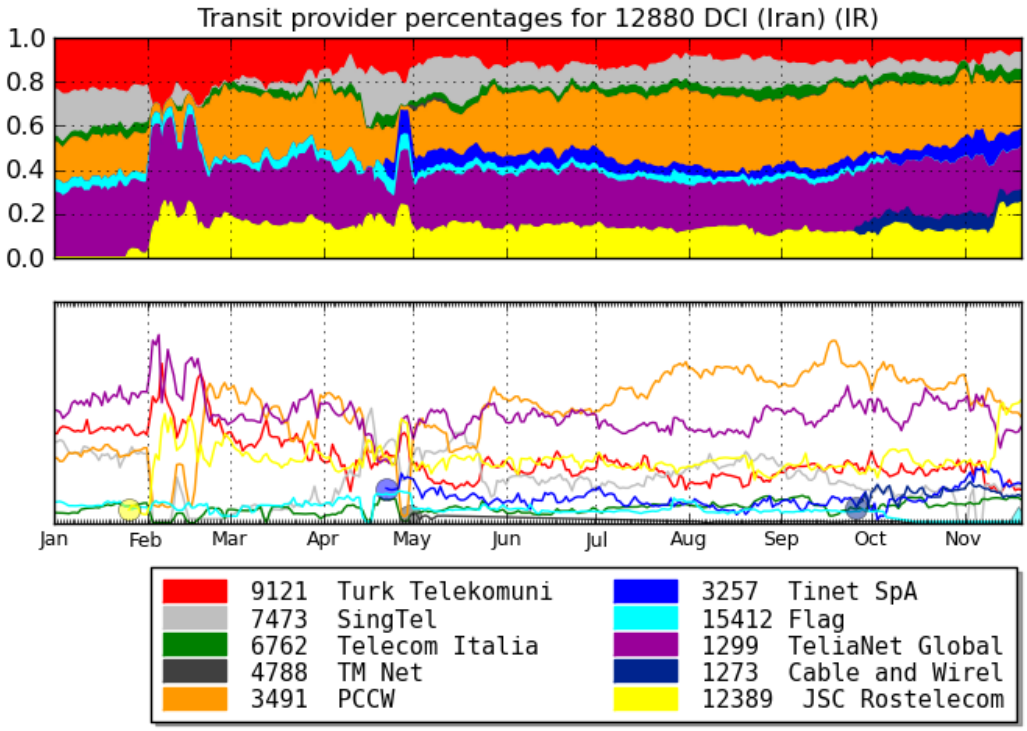


Iran

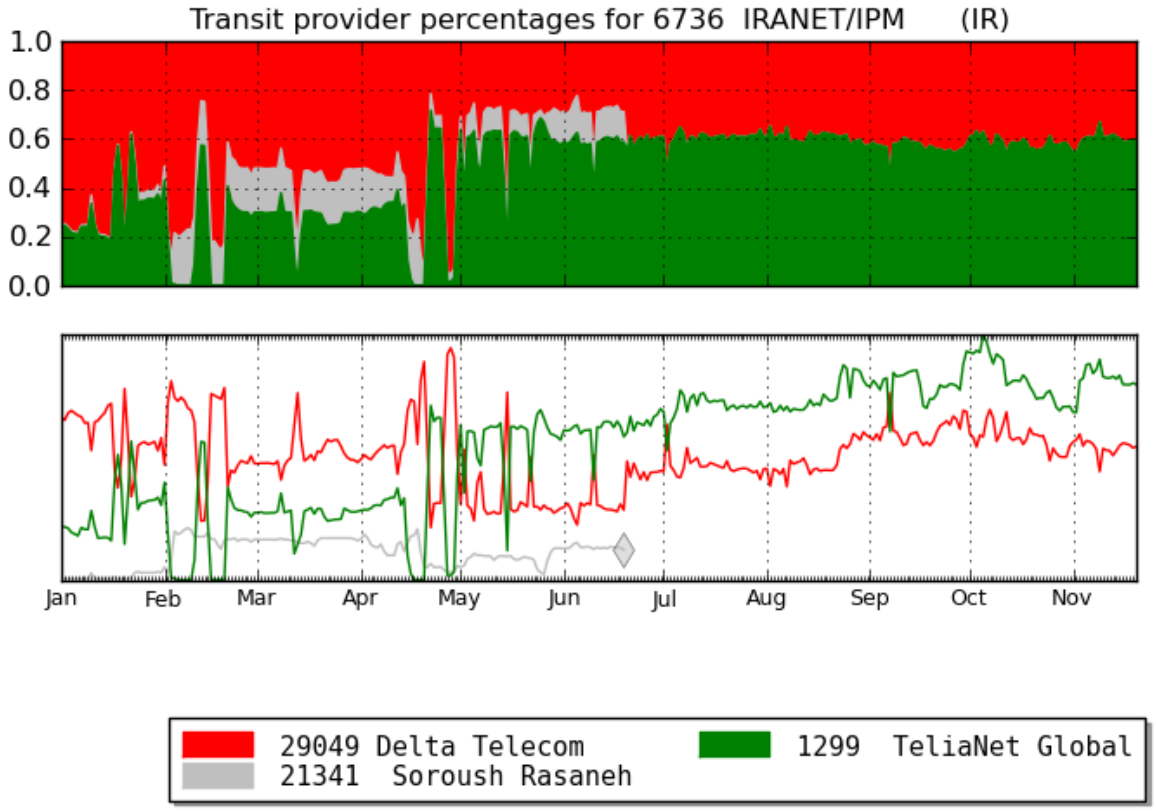
A regional discussion of Internet transit would be incomplete without a look at Iran, the 50th largest Internet ecosystem worldwide. The state-owned telecommunications company, **DCI** (AS12880) is the dominant provider, with 89% of the national market on-net; they serve 76 domestic ASN customers and transit more than 900 IPv4 networks.



Iranian international transit is diverse, with submarine cable connectivity providing the incumbent with access to Telia, PCCW, Tinet (since March 2010), Singtel, Cable and Wireless (since August 2010), TI Sparkle, Telecom Malaysia (since June 2010), and Flag. Terrestrial fiber connectivity in the north provides additional geographic diversity, with significant transit from both Turk Telekom and (since January 2010) Russia's Rostelecom. Indeed, today Rostelecom has become the most important international carrier serving the Iranian market.

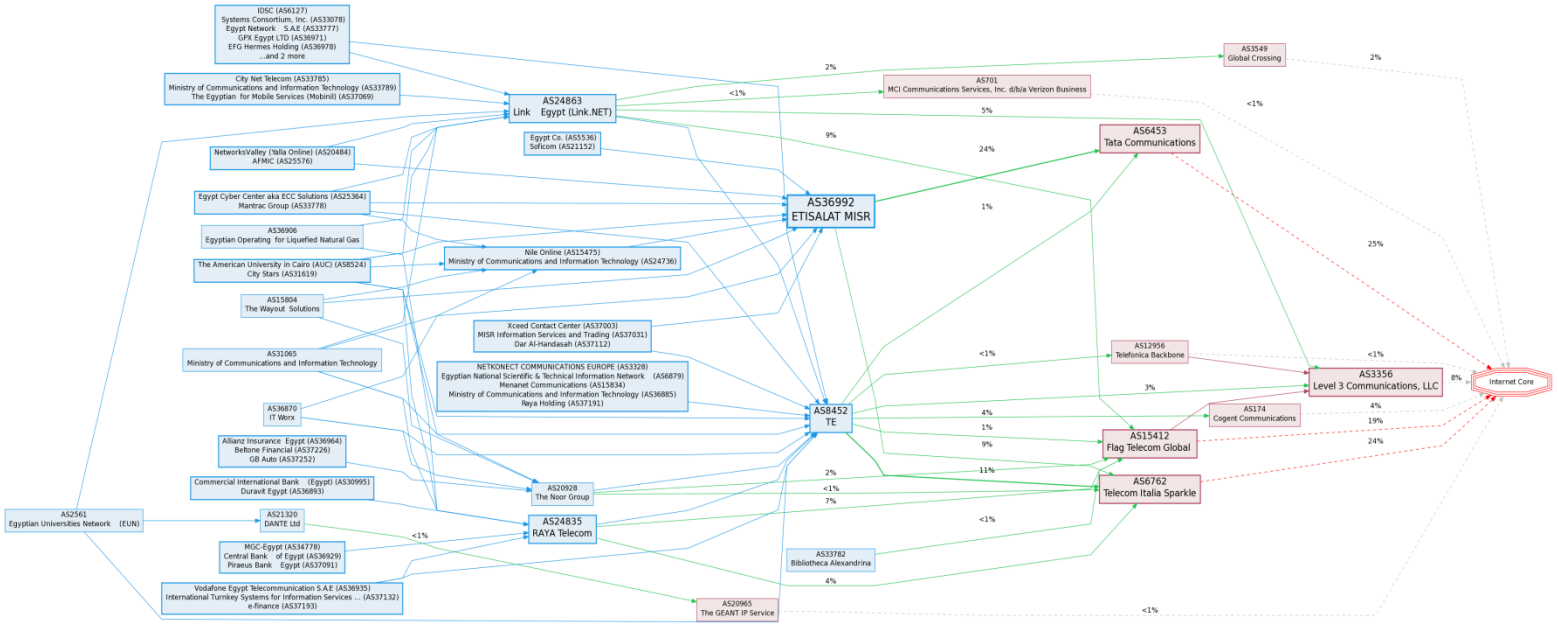


Beyond DCI, international transit for Iran is scarce but growing. **Iranet/IPM** (AS6736, with 18% of the Iranian market on-net) is a distant second, with 19 ASNs downstream and 248 networks transited. Iranet receives international transit from Azeri Delta Telecom (60%) and Telia (40%).

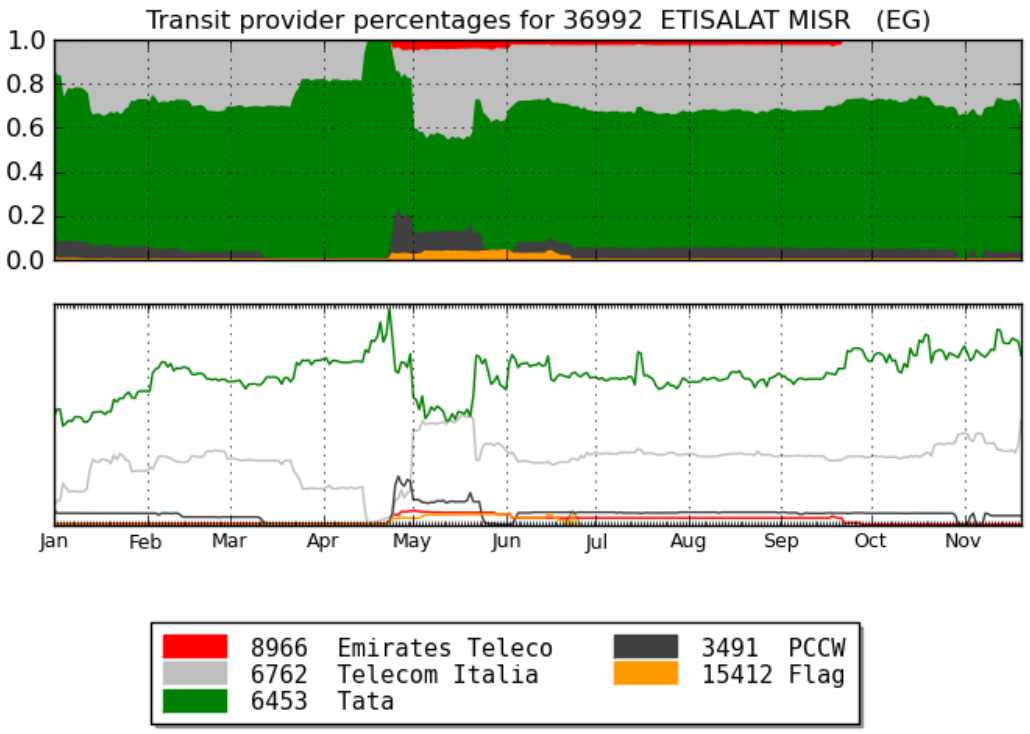


Egypt

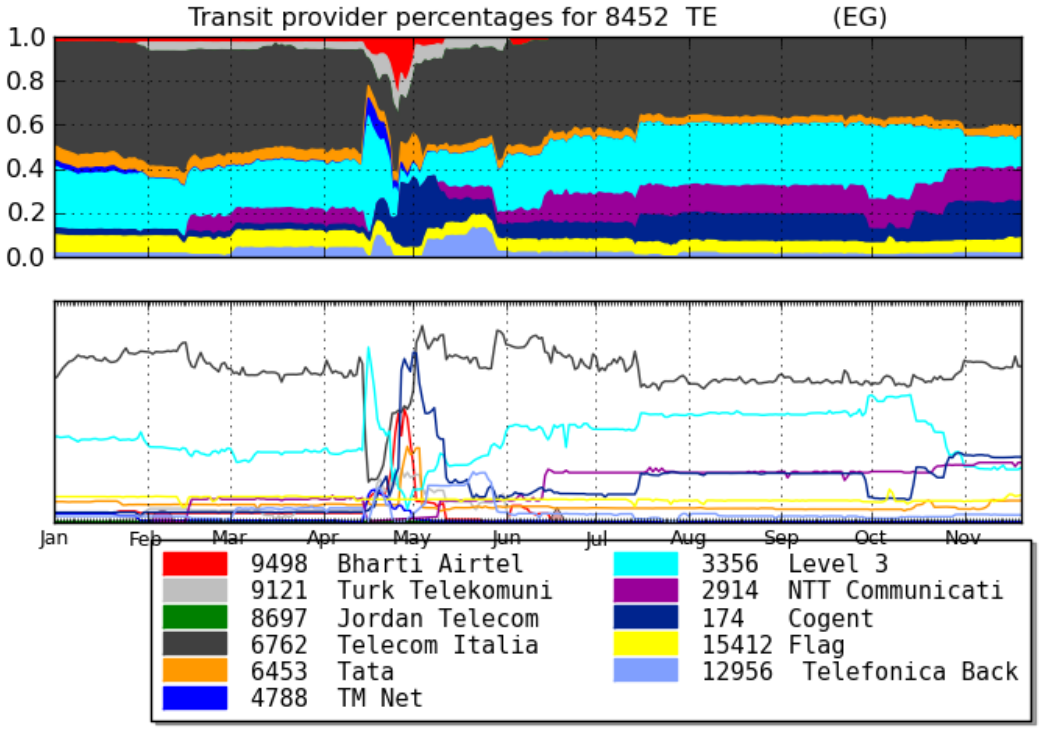
Egypt's Internet ecosystem (ranked 47th globally) is similar in size to Iran's, but exhibits significantly higher domestic diversity.



Etisalat Misr (AS36992, with 37% of the Egyptian market on-net) has 14 ASN customers, 648 networks originated, and 252 transited. International transit is balanced between TI Sparkle and Tata, with minor contributions from PCCW and Emirates.

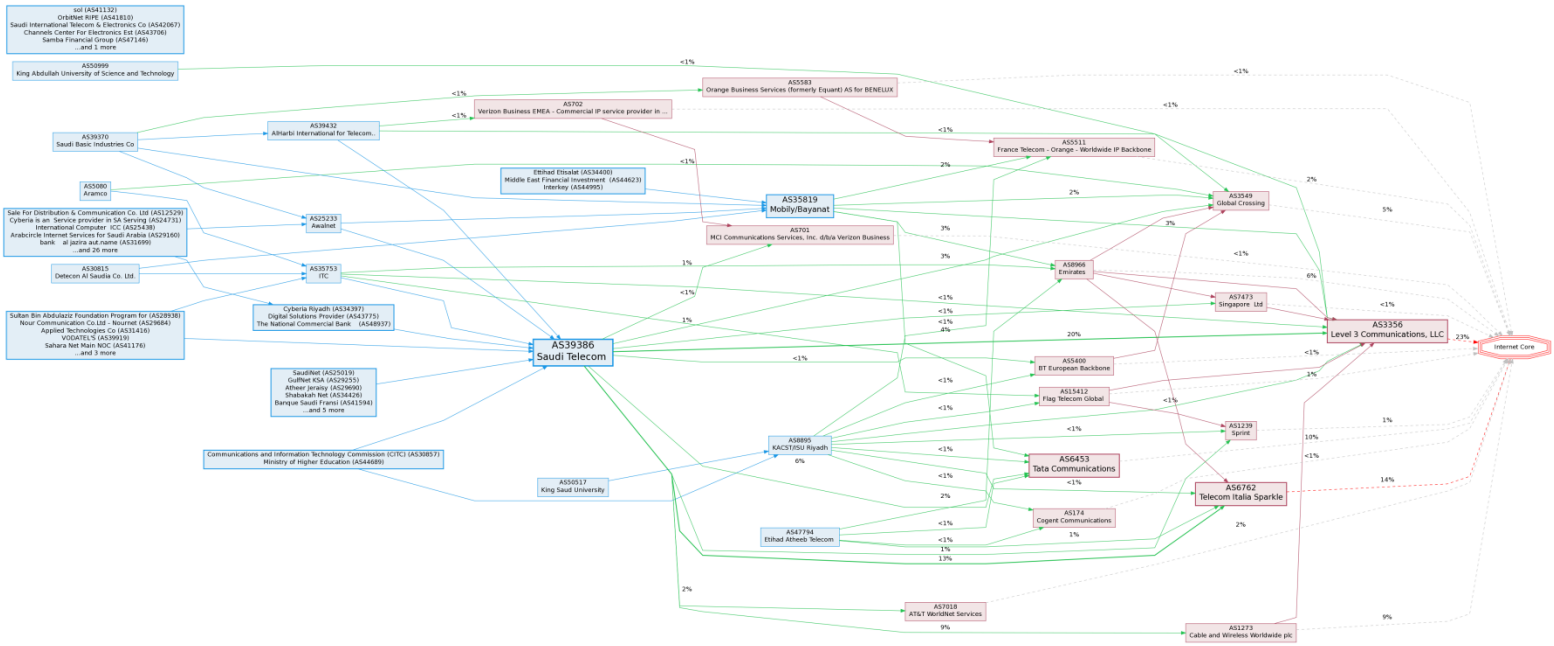


The incumbent, **Telecom Egypt** (AS8452, 31% on-net) has 30 ASN customers, originates 1114 IPv4 networks (plus 1 IPv6), and transits 552 more. International transit is broadly distributed across TI Sparkle (40%), Level3 (15%), Cogent (15%), NTT (15%), Tata (5%), TM Net (5%), and Flag (5%). This transit blend has been largely stable in recent years, except during times of crisis (such as the April 2010 SMW4 shunt fault incident, clearly visible in the transit shift plot below).

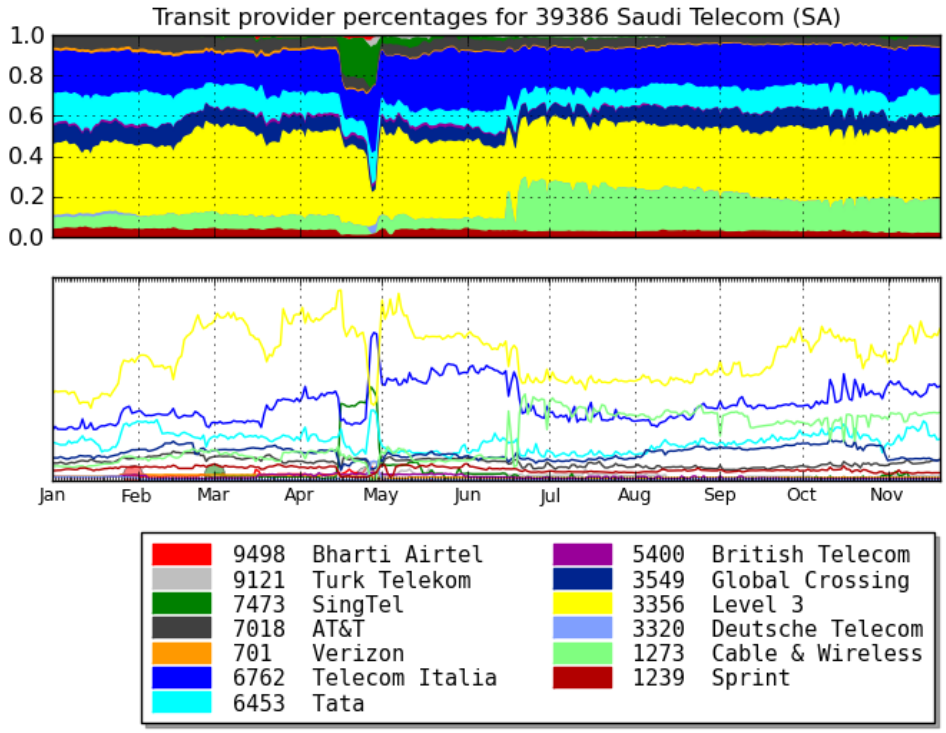


Saudi Arabia

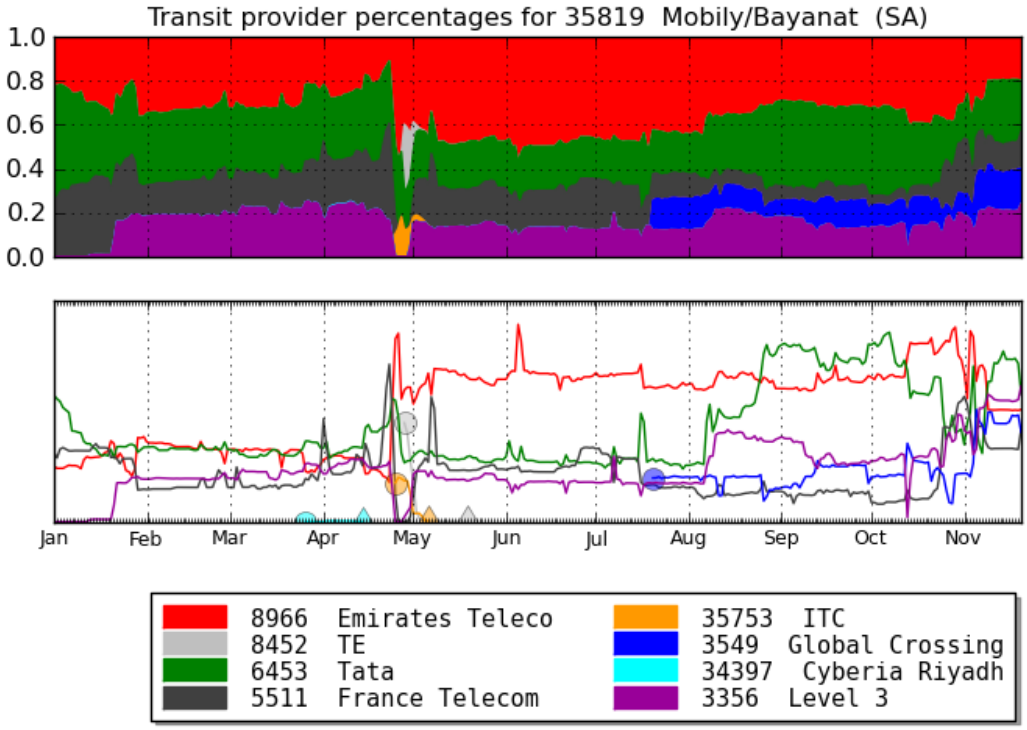
The 44th largest Internet ecosystem in the world belongs to Saudi Arabia.



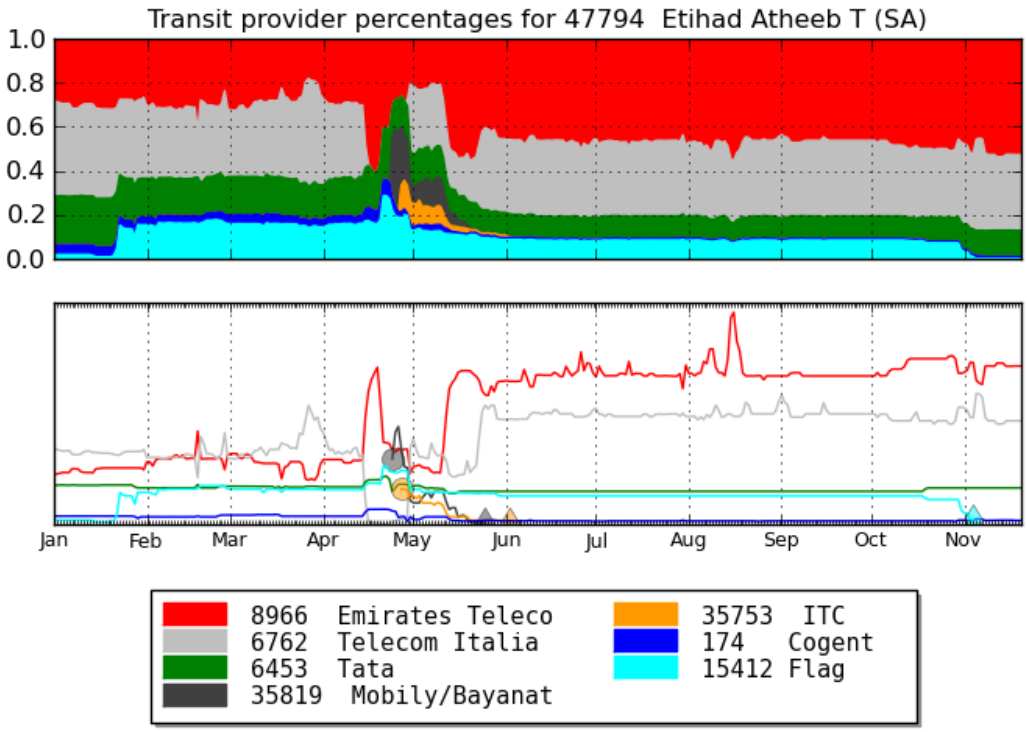
Incumbent **Saudi Telecom** (AS39386) maintains a dominant share of 68% of the domestic market. STC originates 10 IPv4 networks and 1 IPv6 network, transits 703 networks on behalf of 37 ASN customers, and maintains a very broad set of 13 international service providers (see transit shift plot below).



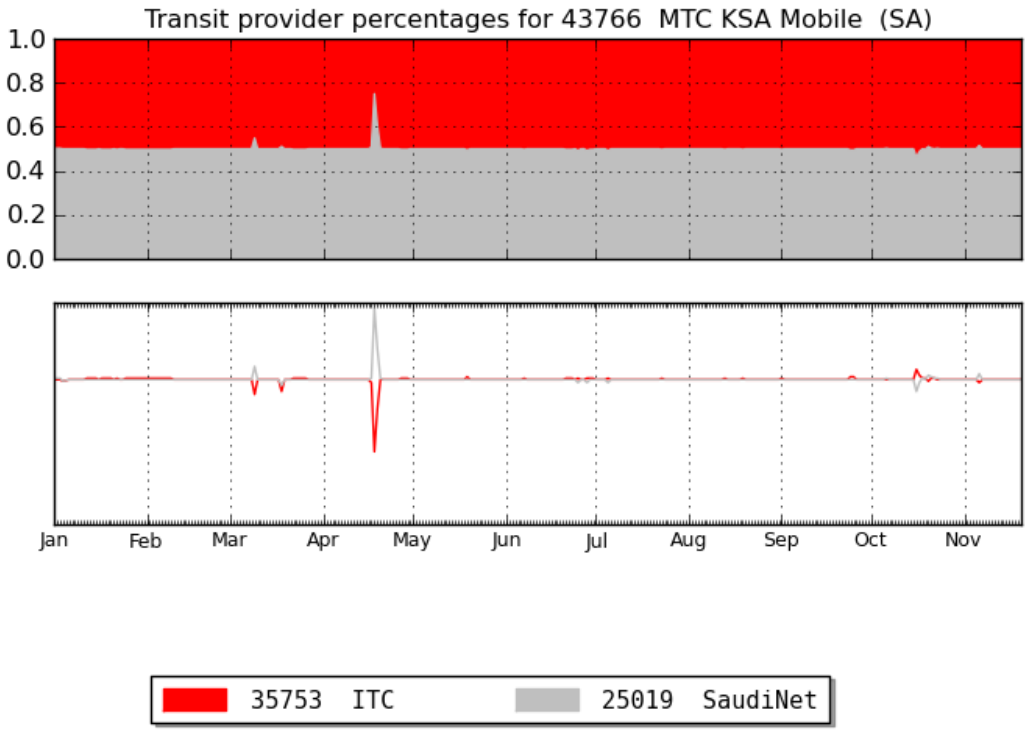
Mobily/Bayanat (AS35819), STC's primary domestic competitor, is a distant second, with only 18% of the domestic market on-net. Mobily provides service to 17 downstream ASNs, originates 206 IPv4 and 2 IPv6 networks, and transits 159 networks. Its providers include France Telecom (25%), Tata (25%), Global Crossing (20%, new since May 2010), Level3 (20%), and Emirates (10%).



Etihad Atheeb (AS47794) comes in an even more distant third in the Saudi market, with nobody downstream and 44 self-originated networks, totaling 6% of the domestic market on-net.

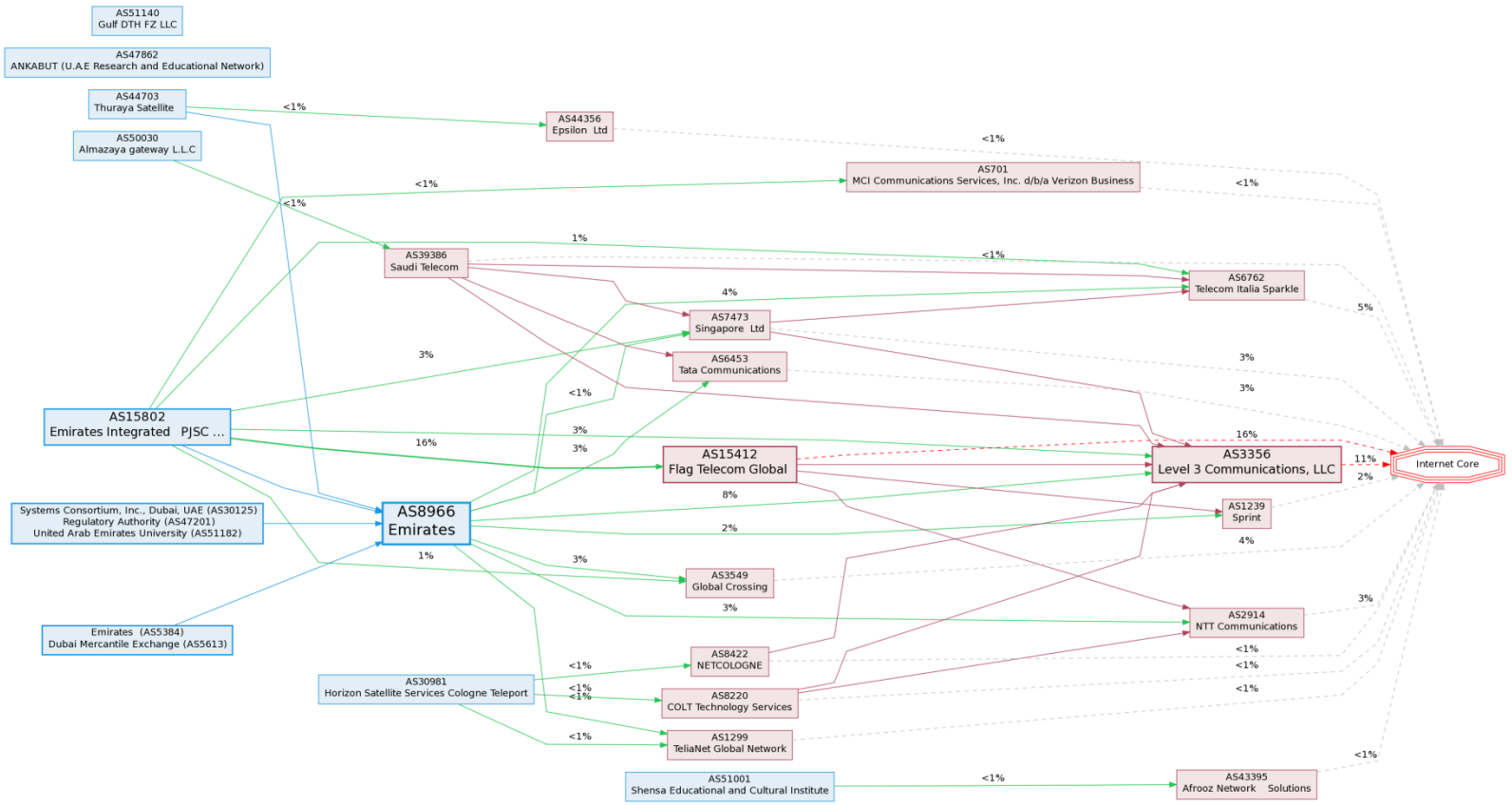


As an example of a smaller Saudi provider, **Zain KSA** (AS43766) originates four Saudi prefixes, splitting its transit between STC and ITC.



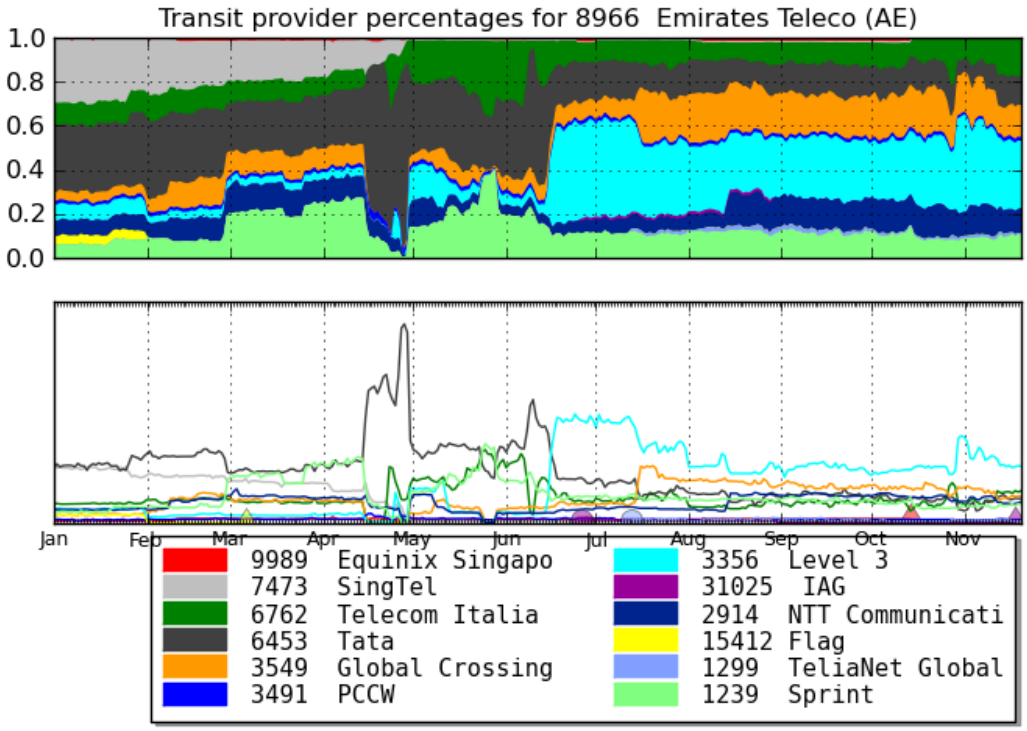
United Arab Emirates

The UAE has, by some measures, the largest regional Internet ecosystem (ranked 40th globally), though certainly not the most diverse. The Internet transit market consists of a duopoly between two largely state-owned incumbents, Etisalat and Du.



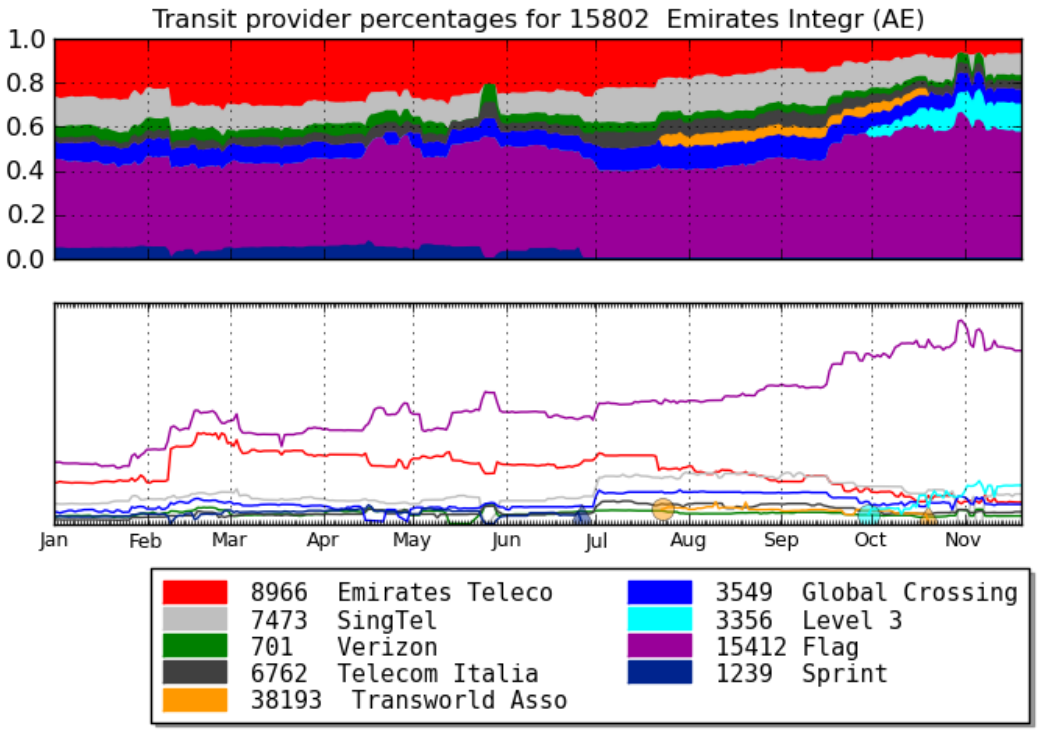
Emirates Telecom ("Etisalat," AS8966) is the dominant half of the duopoly, with 98% of the domestic Internet transit market on-net. Region-wide, they serve 19 ASN customers downstream, and over 840 transited networks. Domestically, there are only a few ASNs downstream, including the TRA, competing incumbent Du, Emirates Internet (AS5384, operated by Etisalat), and the ISC's Dubai instance of the F-root server.

International transit diversity, on the other hand, is very strong, thanks to the landings of every major regional and consortium-based submarine cable. In 2010, Level3's contribution grew most strongly, after a brief outage during the April shunt fault.



Emirates Integrated Telecom ("Du", AS15802) provides some internal competition to Etisalat, and has 28% of the domestic market on-net. They originate 127 IPv4 prefixes, and offer Internet transit service to the Dubai Mercantile Exchange (AS5613), but have no other autonomous system customers downstream.

Like Etisalat, Du enjoys significant international transit diversity, and has steadily increased the proportion of its routes selected through direct international providers, while reducing its visibility through its competitor. Flag has been the largest beneficiary of this process in 2010, and now appears in nearly 60% of selected routes for Du, with newcomer Level3 picking up another 10% in the last months of 2010.



Regional Trends in Internet Transit Markets

To begin to summarize some of the trends exposed in these brief country summaries, it's helpful to look at the nation-scale transit picture from two different perspectives:

- international provider strength (measuring diversity available at the cable landing), and
- domestic provider strength (measuring diversity available in the local market).

The following sections contain tables of on-net customer percentages to support both perspectives on the data, looking back over the period 2007-2010.

Market Dominance of International Providers: "On-Net" Percentages

Looking first at international carrier dominance in each market, the "on net" percentages show how much of each national Internet Ecosystem is a customer of each provider over time. A carrier's on-net percentage can rise if it is successful in selling to more customers. The most common cause of a reduction of on-net percentage is the entry of new carriers into the market, leading existing customers to fail to renew existing contracts. However, on-net percentages can also fall even when existing customers are satisfied, if the domestic market is growing quickly and new growth accrues to other competitors. **Note that percentages will sum to more than 100%** in markets where customers have multiple service providers – on-net percentages are upper bounds for route selection percentages.

The following tables list selected on-net percentages for the largest international providers serving each national market, from 2007 through 2010 . "On-net" is computed by dividing a given provider's estimated domestic customer base by the total size of the national market for IP transit. A "domestic provider" is one that originates no more than 30% of its total customer base outside the country.

CC	ASN	NSP	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10	Nov-10
AE	3356	Level 3	59%	50%	30%	33%	40%	46%	49%	54%
AE	3549	Global Crossing	51%	48%	18%	41%	24%	20%	29%	43%
AE	2914	NTT	56%	46%	17%	13%	29%	24%	27%	41%
AE	6762	Telecom Italia Sparkle	35%	36%	27%	25%	40%	29%	40%	39%
AE	1239	Sprint	69%	66%	45%	33%	48%	51%	45%	37%
AE	15412	Flag Telecom	56%	46%	18%	16%	16%	15%	18%	28%
AE	6453	Tata	24%	50%	20%	26%	49%	47%	23%	15%
AE	7473	SingTel	3%	28%	31%	34%	33%	43%	25%	8%
AE	3491	PCCW	21%	41%	17%	26%	3%	2%	2%	1%
BH	**6453**	**Tata**	**93%**	**95%**	**92%**	**99%**	**97%**	**93%**	**93%**	**82%**
BH	1239	Sprint	46%	45%	58%	26%	51%	60%	61%	72%
BH	3356	Level 3	44%	47%	58%	26%	51%	60%	24%	59%
BH	2914	NTT	43%	47%	30%	56%	35%	60%	55%	48%
BH	**15412**	**Flag Telecom**	**42%**	**46%**	**32%**	**26%**	**22%**	**26%**	**20%**	**45%**
BH	6762	Telecom Italia Sparkle			27%		35%	35%	42%	42%
BH	**8966**	**Emirates**			**27%**	**31%**	**35%**	**35%**	**38%**	**28%**
BH	3549	Global Crossing					35%	35%	42%	28%
EG	1239	Sprint	90%	91%	92%	60%	73%	69%	75%	77%
EG	6762	Telecom Italia Sparkle	25%	44%	74%	43%	36%	45%	59%	59%
EG	3356	Level 3	68%	58%	53%	62%	77%	55%	46%	40%
EG	6453	Tata			1%	28%	19%	26%	30%	32%
EG	2914	NTT	68%	58%	49%	45%	51%	32%	22%	28%
EG	15412	Flag Telecom	68%	58%	49%	55%	41%	34%	25%	23%
EG	3549	Global Crossing			1%	10%	15%	12%	13%	8%
EG	701	Verizon Business	37%	12%	6%	8%	10%	7%	3%	3%

CC	ASN	NSP	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10	Nov-10
IQ	3549	Global Crossing	20%	29%	55%	11%	7%	57%	72%	71%
IQ	3356	Level 3	18%	17%	26%	60%	91%	66%	54%	55%
IQ	1299	Telia	3%	9%	13%	35%	34%	41%	47%	45%
IQ	9121	Turk Telekom				8%	17%	21%	29%	40%
IQ	3491	PCCW					1%		20%	25%
IQ	701	Verizon Business	11%	16%	19%	37%	24%	6%	11%	11%
IQ	702	Verizon Business EMEA	9%	8%	19%	28%	24%	6%	11%	11%
IQ	1239	Sprint	9%	29%	49%	36%	46%	57%	35%	8%
IQ	209	Qwest	77%	61%					9%	7%
IQ	22351	Intelsat	9%	8%	9%	18%	13%	6%	7%	7%
IQ	6453	Tata	9%	8%	16%	24%	35%	21%	16%	3%
IQ	2914	NTT	2%	3%	16%	17%	30%	43%	9%	2%
IQ	174	Cogent		8%	6%	19%	7%	15%	8%	
IR	1299	Telia	4%	5%	2%	77%	93%	97%	94%	91%
IR	3549	Global Crossing	79%	38%	26%	64%	80%	72%	72%	61%
IR	3356	Level 3	75%	85%	82%	90%	88%	76%	66%	51%
IR	3491	PCCW	50%	35%	26%	33%	39%	36%	55%	51%
IR	3257	Tinet	2%	4%	31%			32%	65%	44%
IR	3561	Savvis	52%	70%	71%	59%	76%	10%	31%	31%
IR	9121	Turk Telekom	73%	69%	41%	89%	57%	56%	31%	29%
IR	12389	Rostelecom						10%	33%	15%
IR	2914	NTT	84%	88%	60%	47%	39%	20%	3%	14%
IR	6762	Telecom Italia Sparkle	82%	89%	62%	80%	56%	41%	25%	8%
IR	1239	Sprint	91%	89%	69%	87%	70%	48%	27%	8%
IR	7473	SingTel	43%	69%	71%	61%	76%	50%	41%	6%
IR	15412	Flag Telecom	63%	66%	37%	58%	39%	12%	3%	
JO	5511	France Telecom - Orange	97%	100%	98%	100%	88%	85%	77%	75%
JO	3356	Level 3	1%				27%	28%	29%	37%
JO	39386	Saudi Telecom					1%	5%	36%	31%
JO	7018	AT&T						5%	35%	27%
JO	6762	Telecom Italia Sparkle	3%				9%	12%	30%	26%
JO	1239	Sprint	94%			49%	30%	30%	24%	23%
JO	3561	Savvis	13%					5%	5%	22%
JO	6453	Tata		14%	21%	49%	21%	24%	22%	20%
JO	3257	Tinet				49%	21%	30%	21%	19%
JO	8452	Telecom Egypt	1%	1%	1%	1%	10%	8%	9%	10%

JO	3549	Global Crossing					9%	12%	22%	5%
JO	3491	PCCW	13%				8%	7%	8%	4%
CC	**ASN**	**NSP**	**Jul-07**	**Jan-08**	**Jul-08**	**Jan-09**	**Jul-09**	**Jan-10**	**Jul-10**	**Nov-10**
KW	6453	Tata	59%	59%	60%	75%	74%	78%	72%	76%
KW	1239	Sprint	53%	41%	49%	36%	51%	57%	44%	54%
KW	3549	Global Crossing	48%	56%	3%	25%	51%	64%	60%	48%
KW	6762	Telecom Italia Sparkle	39%	30%	44%	10%	41%	56%	49%	41%
KW	8966	Emirates	38%	32%	47%	60%	42%	57%	51%	39%
KW	3356	Level 3	47%	39%	38%	46%	49%	57%	40%	35%
KW	2914	NTT	43%	38%	36%	31%	41%	59%	49%	25%
KW	15412	Flag Telecom	43%	38%	37%	37%	9%	14%	11%	21%
KW	3491	PCCW	15%	55%	1%	11%	8%	14%	18%	16%
KW	7473	SingTel		17%	34%	33%	36%		19%	5%
KW	1273	Cable and Wireless	38%							2%
KW	3561	Savvis	56%		31%	29%	36%			2%
KW	701	Verizon Business	51%	30%	7%	1%	1%			
LB	3356	Level 3	63%	78%	76%	66%	71%	77%	88%	86%
LB	7018	AT&T				36%	51%	52%	52%	48%
LB	1299	Telia	36%	40%	57%	44%	31%	28%	32%	28%
LB	3549	Global Crossing	32%	68%	64%	52%	28%	31%	31%	23%
LB	6453	Tata	6%	1%			2%	1%	17%	14%
LB	3491	PCCW	32%	47%	35%	27%	11%	9%	9%	10%
LB	1239	Sprint	59%	64%	55%	23%	32%	11%	11%	6%
LB	2914	NTT	48%	46%	35%	1%	11%	7%	6%	6%
LB	30721	SatGate	8%	11%	38%	40%	21%	22%	20%	5%
LB	8764	TEO LT AB	8%	11%	38%	37%	21%	22%	20%	5%
LB	12989	Eweka Internet			3%	6%	1%	17%	20%	5%
LB	15412	Flag Telecom	48%	59%	35%	13%	9%	6%	5%	5%
LB	174	Cogent	1%	3%	8%	1%	17%	17%	18%	4%
LB	3257	Tinet		4%	19%	17%	19%	3%	3%	1%
OM	6762	Telecom Italia Sparkle	98%	100%	100%	25%	68%	83%	99%	100%
OM	3491	PCCW	98%	100%	100%	100%	88%	93%	96%	97%
OM	3549	Global Crossing	98%	100%	100%	100%	88%	100%	96%	97%
OM	1239	Sprint	98%	100%	100%		60%	55%	96%	97%
OM	3257	Tinet						13%	94%	95%
OM	286	KPN						90%	86%	87%
OM	3356	Level 3			56%	91%	76%	90%	90%	85%
OM	7473	SingTel		100%	68%	85%	76%	70%	75%	82%
OM	9121	Turk Telekom							1%	62%
OM	4755	Tata						77%	86%	

CC	ASN	NSP	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10	Nov-10
QA	8781	Qatar Telecom (Q-Tel)	83%	83%	85%	75%	98%	99%	99%	99%
QA	6453	Tata	85%	95%	93%	98%	96%	92%	86%	98%
QA	3356	Level 3	66%	67%	55%	82%	65%	91%	85%	92%
QA	6939	Hurricane Electric					18%	51%	77%	87%
QA	1239	Sprint	66%	77%	41%	79%	46%	91%	70%	81%
QA	15412	Flag Telecom	66%	63%	41%	79%	50%	85%	69%	80%
QA	2914	NTT	66%	63%	41%	79%	45%	82%	23%	80%
QA	7018	AT&T			58%		56%	68%	52%	55%
QA	7473	SingTel		72%	52%	76%	50%	68%	57%	
SA	1239	Sprint	90%	93%	90%	84%	78%	80%	83%	81%
SA	3356	Level 3	52%	23%	22%	46%	64%	78%	78%	79%
SA	6762	Telecom Italia Sparkle	81%	89%	82%	78%	80%	77%	81%	78%
SA	6453	Tata	62%	80%	82%	78%	68%	76%	72%	76%
SA	7018	AT&T	64%	77%	74%		51%	57%	51%	53%
SA	3561	Savvis	36%	8%	15%	10%	32%	22%	60%	53%
SA	3549	Global Crossing	40%	13%	16%	85%	71%	71%	74%	48%
SA	701	Verizon Business	89%	62%	52%	6%	46%	49%	26%	17%
SY	6762	Telecom Italia Sparkle	42%	97%	87%	57%	69%	28%	4%	
SY	1299	Telia				22%	14%	65%	59%	
SY	1239	Sprint	42%	97%	87%	15%	69%	22%	57%	65%
SY	3491	PCCW	53%	63%	54%	36%	37%	41%	44%	30%
SY	3549	Global Crossing	53%	63%	52%	36%	44%	41%	52%	25%
SY	3320	Deutsche Telekom							57%	60%
SY	9121	Turk Telekom	54%	50%	46%	22%	14%	65%	59%	
SY	3356	Level 3				22%	7%	9%	51%	
SY	6453	Tata	4%	3%	58%	84%	40%	38%	13%	16%

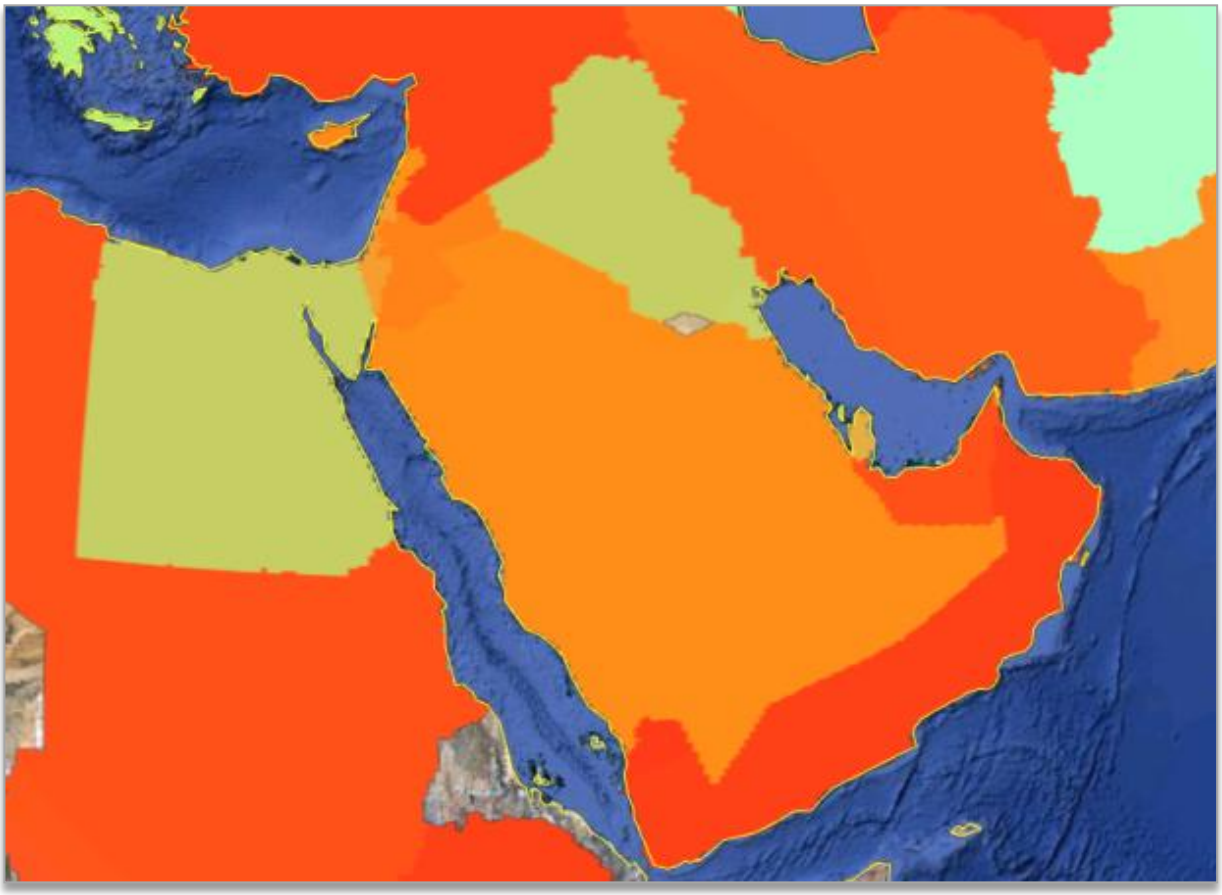
Market Dominance of Domestic Providers: "On-Net" Percentages

Similarly, one can compute the on-net percentages for the largest domestic providers in each national market. In the tables of domestic provider on-net numbers on the following pages, note that **Iran, Syria, the UAE, Qatar,** and **Oman** 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.

Jordan, Lebanon and **Saudi Arabia** are intermediate cases, whose incumbent provider still 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.

Kuwait, Egypt, Iraq, and **Bahrain** all 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.

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.



CC	ASN	NSP	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10	Nov-10
AE	**8966**	**Etisalat**	**90%**	**92%**	**93%**	**97%**	**97%**	**98%**	**98%**	**98%**
AE	5384	Emirates Internet (Etisalat)	71%	77%	82%	78%	79%	80%	71%	70%
AE	15802	Emirates Integrated Telecom (Du)	26%	21%	16%	20%	19%	19%	28%	28%
BH	**5416**	**BATELCO-BH**	**41%**	**45%**	**55%**	**40%**	**34%**	**31%**	**27%**	**26%**
BH	31452	Zain Bahrain	4%	4%	7%	24%	27%	27%	33%	28%
BH	39015	Menatelecom	2%	2%	1%	5%	10%	15%	17%	22%
BH	35019	Bahrain Internet Exchange	51%	45%	31%	32%	36%	26%	21%	17%
EG	**8452**	**TE**	**34%**	**55%**	**80%**	**82%**	**51%**	**39%**	**34%**	**31%**
EG	36992	ETISALAT MISR	--	--	--	--	18%	25%	34%	37%
EG	24863	Link Egypt (Link.NET)	25%	19%	19%	21%	31%	33%	27%	25%
EG	24835	RAYA Telecom	24%	29%	27%	24%	20%	14%	16%	17%
EG	15475	Nile Online	19%	14%	10%	13%	12%	14%	7%	9%
IQ	21277	Newroz Telecom Ltd.	--	--	--	8%	17%	21%	26%	**40%**
IQ	---	US DoD	77%	72%	49%	--	--	29%	20%	19%
IQ	44217	IQ Networks	--	--	--	--	--	--	12%	18%
IQ	49571	CellNet ltd ASN block	--	--	--	--	--	10%	10%	10%
IQ	50597	ScopeSky Communication	--	--	--	--	--	--	--	8%
IR	**12880**	**DCI**	**90%**	**91%**	**94%**	**98%**	**94%**	**92%**	**90%**	**89%**
IR	6736	IRANET/IPM	3%	2%	4%	5%	9%	11%	14%	18%
IR	21341	Soroush Rasaneh Institute	16%	13%	14%	15%	16%	13%	10%	8%
IR	34513	TSTonline	11%	9%	2%	1%	2%	3%	2%	2%
JO	**8697**	**Jordan Telecom**	**97%**	**100 %**	**100 %**	**100 %**	**88%**	**85%**	**77%**	**75%**
JO	8376	Jordan Data Communications	34%	38%	36%	46%	41%	44%	37%	37%
JO	42912	XOL Jo	--	--	--	--	1%	5%	11%	14%
JO	9038	Batelco Jordan	9%	16%	15%	12%	11%	8%	8%	8%

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

CC	ASN	NSP	Jul-07	Jan-08	Jul-08	Jan-09	Jul-09	Jan-10	Jul-10	Nov-10
KW	43852	Kuwait Data Center co.	--		--	27%	23%	30%	33%	**34%**
KW	9155	QualityNet	27%	26%	28%	28%	20%	25%	26%	24%
KW	21050	Fast W.L.L.	24%	19%	17%	20%	20%	19%	19%	20%
KW	6412	KEMS	22%	24%	26%	22%	26%	23%	21%	20%
KW	3225	Gulfnet Kuwait	18%	24%	20%	13%	17%	16%	15%	19%
KW	29357	WATANIYA TELECOM	1%	5%	5%	9%	9%	9%	18%	18%
LB	**42020**	**Liban Telecom**	**--**	**40%**	**30%**	**45%**	**66%**	**64%**	**63%**	**68%**
LB	42003	OGERO Telecom	18%	26%	21%	23%	42%	42%	46%	51%
LB	20535	InSat GmbH	--	4%	3%	2%	2%	3%	6%	18%
LB	39010	TerraNet sal	25%	19%	20%	17%	17%	18%	16%	14%
LB	8261	Archway	--	--	--	--	--	12%	14%	13%
LB	24634	Cyberia	14%	18%	14%	12%	13%	13%	11%	10%
OM	**8529**	**OmanTel**	**98%**	**100%**	**100%**	**100%**	**100%**	**100%**	**99%**	**100%**
OM	28885	OmanTel NAP	98%	100%	91%	100%	100%	100%	86%	87%
OM	50010	Omani Qatari	--	--	--	--	--	--	13%	13%
QA	**8781**	**Qatar Telecom**	**83%**	**83%**	**85%**	**75%**	**98%**	**99%**	**99%**	**99%**
QA	29384	Qatar Foundation	17%	16%	14%	15%	15%	15%	12%	12%
SA	**39386**	**Saudi Telecom Company**	**70%**	**80%**	**79%**	**75%**	**65%**	**67%**	**72%**	**68%**
SA	25019	SaudiNet	17%	17%	24%	26%	31%	31%	48%	49%
SA	35819	Mobily/Bayanat	2%	2%	2%	6%	18%	15%	12%	18%
SA	34400	Ettihad Etisalat		4%	8%	7%	10%	11%	8%	11%
SY	**29386**	**Syrian Telecom**	**54%**	**63%**	**64%**	**52%**	**66%**	**84%**	**99%**	**99%**
SY	24814	SCS	42%	34%	32%	44%	33%	27%	28%	28%

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

Middle East Internet Index Ratings

Customer Base: Wholesale — Middle East

1		Emirates Telecommunications Corporation	8966
2		Tinet SpA	3257
3		Level 3 Communications, LLC	3356
4		Saudi Telecom Company	39386
5		Flag Telecom Global Internet	15412
6		Telecom Italia Sparkle	6762
7		DCI	12880
8	↑ 2	Tata Communications	6453
9		PCCW Global	3491
10	↓ 2	Verizon Business EMEA - Commercial IP service provider in ...	702
11		Global Crossing	3549
12		Singapore Telecommunications Ltd	7473
13	↑ 1	MCI Communications Services, Inc. d/b/a Verizon Business	701
14	↓ 1	TeliaNet Global Network	1299
15		012 Smile Communications Main	9116
16	↑ 4	Mobily/Bayanat	35819
17		Bezeqint Internet Backbone	8551
18		013 NetVision Ltd.	1680
19		TE	8452
20	↑ 1	ETISALAT MISR	36992
21	↓ 5	Turk Telekomunikasyon Anonim Sirketi	9121
22		Kuwait Data Center co.	43852
23		Qatar Telecom (Q-Tel)	8781
24		NTT Communications	2914
25		Deutsche Telekom AG	3320
26		Jordan Telecom	8697
27	↑ 2	Oman Telecommunications Company - OmanTel	8529
28	↓ 1	Link Egypt (Link.NET)	24863
29	↓ 1	JSC Rostelecom	12389
30	↑ 1	Syrian Telecommunications Establishment	29386
31	↓ 1	IRANET/IPM	6736
32	↑ 1	QualityNet	9155
33	↑ 1	Cogent Communications	174
34	↓ 2	Liban Telecom	42020
35		Delta Telecom LTD.	29049
36		The GEANT IP Service	20965
37		Hurricane Electric, Inc.	6939
38		Gulfnet Kuwait	3225
39		France Telecom - Orange - Worldwide IP Backbone	5511
40		Soroush Rasaneh Institute	21341

Top wholesale Internet providers in the Middle East region, as a single unified ranking.

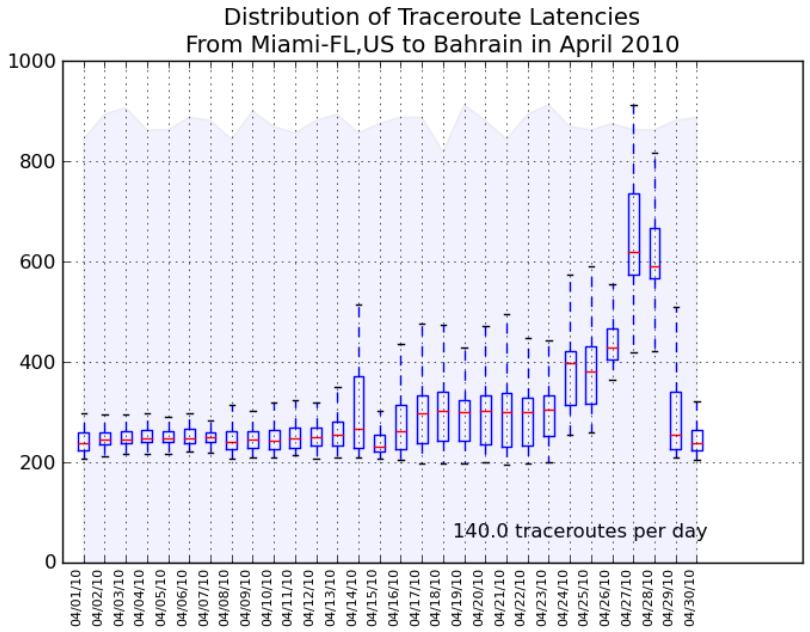
These providers supply IP transit to the autonomous systems in each national market that originate the largest share of Middle Eastern IP space.

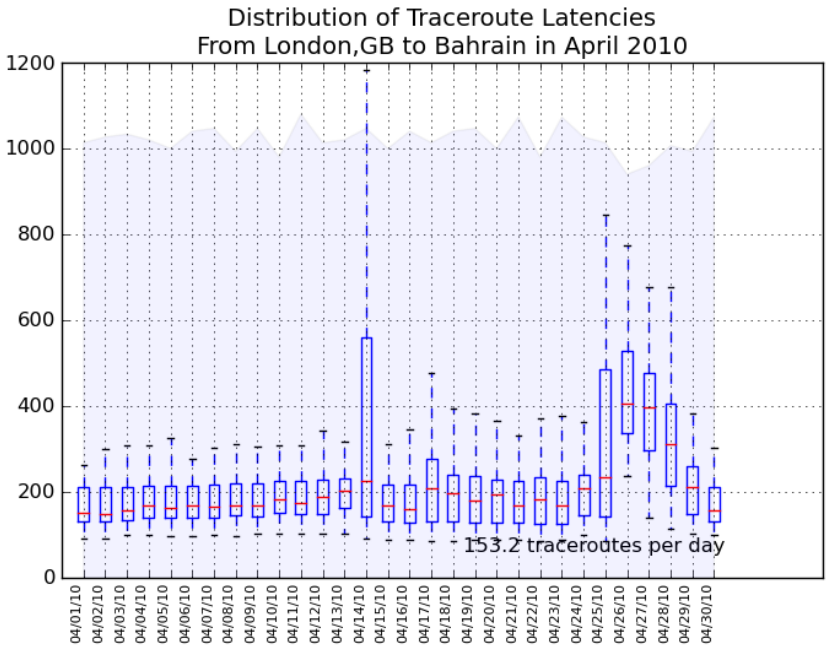
Source: Renesys Market Intelligence, Nov. 2010.
http://www.renesys.com/products_services/market_intel/

Key Internet Outage Event of 2010

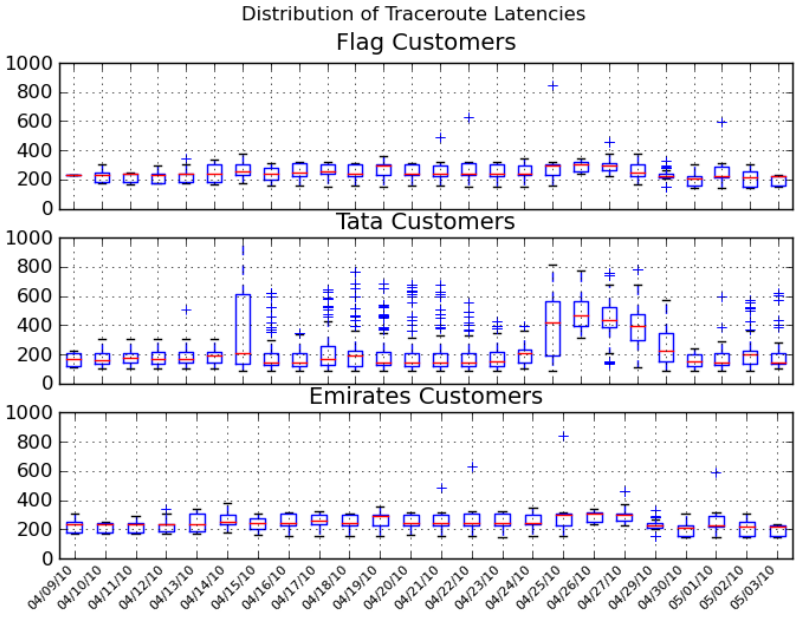
By far, the most significant regional Internet outage event of 2010 was the April 13th shunt fault of SMW4 off Alexandria, Egypt. During the repair window, which lasted several days in the last week of April, customers relying on this cable for transit encountered problems, as traffic to Europe and the US was re-routed through Asia, resulting in congestion and higher latencies.

This effect is clearly visible in traceroute timeseries from various observation points to Bahrain through the month of April, with a short spike in measured latencies on the day of the shunt fault, a modest rise due to congestion in subsequent weeks, and a more significant increase (by a factor of 3x or more) during the multiday repair window itself.

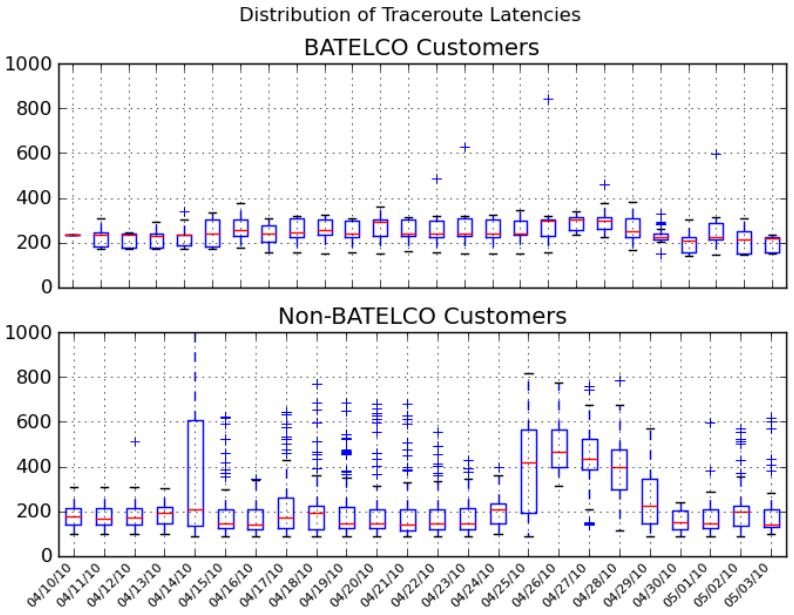




Looking at traceroute round trip latencies from London to Bahrain broken out by the last international carrier, one can see clear differences in customer experience, depending on whether the paths traversed Tata, FLAG, or Emirates.



Because of this provider-dependent behavior, Bahraini customers of Batelco suffered little disruption during the event (Batelco utilizes diverse FLAG and Tata transit, and peers with Emirates).

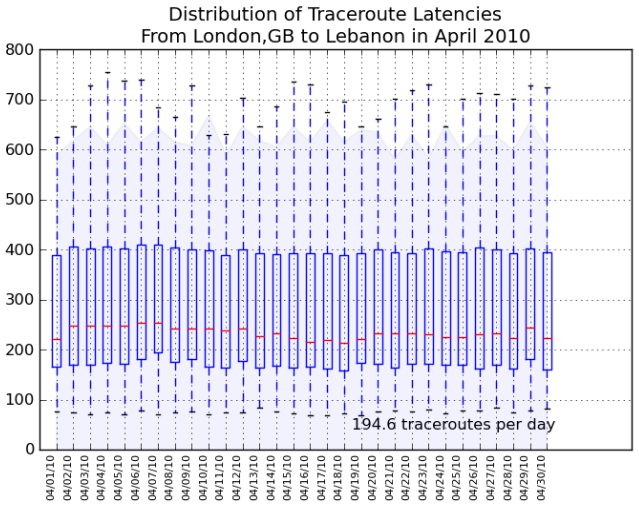


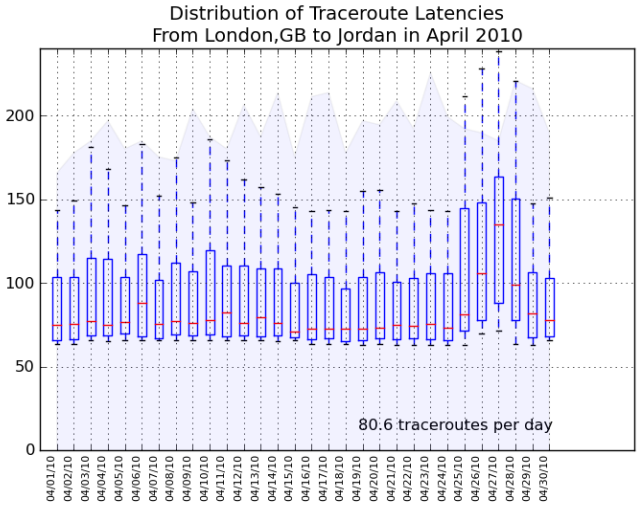
Other countries in the region generally experienced similar latency increases if they were reliant on SMW4 transit for around-the-world routing to the destinations in question.

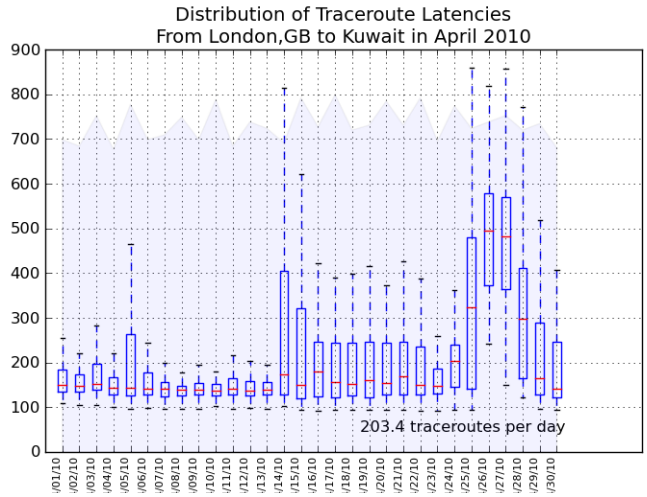
Lebanon experienced no measurable change in latency from any site, since their connectivity (via Cyprus) was unaffected.

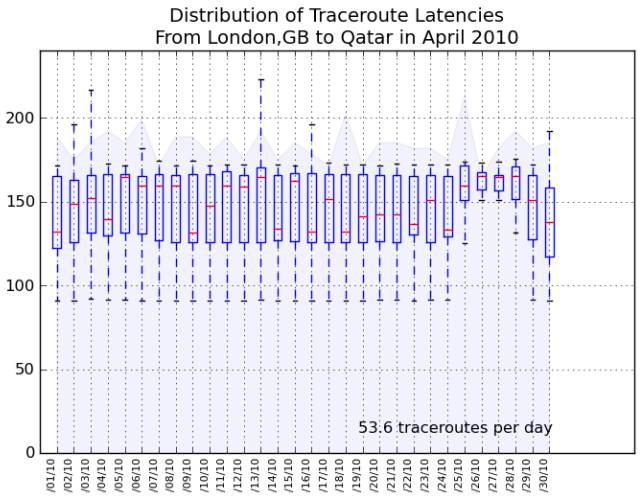
Jordanian customers experienced some degree of latency increase if they were exposed to SMW4 routing via Saudi terrestrial transit, but no increase if they relied on FLAG FEA.

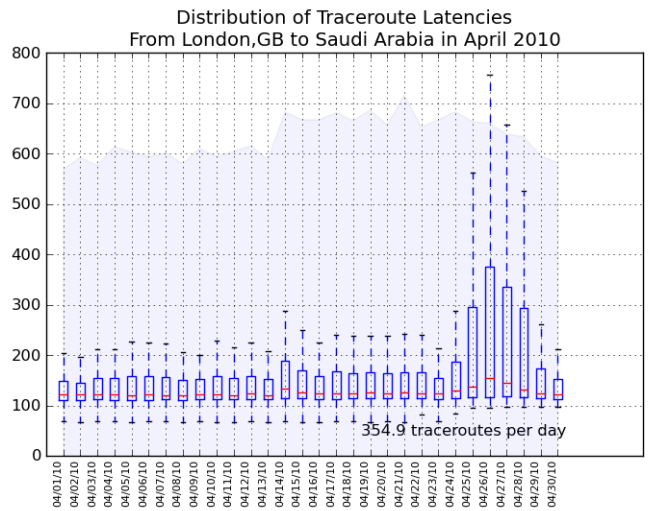
Saudi Arabia, Qatar, Kuwait, and **Oman** experienced increased latencies that were similar to those experienced by Bahraini consumers, with the least severe impact in Qatar, and the most severe in Kuwait.

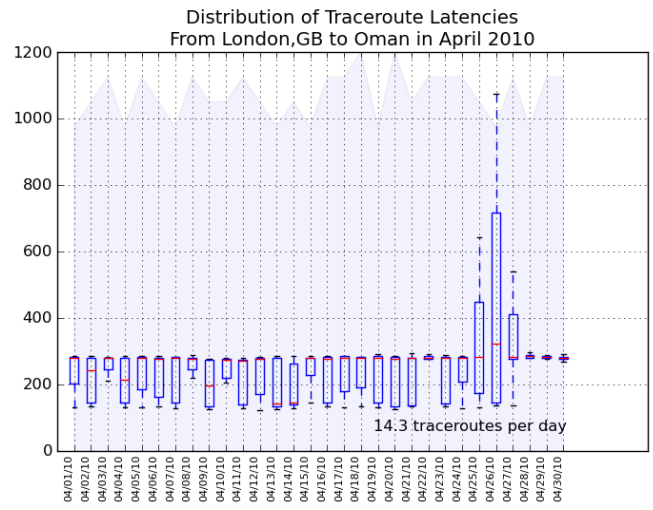












Snapshot of the IPv6 Regional Internet

Country	ASN	IPv6 Prefix	Transit Via…	Originator
AE	AS47862	2001:8f8::/44	AS11537 (Internet2)	ANKABUT (U.A.E Research Edu Network)
AE	AS51182	2a02:1718::/32	AS6939 (Hurricane Electric) and AS47862 (ANKABUT)	United Arab Emirates University
EG	AS24863	2001:4300:2001::/48	AS33789 (MCIT)	Link Egypt (Link.NET)
EG	AS24863	2001:4300:2002::/48	AS33789 (MCIT)	Link Egypt (Link.NET)
EG		*… 19 consecutive blocks..*		
EG	AS24863	2001:4300:2019:/48	AS33789 (MCIT)	Link Egypt (Link.NET)
EG	AS2561	2001:4300:2000::/43	AS24863 (Link Egypt)	Egyptian Universities Network
EG	AS2561	2001:4300:2020::/48	AS24863 (Link Egypt)	Egyptian Universities Network
EG	AS31065	2001:4300:5503::/48	AS8452 (Telecom Egypt)	Ministry of Communications and IT
EG	AS8452	2001:4388::/32	AS6762 (Telecom Italia)	Telecom Egypt
JO	AS8697	2a00:18d8::/32	AS551 (France Telecom)	Jordan Telecom
JO	AS8934	2a02:9c0::/32	AS47887 (NEU), via AS3257 (Tinet)	National Information Technology Center
LB	AS41833	2a02:f50::/32	AS41589 (Sidus)	Moscanet (WISE)
OM	AS8529	2001:1670::/32	AS286 (KPN)	OmanTel
QA	AS8781	2001:1a10:300::/40	AS6939 (Hurricane Electric)	Q-Tel
QA	AS8781	2001:1a10::/32	AS6939 (Hurricane Electric)	Q-Tel
QA	AS8781	2001:1a10:3999::/48	AS6939 (Hurricane Electric)	Q-Tel
SA	AS29684	2a00:1560::/32	AS6939 (Hurricane Electric) and AS35819 (Mobily)	Nournet
SA	AS30857	2001:67c:130::/48	AS6939 (Hurricane Electric) and AS8895 (KACST)	Communications and IT Commission (CITC)
SA	AS31416	2a00:18f8::/32	AS6939 (Hurricane Electric)	Applied Technologies Co
SA	AS35819	2a02:9b0::/32	AS3356 (Level3)	Mobily/Bayanat
SA	AS35819	2a02:ce0::/32	AS3356 (Level3)	Mobily/Bayanat
SA	AS39386	2001:16a0::/32	AS174 (Cogent) and AS6762 (Telecom Italia)	Saudi Telecom Company
SA	AS41176	2a02:d70::/32	AS6939 (Hurricane Electric)	Sahara Net
SA	AS8895	2001:1490::/32	AS5400 (BT), AS6453 (Tata), and AS174 (Cogent)	KACST/ISU Riyadh

IPv6 routes currently seen from regional providers (Nov 2010).

IPv6 Trends by Country

The table on the previous page summarizes the origination and routing of the region's still-modest contribution to the global IPv6 routing table – about 40 networks in all, out of a global table of about 3,500 IPv6 routes.

Egypt has the most extensive IPv6 Internet ecosystem, representing about half of the total regional routes. Telecom Egypt ultimately transits all Egyptian IPv6 transit, by way of Telecom Italia.

Jordan's IPv6 Internet follows similar lines of division as its IPv4 Internet, with one block advertised by the incumbent through France Telecom, and the other advertised by NITC, through NEU, using TINet for international transit.

The **UAE** connects to the IPv6 Internet through the Internet2 research project, and through Hurricane Electric. **Lebanon's** sole IPv6 allocation, appropriately enough, transits a German satellite provider; **Oman's** transits KPN, and **Qatar's** 5 networks transit Hurricane Electric.

Saudi Arabia's IPv6 Internet is interesting because of its international diversity. In addition to tunnels provided by Hurricane Electric, Saudi providers have succeeded in establishing IPv6 connectivity with Level3, Tata, Cogent, and Telecom Italia. This level of transit diversity, in the absence (so far) of significant amounts of traffic, suggests that IPv6 growth is an important strategic goal for the Kingdom.

While it does not yet appear that any IPv6 networks are being originated by **Kuwaiti** or **Bahraini** providers, it should be noted that the IPv6 routing table is still in its infancy. Total worldwide traffic volumes for IPv6 are, as of yet, unmeasurably small, compared to the existing IPv4 Internet.

The Future of the IPv6+IPv4 Dual Internet

A lack of IPv6-only content has contributed to a chicken-and-egg problem for service providers worldwide: service providers are reluctant to invest in IPv6 absent clear demand from users, users have no demand for IPv6 because there's no content to view, and content providers are not eager to invest in IPv6 services because there's no audience.

Despite the failure of IPv6 to thrive, the IPv4 Internet is shortly going to become a somewhat more crowded place to do business. As IPv4 address space becomes exhausted, regional providers will find themselves having to use existing allocations of that address space more efficiently. They should plan for a transition period lasting many years, in which large providers with large, mostly unused IPv4 allocations will find themselves in control of a valuable (and monetizable) asset.

Telecommunications regulators throughout the region may rapidly find themselves overseeing a lucrative (and increasingly desperate) market for IPv4 address space, in which new market entrants can be shut out by existing providers for lack of adequate IPv4 addressing resources. Affected parties should begin to consider whether a country's existing IPv4 allocations might constitute a finite national resource, like radio spectrum, that is potentially subject to regulatory oversight.

Appendix A: 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) sells 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 multihomed to FLAG (AS15412) and to the BIX (AS35019).

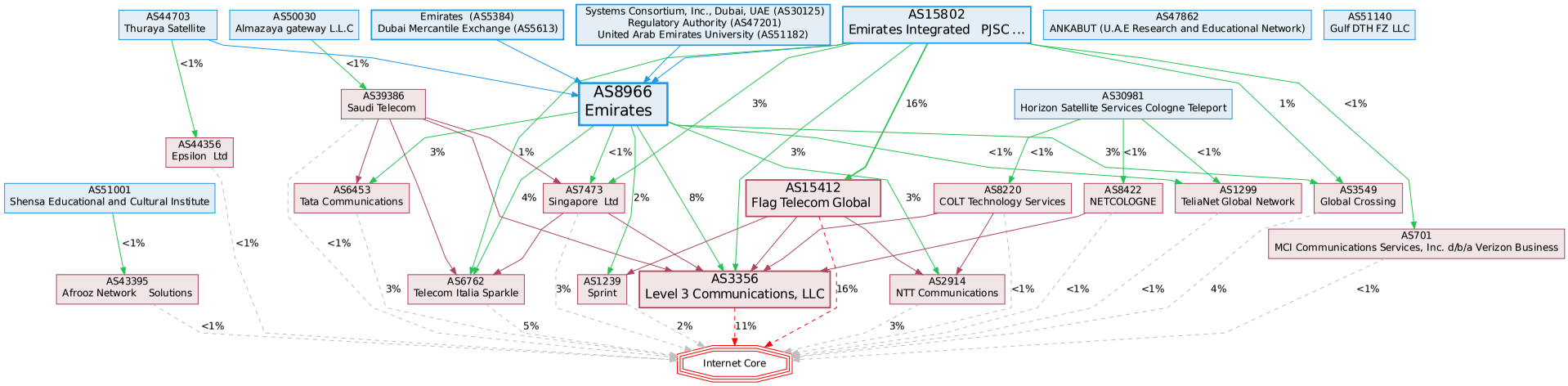
Reachable, Unreachable (or "Outaged'): If a router has a route to a given prefix, that prefix is Reachable from its perspective; if it no longer has a route, the prefix is Unreachable. When a network prefix becomes unreachable (that is, it is no longer being announced to any transit provider), it is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

Instability: When the routes to a prefix change very quickly (often because a physical link is very congested, or "flapping" in and out of service), the prefix is said to be unstable. A route to it may exist, but traffic may not be flowing smoothly because link quality is poor.

"On Net": a given network is said to be on-net with a given provider if they receive Internet transit from that provider, directly or indirectly. Your customers, your customers' customers, and so forth are all said to be on-net with you.

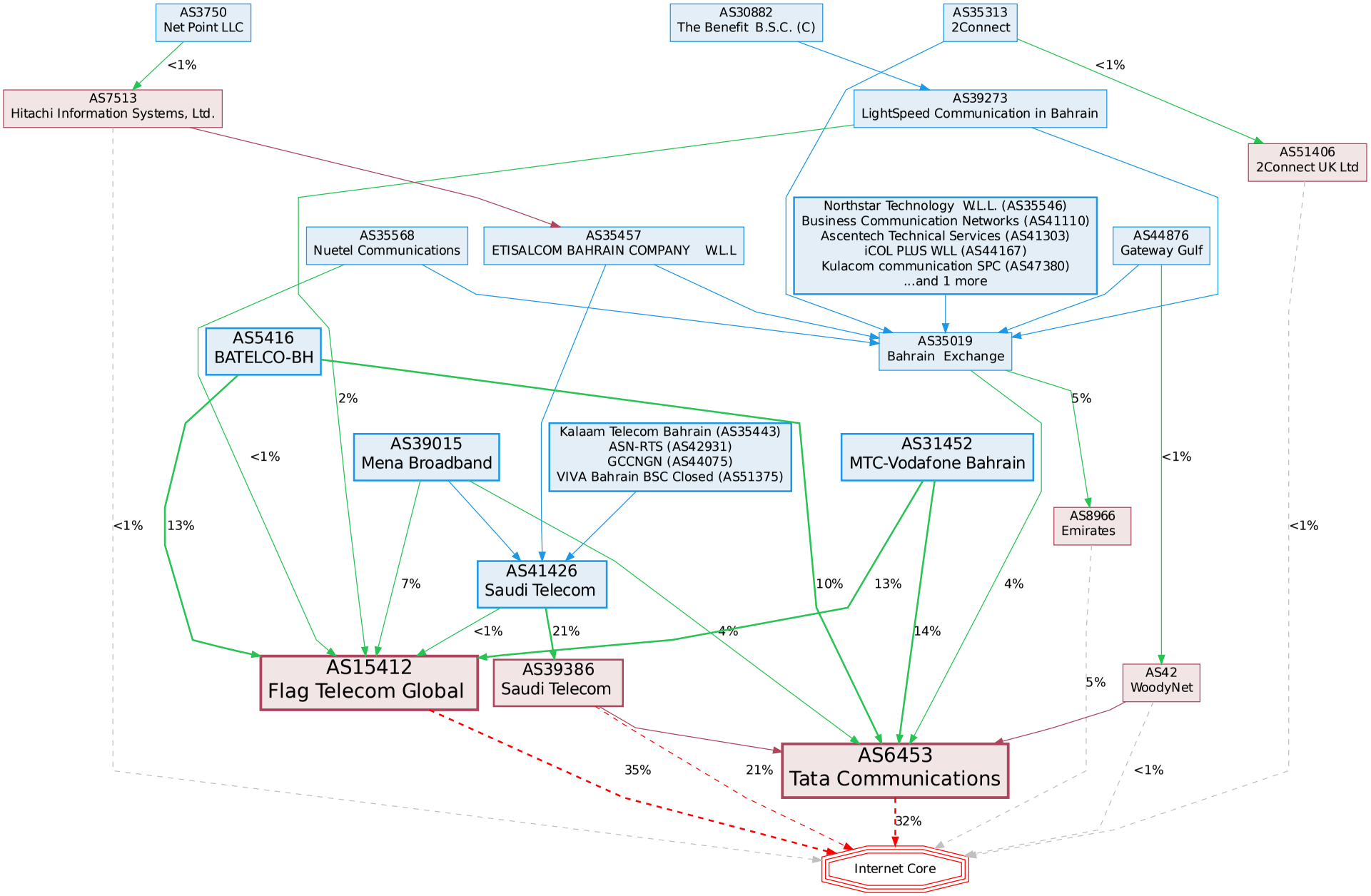
"On Net Percentage": the percentage of a given market (set of prefixes) that are on net with a given provider. ONP serves as a rough measurement of market penetration or leverage, although the existence of a high or low on-net percentage is not sufficient to conclude anything specific about the economics or politics of the Internet ecosystem or the provider's role in it.

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.



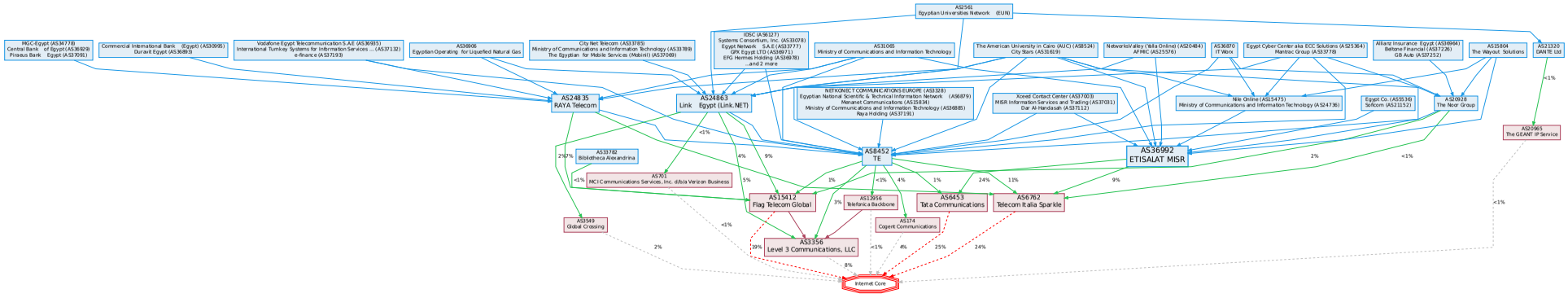
UNITED ARAB EMIRATES

renesys



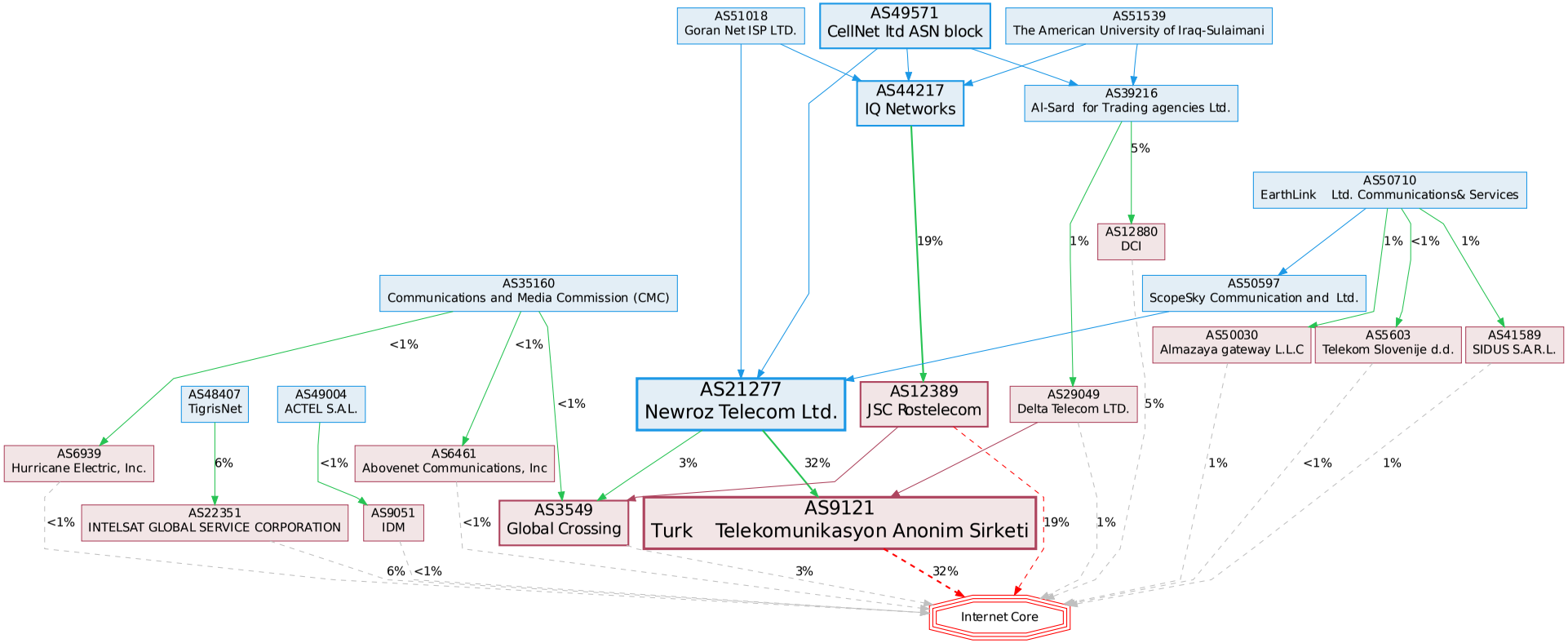
BAHRAIN

renesys



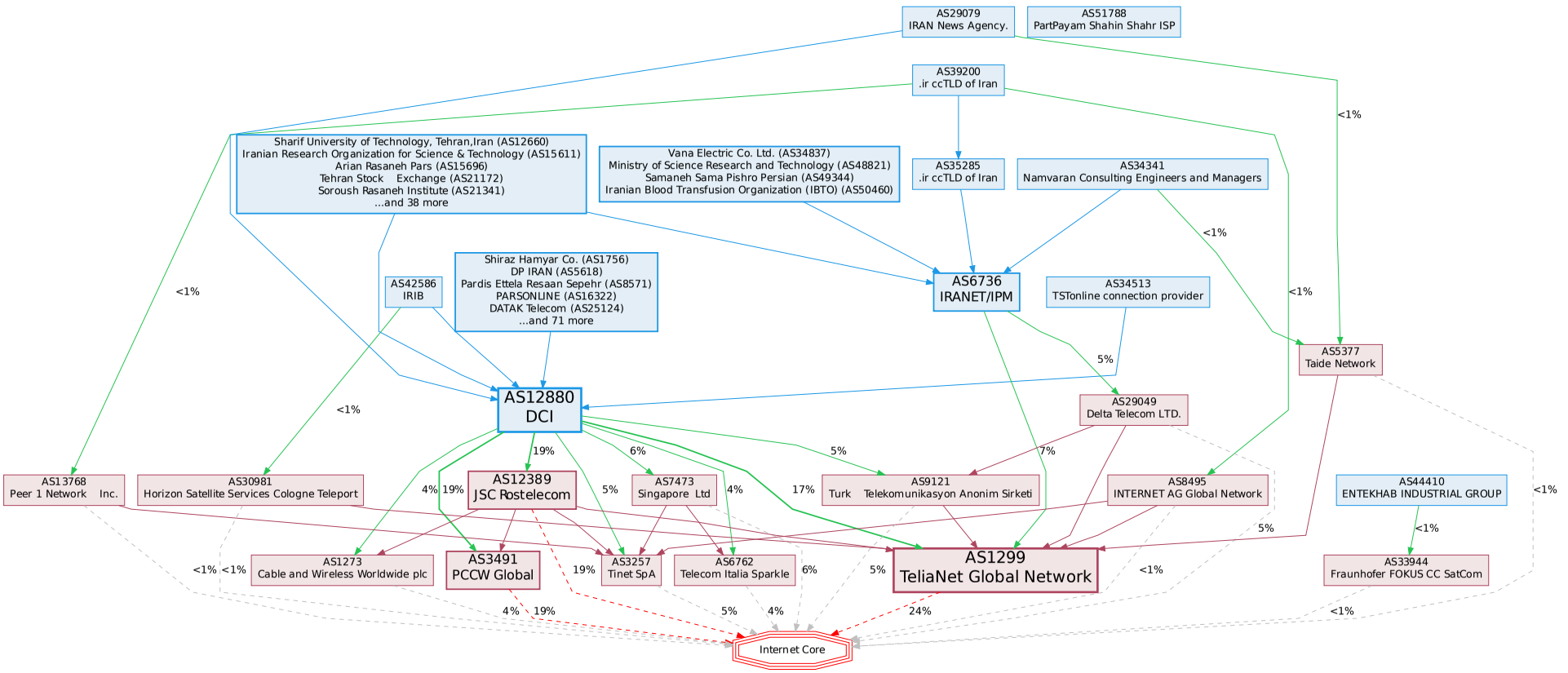
EGYPT

renesys®



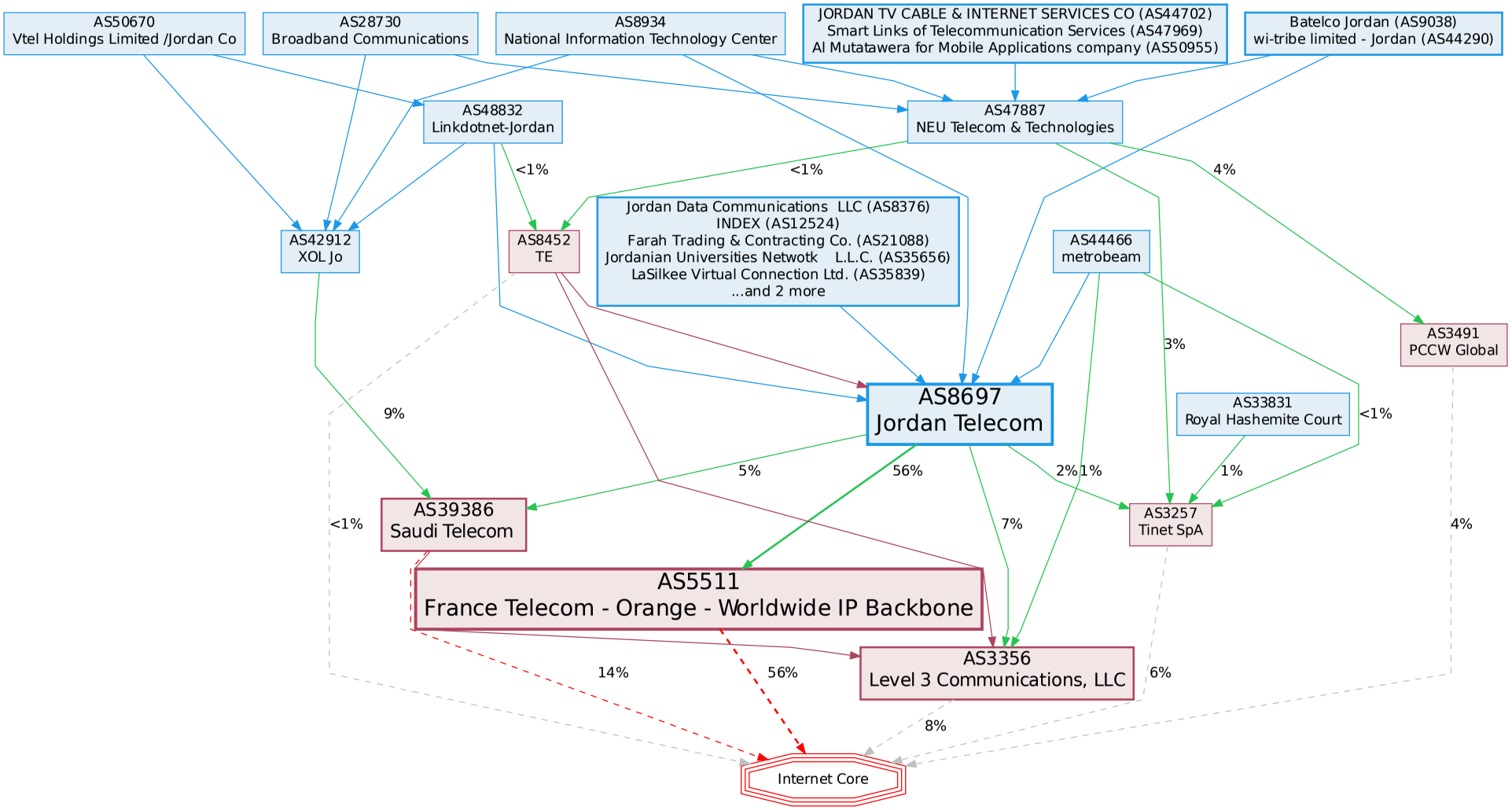
IRAQ

renesys



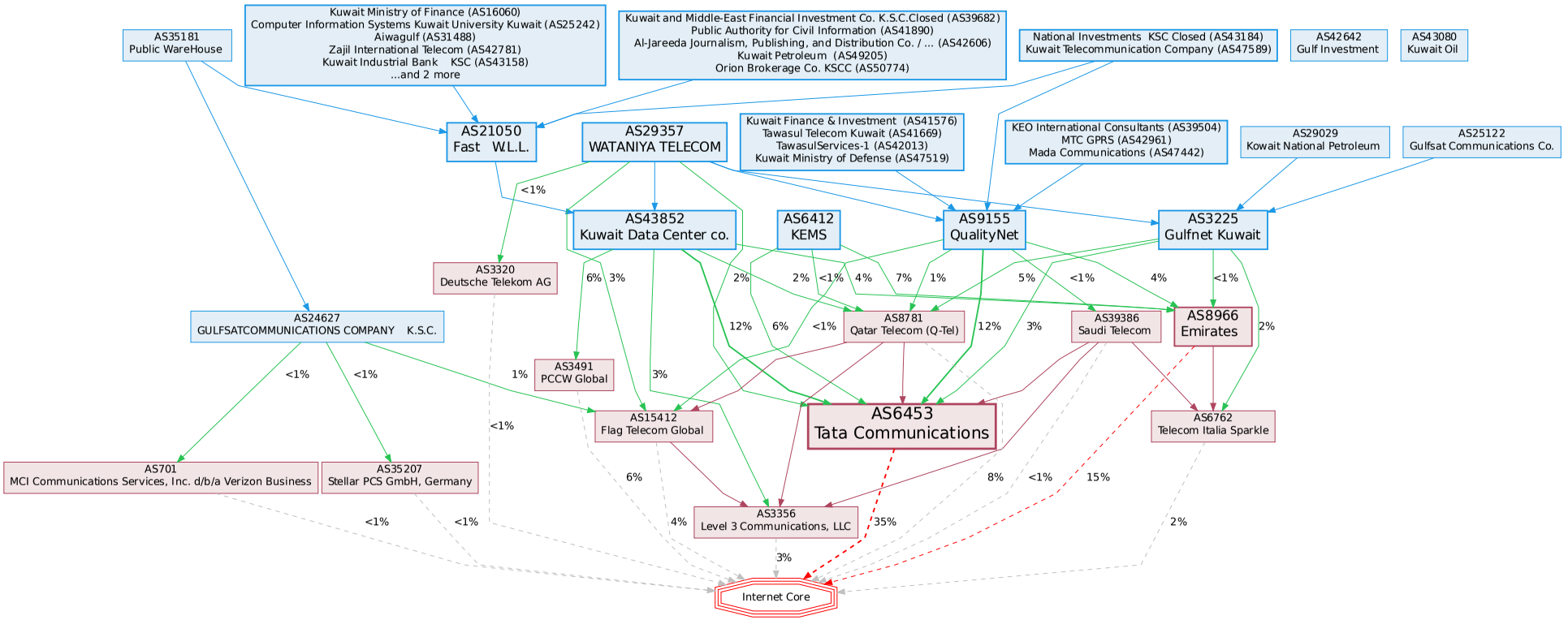
IRAN

renesys



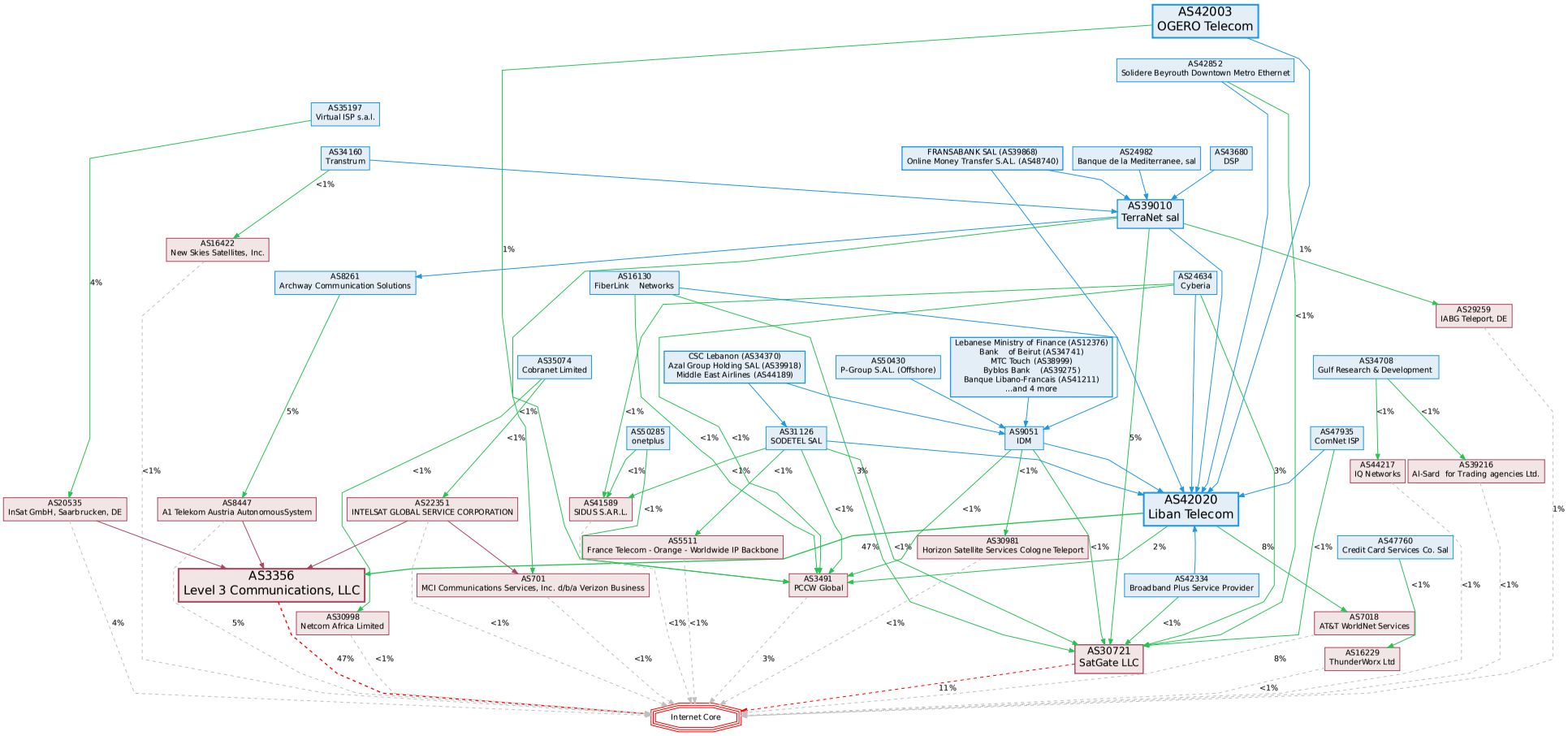
JORDAN

renesys



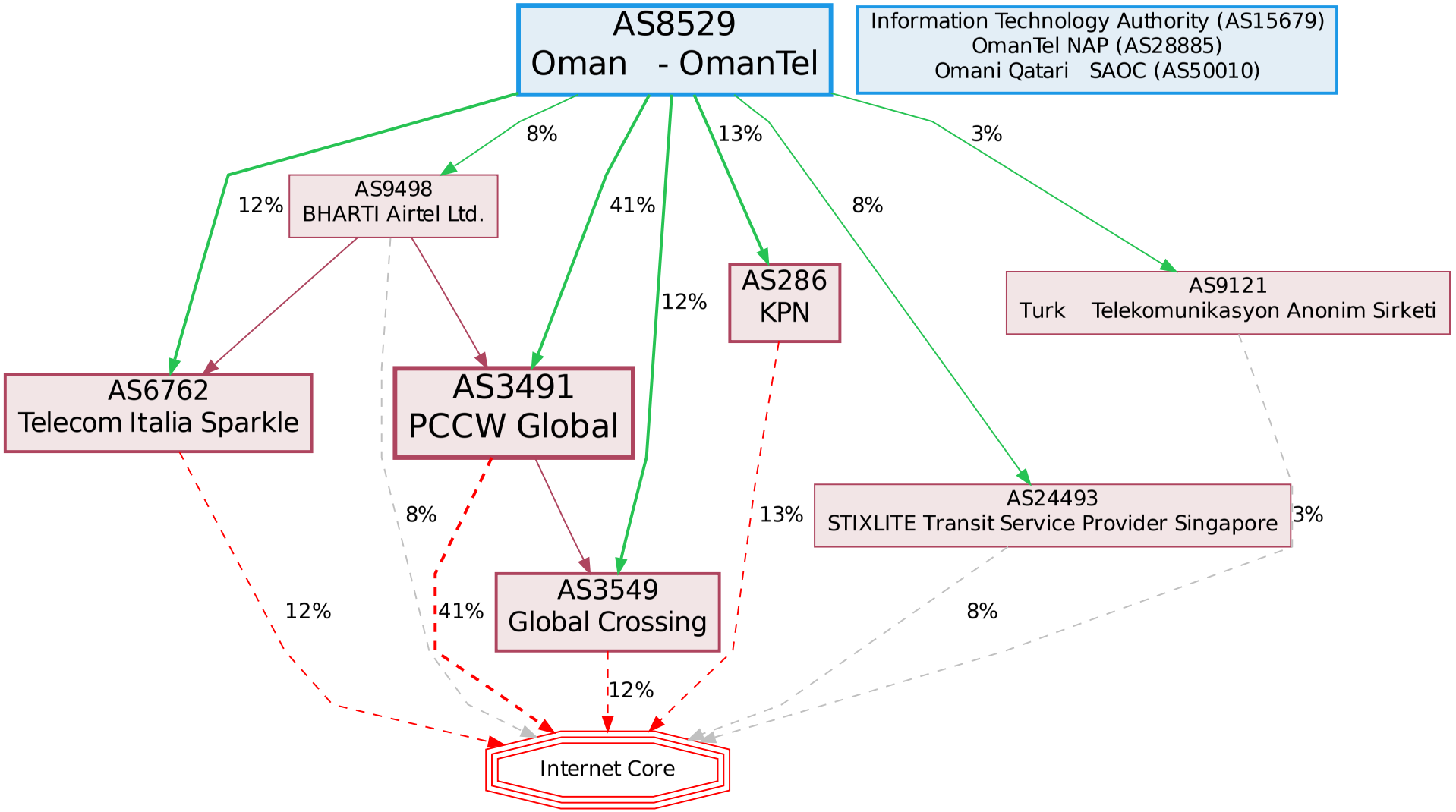
KUWAIT

renesys



LEBANON

renesys



OMAN

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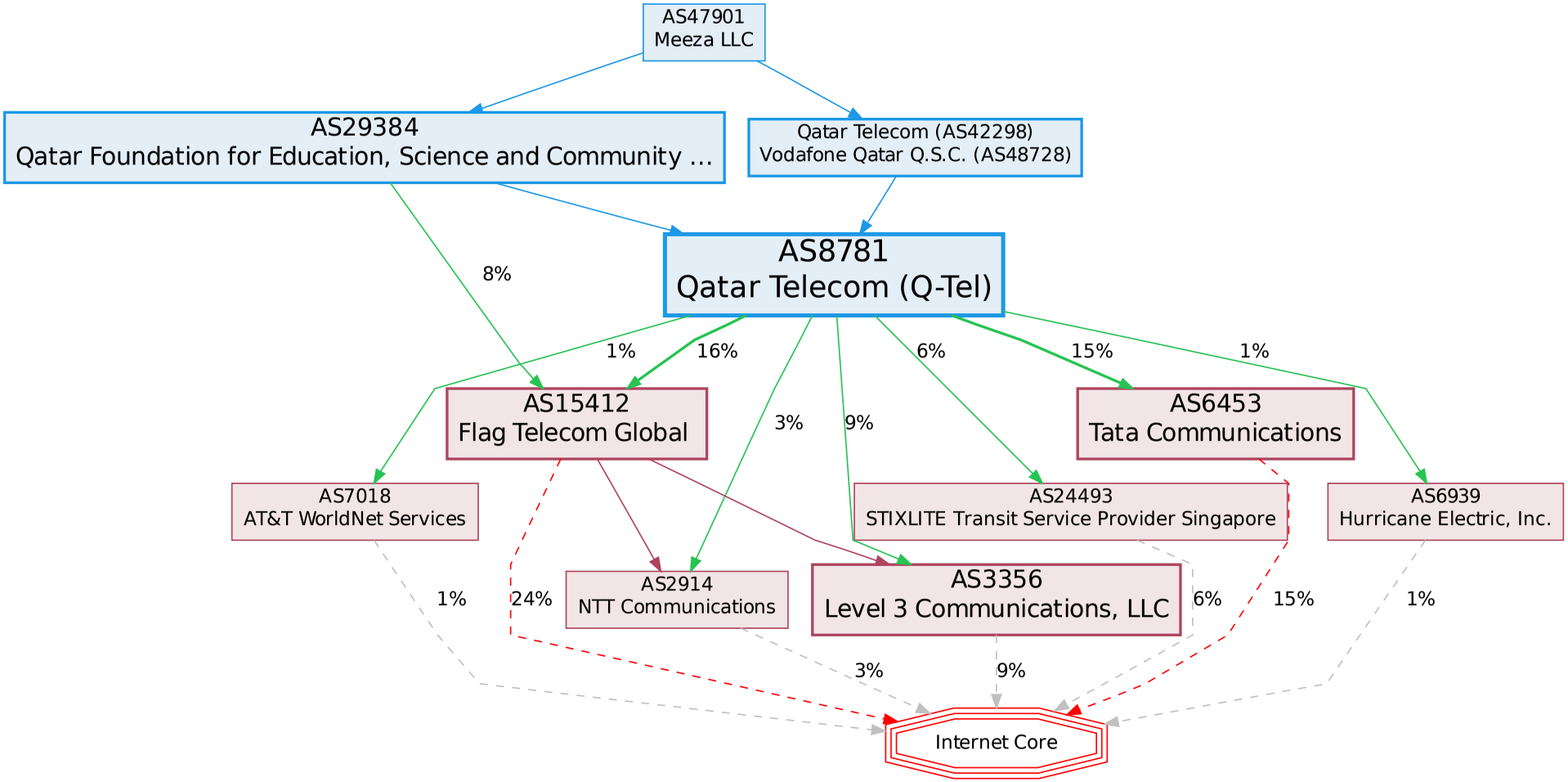

QATAR

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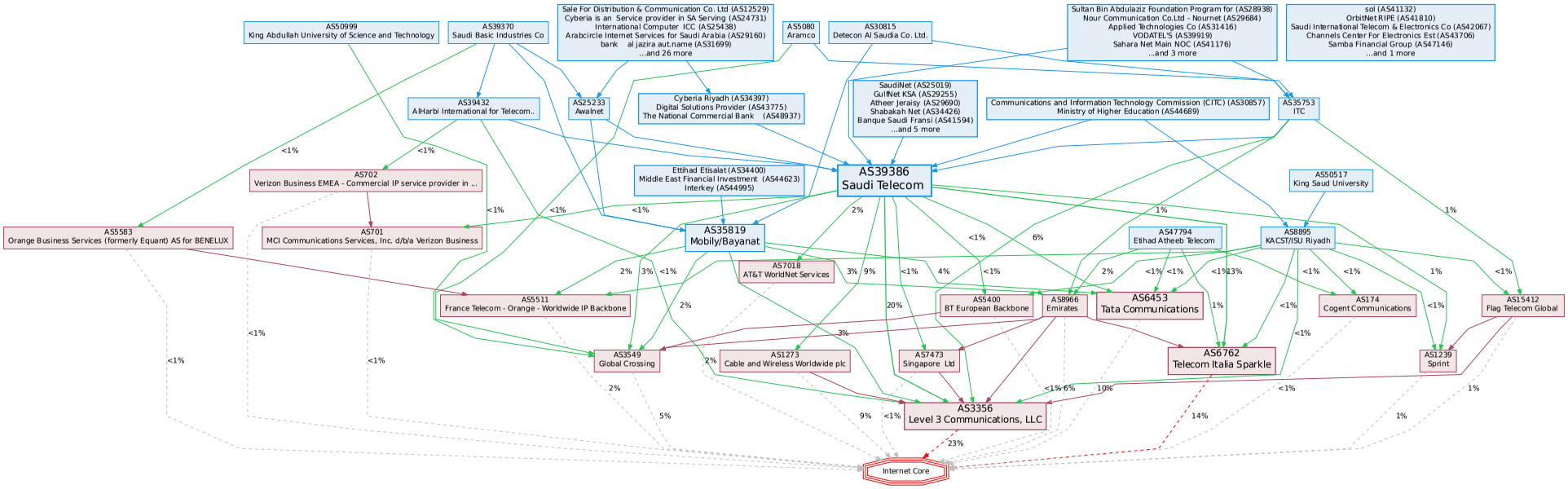
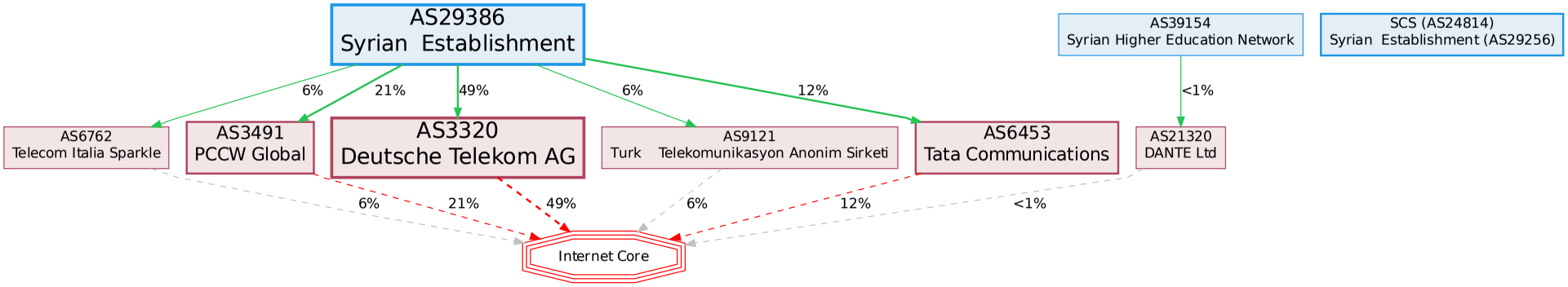


SAUDI ARABIA

renesys



SYRIA

renesys