HURRICANE ELECTRIC
INTERNET SERVICES

Visualizing IP networks within the Arab Region

Pretty diagrams are good!

MENOG11
Amman, Jordan
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Hurricane Electric

Agenda

- Methodology
- Visualizing IPv4 & IPv6 BGP adjacency
- Summary

METHODOLOGY

Existing visualizing of BGP routing …

Network	Next Hop	Metric	LocPrf	Weight	Path
* i80.76.160.0/20	80.81.194.198	1	100	0	15802 48728 i
* i80.76.162.0/24	80.81.194.198	1	100	0	15802 48728 i
* i80.76.163.0/24	80.81.194.198	1	100	0	15802 48728 i
* i80.76.164.0/24	80.81.194.198	1	100	0	15802 48728 i
* i80.76.165.0/24	80.81.194.198	1	100	0	15802 48728 i
* i80.227.0.0/16	80.81.194.198	1	100	0	15802 i
* i80.227.0.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.32.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.64.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.96.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.128.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.160.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.192.0/19	80.81.194.198	1	100	0	15802 i
* i80.227.224.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.0.0/16	80.81.194.198	1	100	0	15802 i
* i87.200.0.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.32.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.64.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.96.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.128.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.160.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.192.0/19	80.81.194.198	1	100	0	15802 i
* i87.200.224.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.0.0/16	80.81.194.198	1	100	0	15802 i
* i87.201.0.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.32.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.64.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.96.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.128.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.160.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.192.0/19	80.81.194.198	1	100	0	15802 i
* i87.201.224.0/19	80.81.194.198	1	100	0	15802 i
* i91.72.0.0/16	80.81.194.198	1	100	0	15802 i
* i91.72.0.0/19	80.81.194.198	1	100	0	15802 i
* i91.72.32.0/19	80.81.194.198	1	100	0	15802 i
* i91.72.64.0/19	80.81.194.198	1	100	0	15802 i
* i91.72.96.0/19	80.81.194.198	1	100	0	15802 i
* i91.72.128.0/19	80.81.194.198	1	100	0	15802 i

This is not easy to visualize!

Checking global IPv6 routing – graphically!

NATIVE IPv6 EVERYWHERE

Showing IPv4/IPv6 route propagation in a graphical form

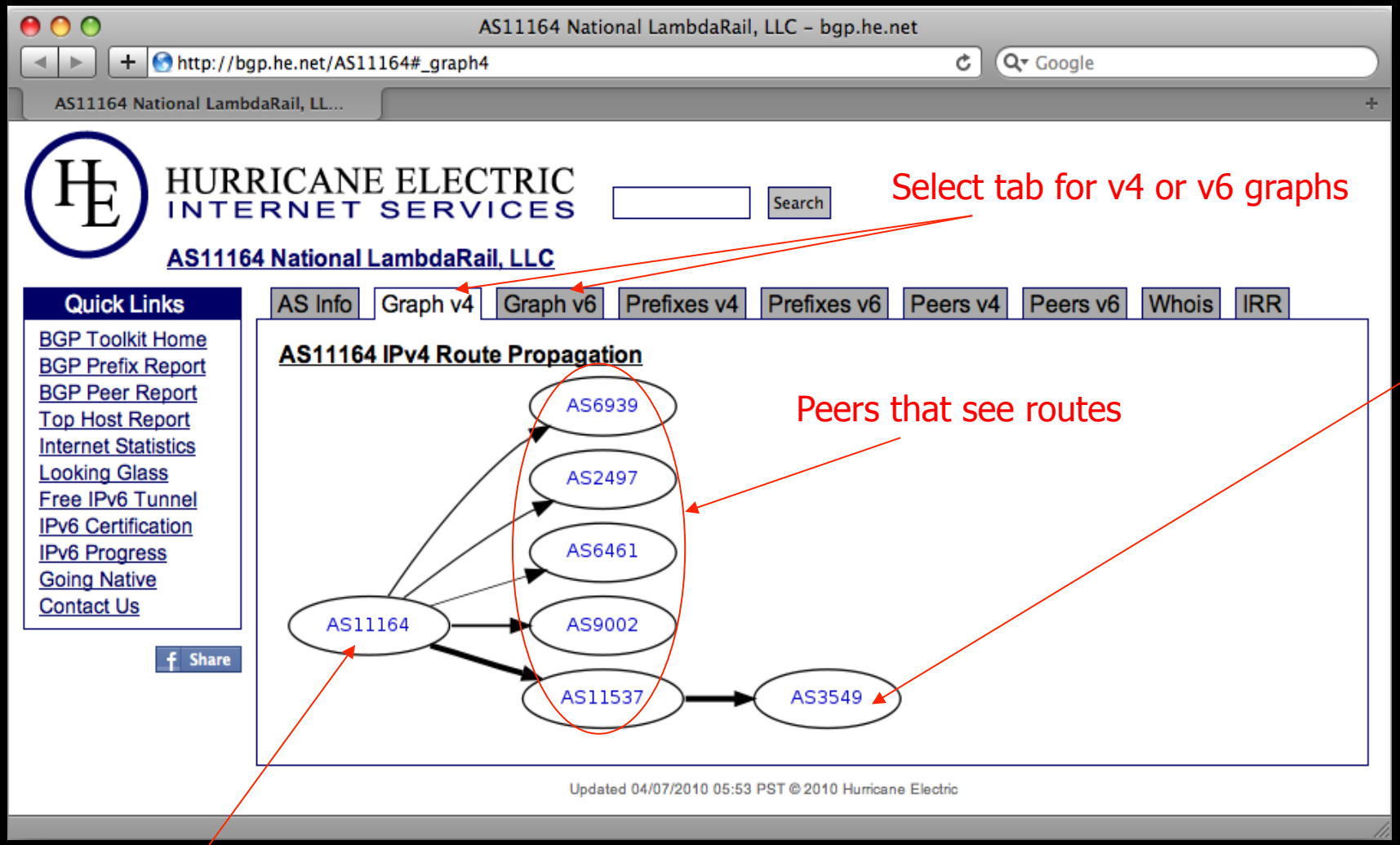
http://bgp.he.net/

Caveat:

- This tool is only as good as its source data.
- IP information is uploaded from RIPE RIS & Oregon routeviews.
- Some views are missing; not all routes and paths are visible.

- NOT based on the Hurricane Electric routing tables.

http://bgp.he.net/ – Route propagation graphs



Routes see downstream of peers

ASN originating routes

Can regional IPv6 routing be measured?

- Question:
  - Is there enough IPv6 routing between ISPs?
  - Can IPv6 BGP routing tables provide insight?

- Methodology:
  - Lots of BGP routing tables collected globally
  - Data from http://bgp.he.net/ processed further
  - Graphical view on a country-to-country basis

Measuring BGP routing by collecting tables

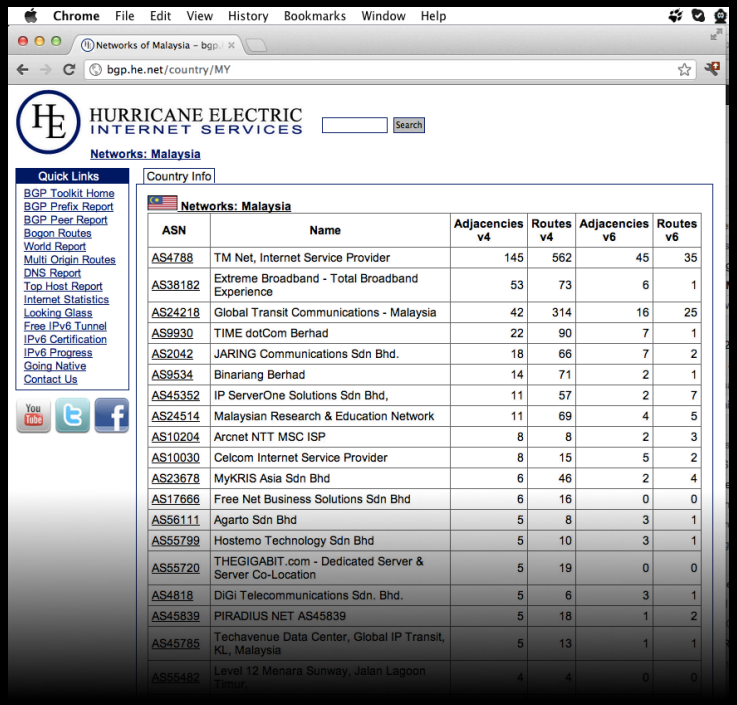
- Build on exceptional work by others
  - RIPE/RIS & Oregon routeviews collect BGP tables
  - A hearty "*thank you*" to RIPE & University of Oregon
- Use Hurricane Electric's http://bgp.he.net/ site and it's database
  - Daily processing of those BGP tables
  - Results are user-friendly visualization of routing
- Take the data one step further …

Measuring BGP routing by collecting tables

- Take the data one step further …
- Only look at BGP peer data (v4 & v6)
  - It's only interesting to look at BGP adjacency
  - Map ASN to country-codes
  - Search for adjacencies where CCs are different
- Process resulting data to search for in-region connections
  - Clean up the data
  - Display the data

Example processing – CC & ASN

http://bgp.he.net/country/MY

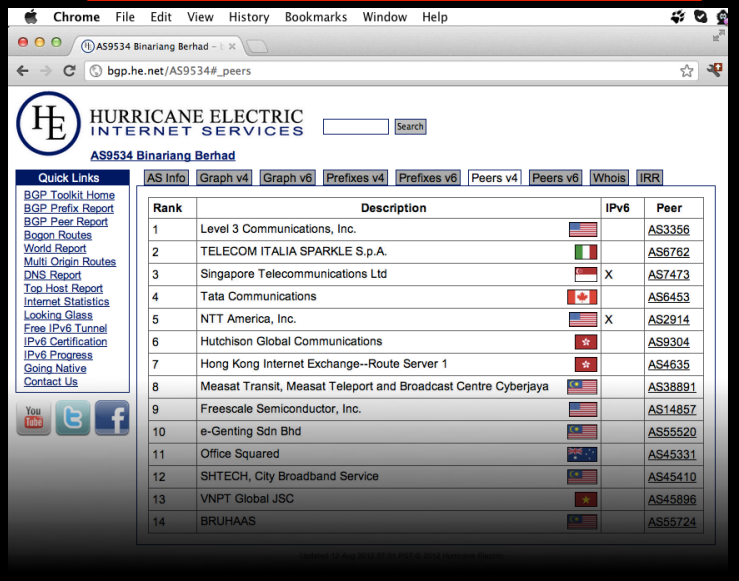


ASN	Name	Adjacencies v4	Routes v4	Adjacencies v6	Routes v6
AS4788	TM Net, Internet Service Provider	145	562	45	35
AS38182	Extreme Broadband - Total Broadband Experience	53	73	6	1
AS24218	Global Transit Communications - Malaysia	42	314	16	25
AS9930	TIME dotCom Berhad	22	90	7	1
AS2042	JARING Communications Sdn Bhd.	18	66	7	2
AS9534	Binariang Berhad	14	71	2	1
AS45352	IP ServerOne Solutions Sdn Bhd,	11	57	2	7
AS24514	Malaysian Research & Education Network	11	69	4	5
AS10204	Arcnet NTT MSC ISP	8	8	2	3
AS10030	Celcom Internet Service Provider	8	15	5	2
AS23678	MyKRIS Asia Sdn Bhd	6	46	2	4
AS17666	Free Net Business Solutions Sdn Bhd	6	16	0	0
AS56111	Agarto Sdn Bhd	5	8	3	1
AS55799	Hostemo Technology Sdn Bhd	5	10	3	1
AS55720	THEGIGABIT.com - Dedicated Server & Server Co-Location	5	19	0	0
AS4818	DiGi Telecommunications Sdn. Bhd.	5	6	3	1
AS45839	PIRADIUS NET AS45839	5	18	1	2
AS45785	Techavenue Data Center, Global IP Transit, KL, Malaysia	5	13	1	1

Process each ASN within each country

Note the ASNs within the country …

http://bgp.he.net/AS24514#_peers



Rank	Description	IPv6	Peer
1	Level 3 Communications, Inc.		AS3356
2	TELECOM ITALIA SPARKLE S.p.A.		AS6762
3	Singapore Telecommunications Ltd	X	AS7473
4	Tata Communications		AS6453
5	NTT America, Inc.	X	AS2914
6	Hutchison Global Communications		AS9304
7	Hong Kong Internet Exchange--Route Server 1		AS4635
8	Measat Transit, Measat Teleport and Broadcast Centre Cyberjaya		AS38891
9	Freescale Semiconductor, Inc.		AS14857
10	e-Genting Sdn Bhd		AS55520
11	Office Squared		AS45331
12	SHTECH, City Broadband Service		AS45410
13	VNPT Global JSC		AS45896
14	BRUHAAS		AS55724

Remove all peers within CC

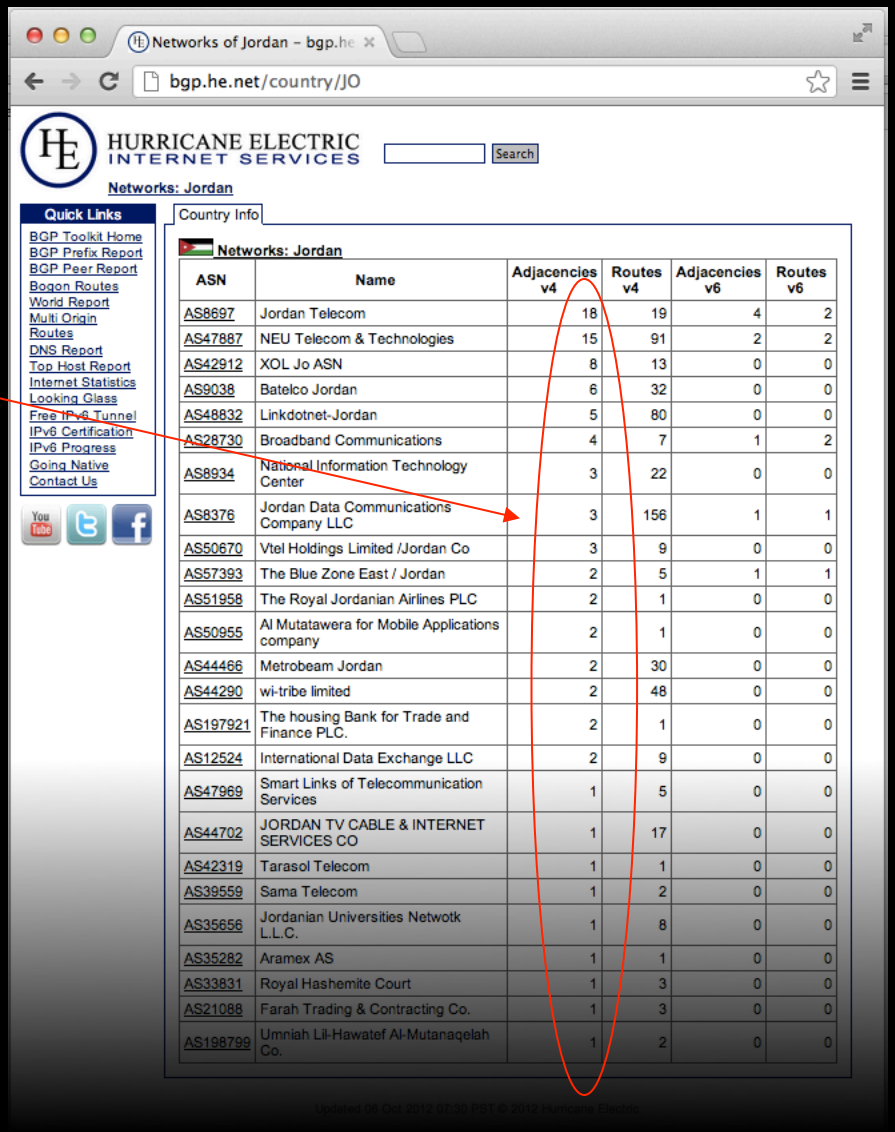
Note the peer connections that are outside the country …

VISUALIZING IPV4 & IPv6 GLOBALLY AND WITHIN THE MIDDLE EAST

Visualizing IPv6 routing in Jordan

- Full country listing at http://bgp.he.net/country/JO

ASNs sorted by Adjacency count

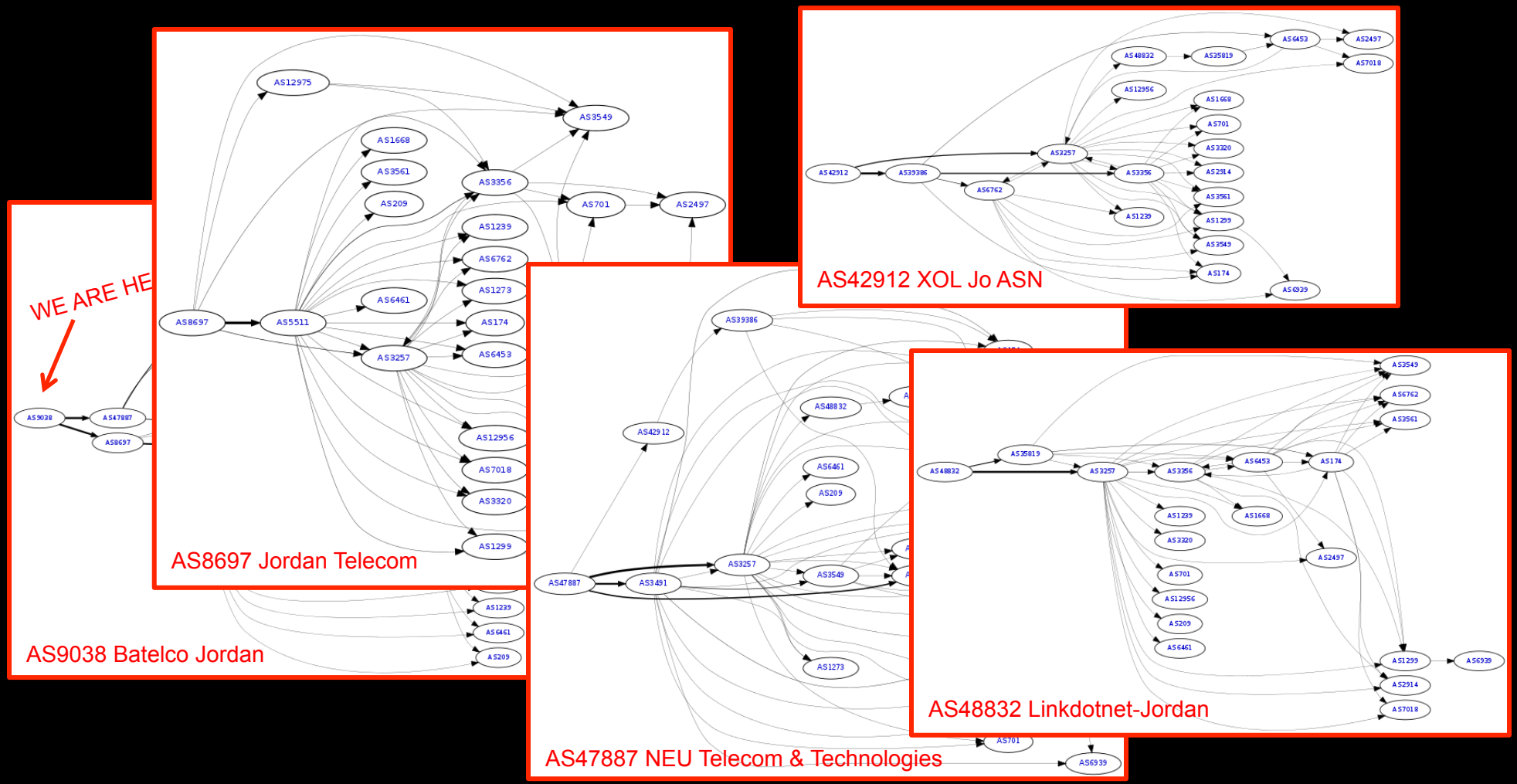


ASN	Name	Adjacencies v4	Routes v4	Adjacencies v6	Routes v6
AS8697	Jordan Telecom	18	19	4	2
AS47887	NEU Telecom & Technologies	15	91	2	2
AS42912	XOL Jo ASN	8	13	0	0
AS9038	Batelco Jordan	6	32	0	0
AS48832	Linkdotnet-Jordan	5	80	0	0
AS28730	Broadband Communications	4	7	1	2
AS8934	National Information Technology Center	3	22	0	0
AS8376	Jordan Data Communications Company LLC	3	156	1	1
AS50670	Vtel Holdings Limited /Jordan Co	3	9	0	0
AS57393	The Blue Zone East / Jordan	2	5	1	1
AS51958	The Royal Jordanian Airlines PLC	2	1	0	0
AS50955	Al Mutatawera for Mobile Applications company	2	1	0	0
AS44466	Metrobeam Jordan	2	30	0	0
AS44290	wi-tribe limited	2	48	0	0
AS197921	The housing Bank for Trade and Finance PLC.	2	1	0	0
AS12524	International Data Exchange LLC	2	9	0	0
AS47969	Smart Links of Telecommunication Services	1	5	0	0
AS44702	JORDAN TV CABLE & INTERNET SERVICES CO	1	17	0	0
AS42319	Tarasol Telecom	1	1	0	0
AS39559	Sama Telecom	1	2	0	0
AS35656	Jordanian Universities Netwotk L.L.C.	1	8	0	0
AS35282	Aramex AS	1	1	0	0
AS33831	Royal Hashemite Court	1	3	0	0
AS21088	Farah Trading & Contracting Co.	1	3	0	0
AS198799	Umniah Lil-Hawatef Al-Mutanaqelah Co.	1	2	0	0

http://bgp.he.net/country/JO

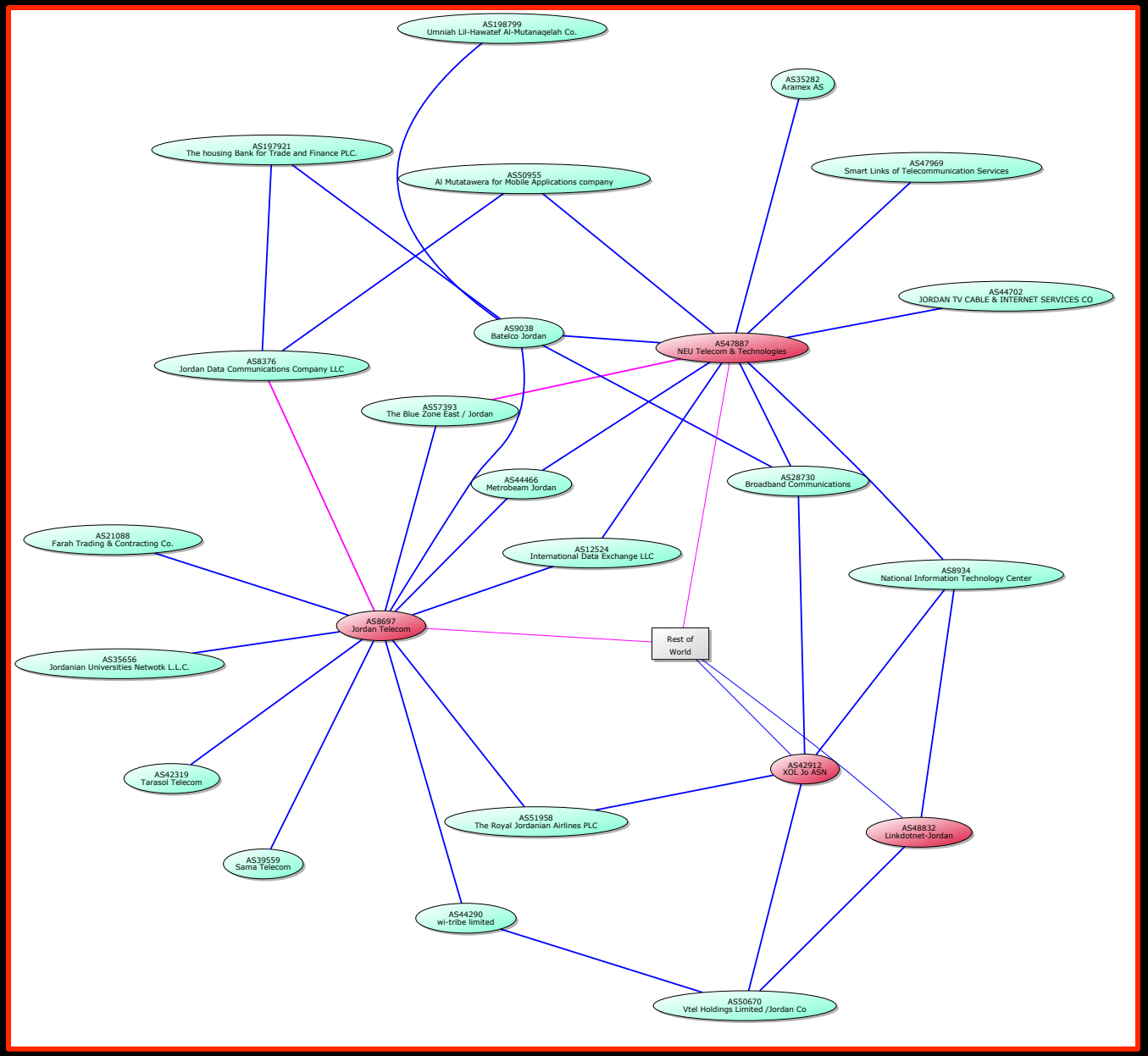
Visualizing routing in Jordan – per ASN

- Routing propagation graphs for three providers in Jordan
  - These change all the time; it's best to look online for latest BGP propagation



Caveat: Not all links will show within these graphs

Visualizing routing within Jordan



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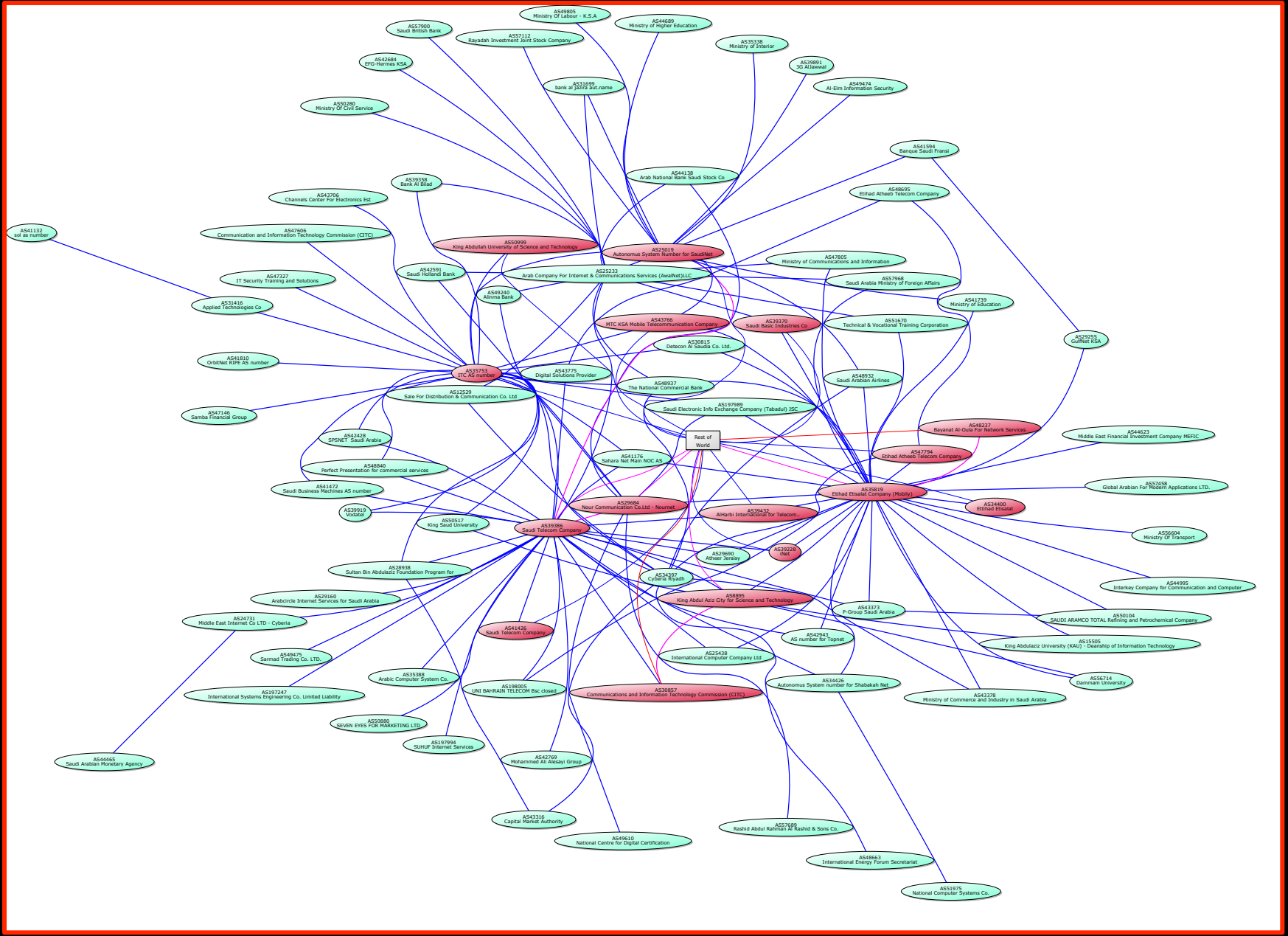
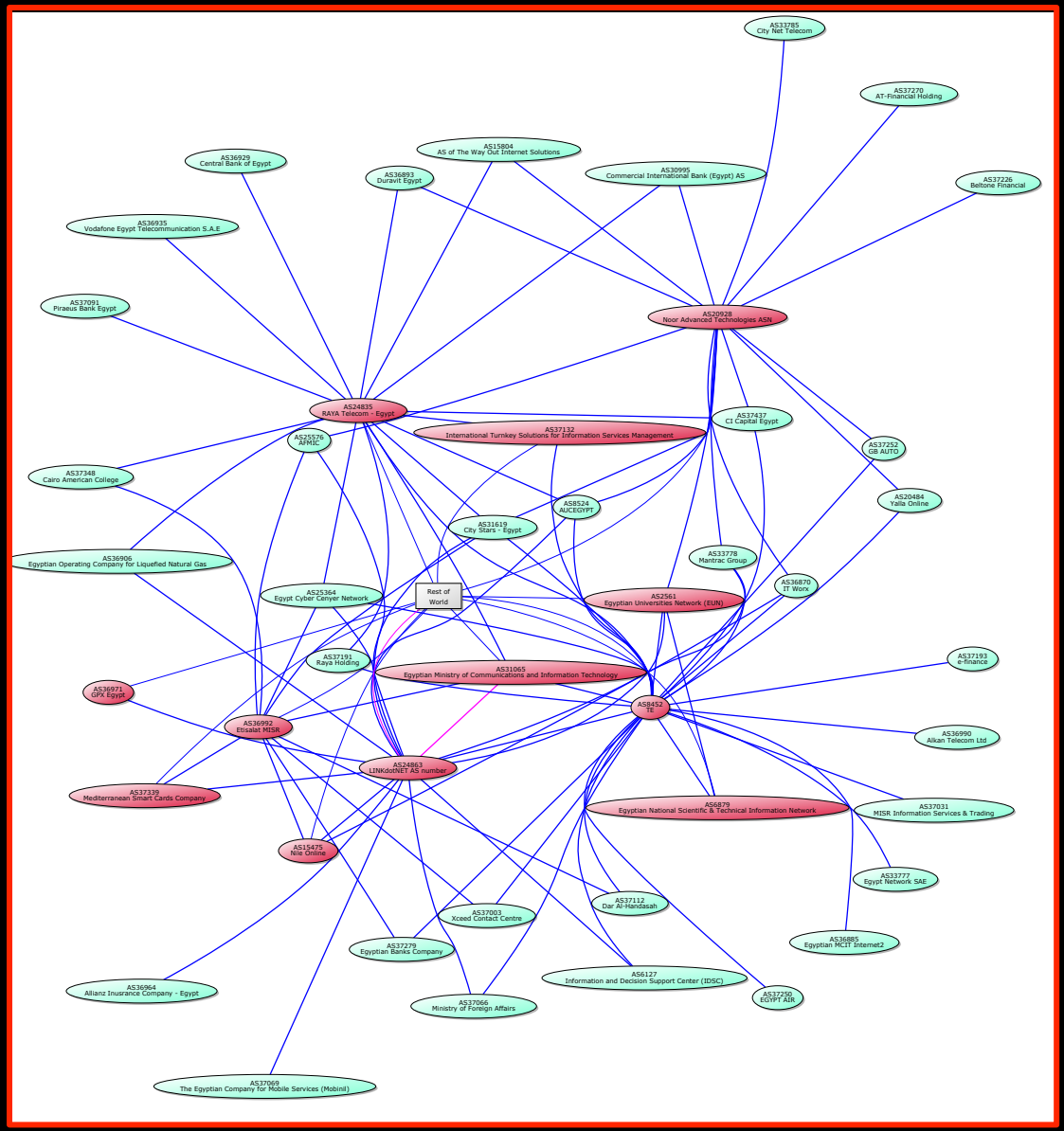
Visualizing routing within Saudi Arabia



IPv4 & IPv6

Caveat: Not all links will show within these graphs

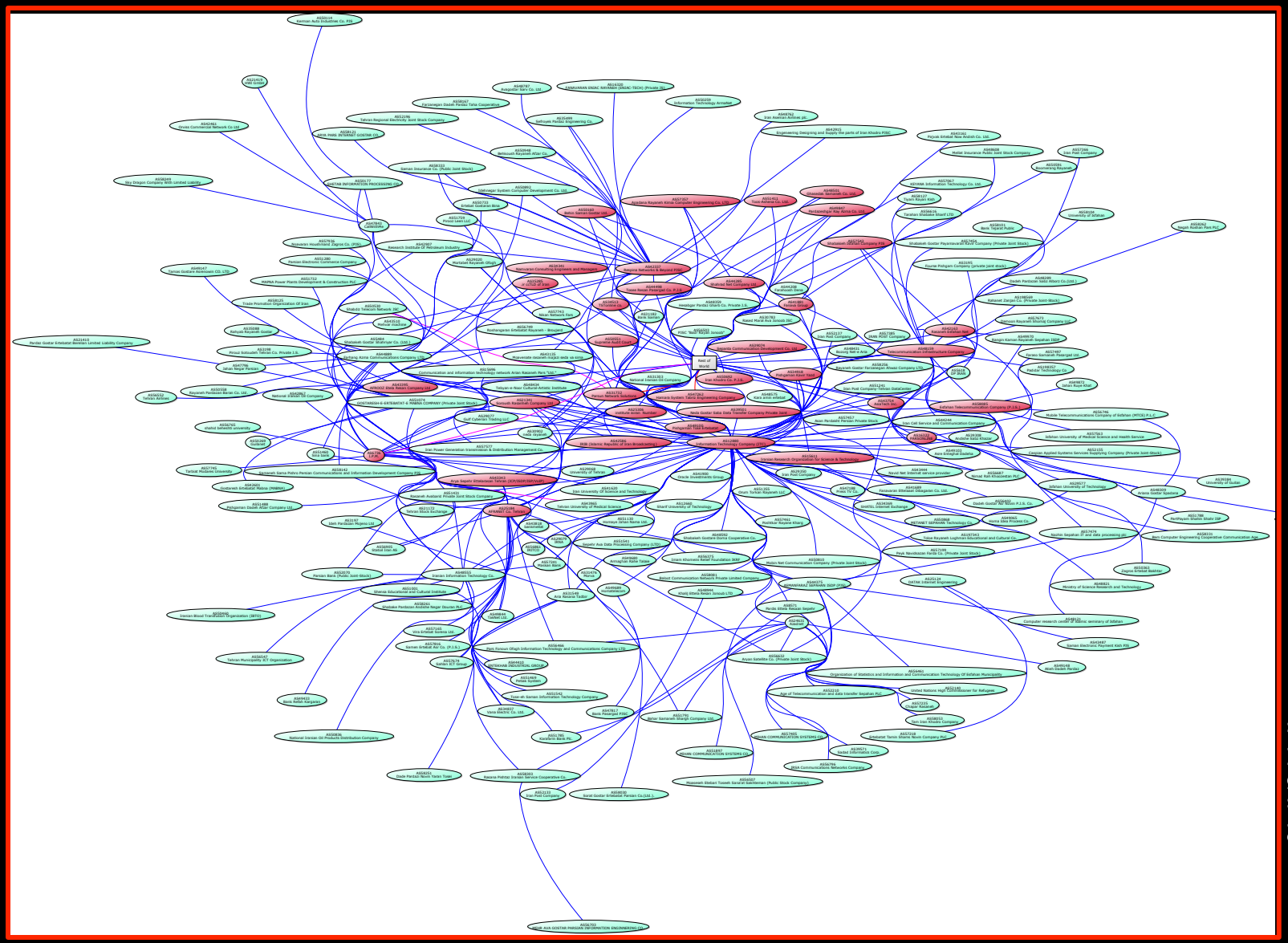
Visualizing routing within Egypt



IPv4 & IPv6

Caveat: Not all links will show within these graphs

Visualizing routing within Iran



IPv4 & IPv6

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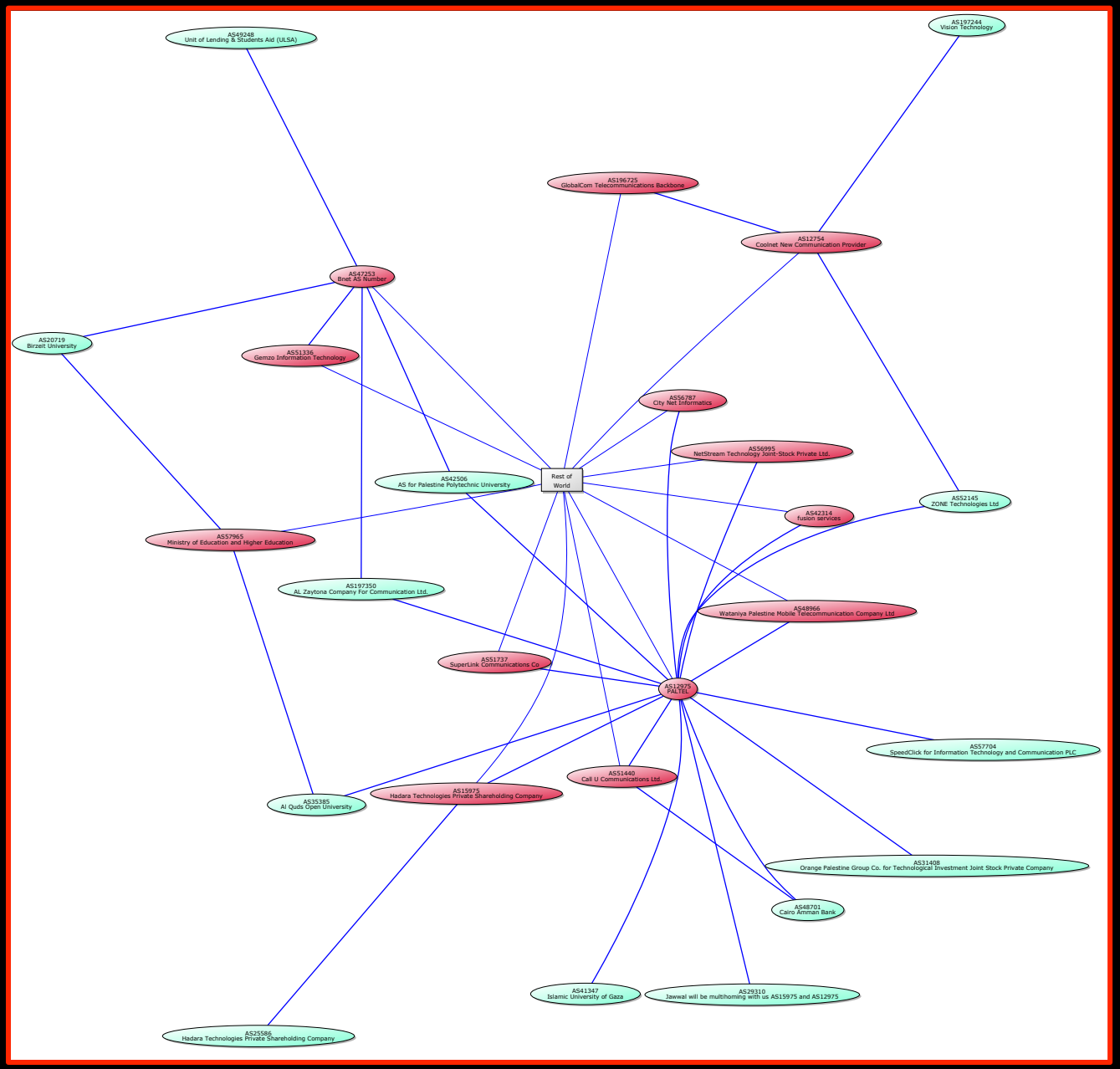
Visualizing routing within Palestinian Territory, Occupied



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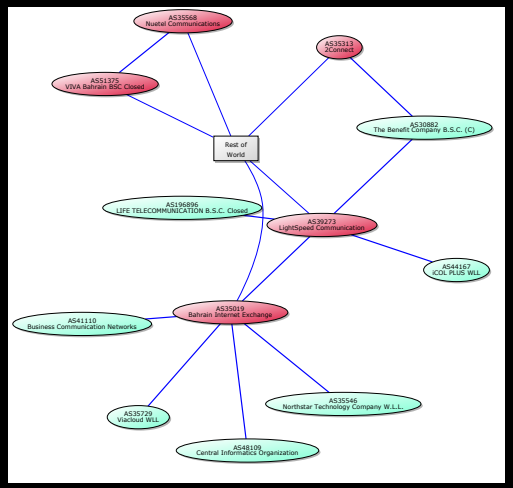
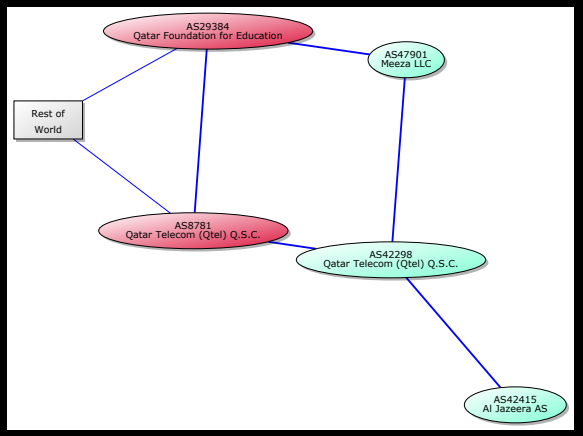
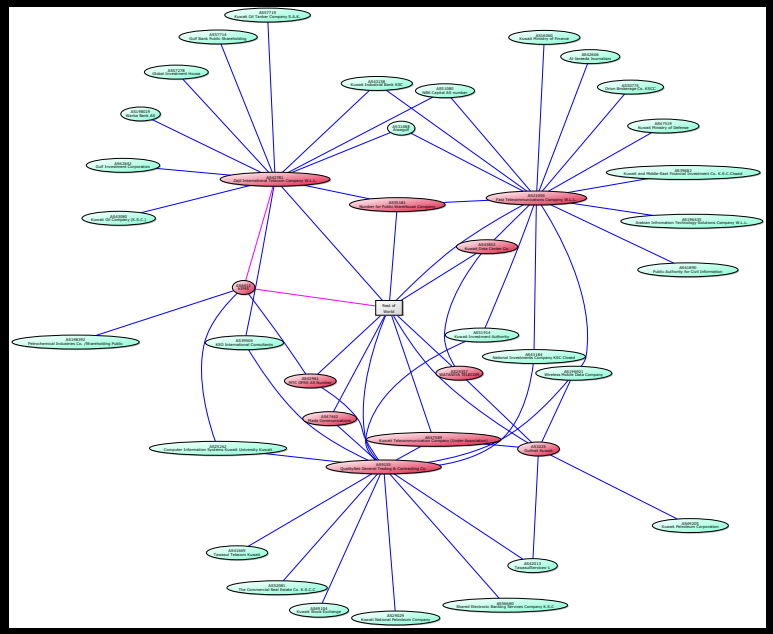
Visualizing routing in other countries …



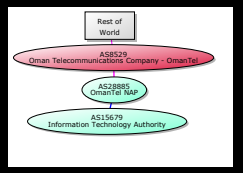
Bahrain



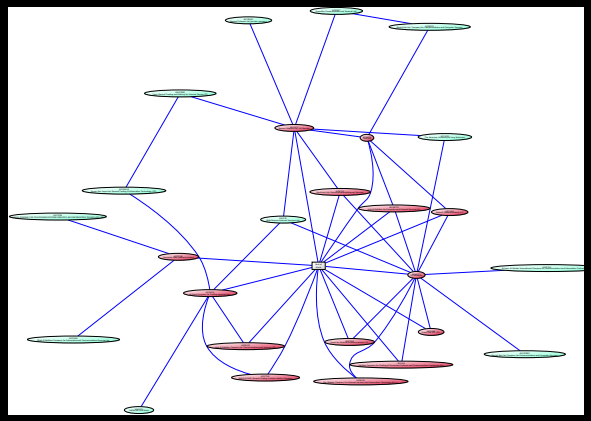
Qatar



Kuwait



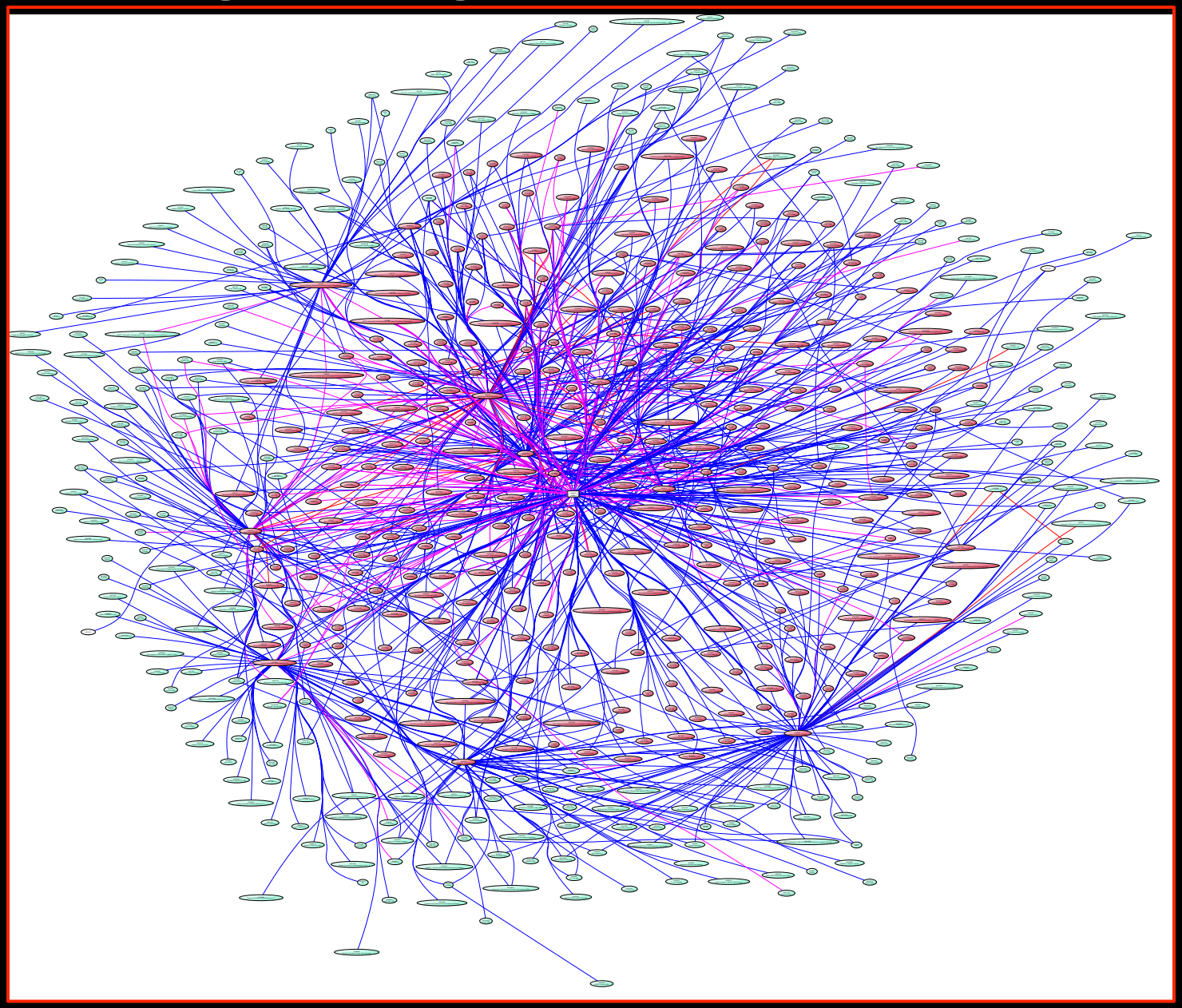
Oman



Iraq

Caveat: Not all links will show within these graphs

Visualizing routing within France

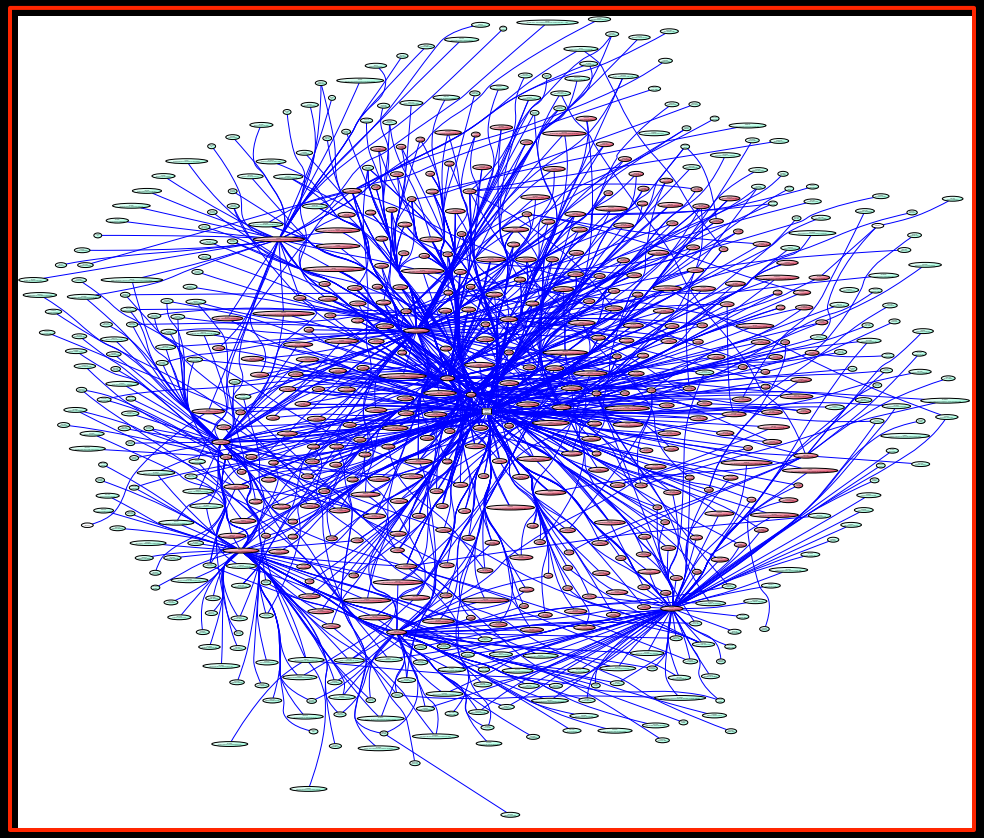


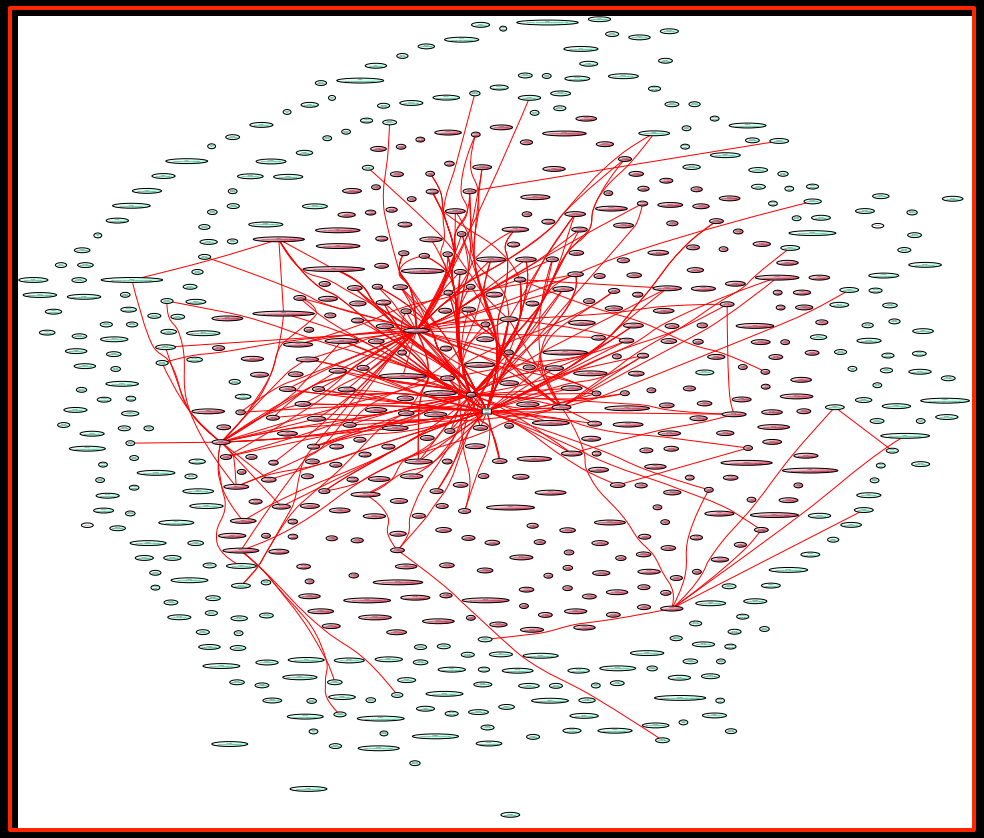
IPv4 & IPv6

Caveat: Not all links will show within these graphs

Visualizing IPv6 routing within France (cont)

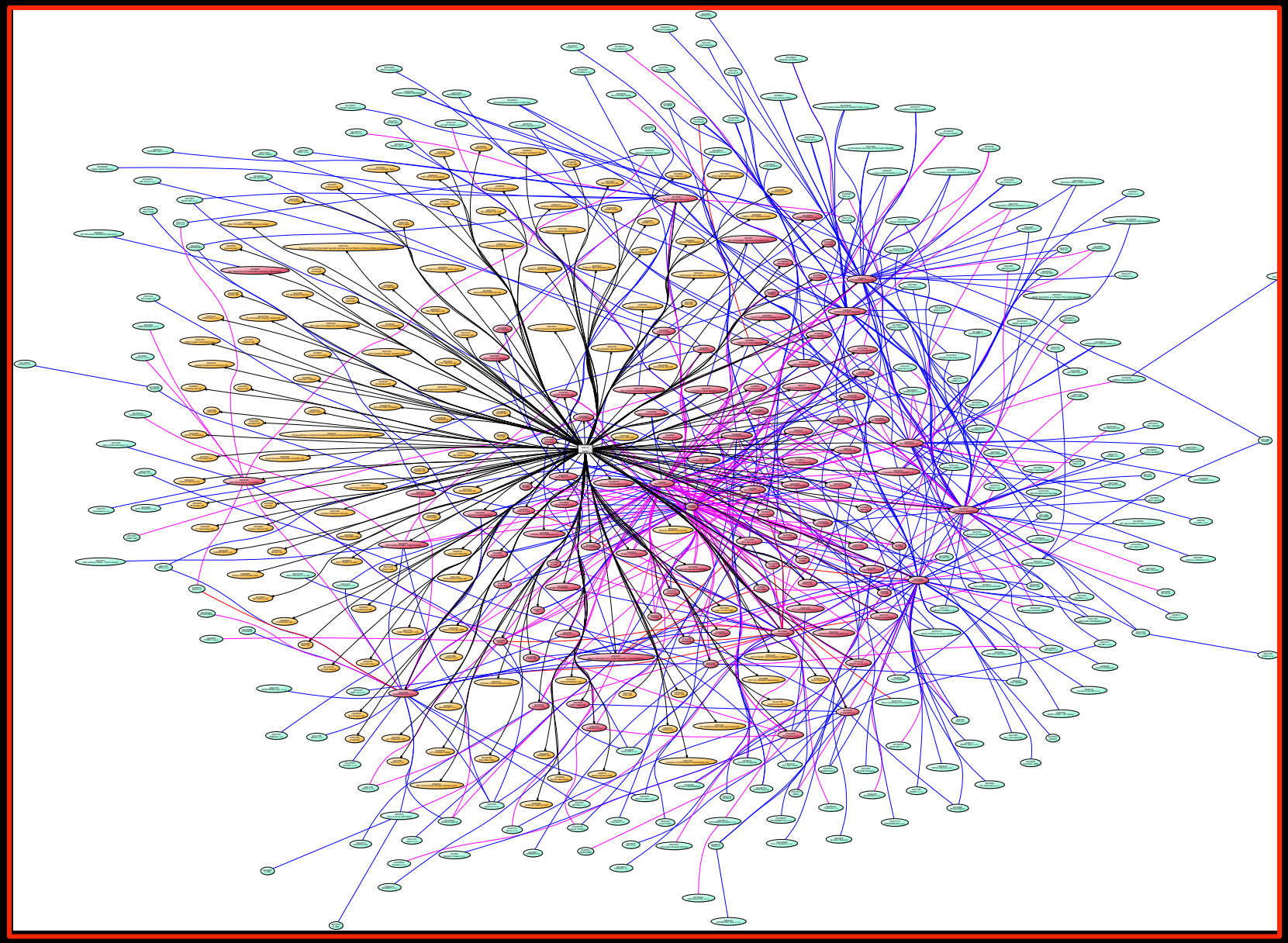
- Even in network-rich countries (like France), the IPv6 interconnection is sparse





Caveat: Not all links will show within these graphs

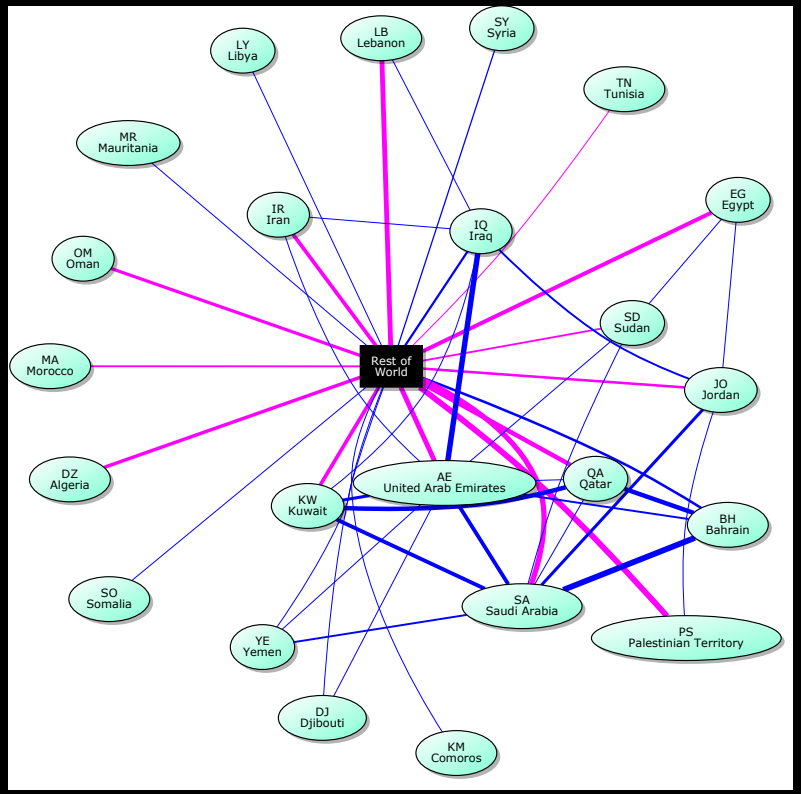
Visualizing IPv6 routing within Czech Republic

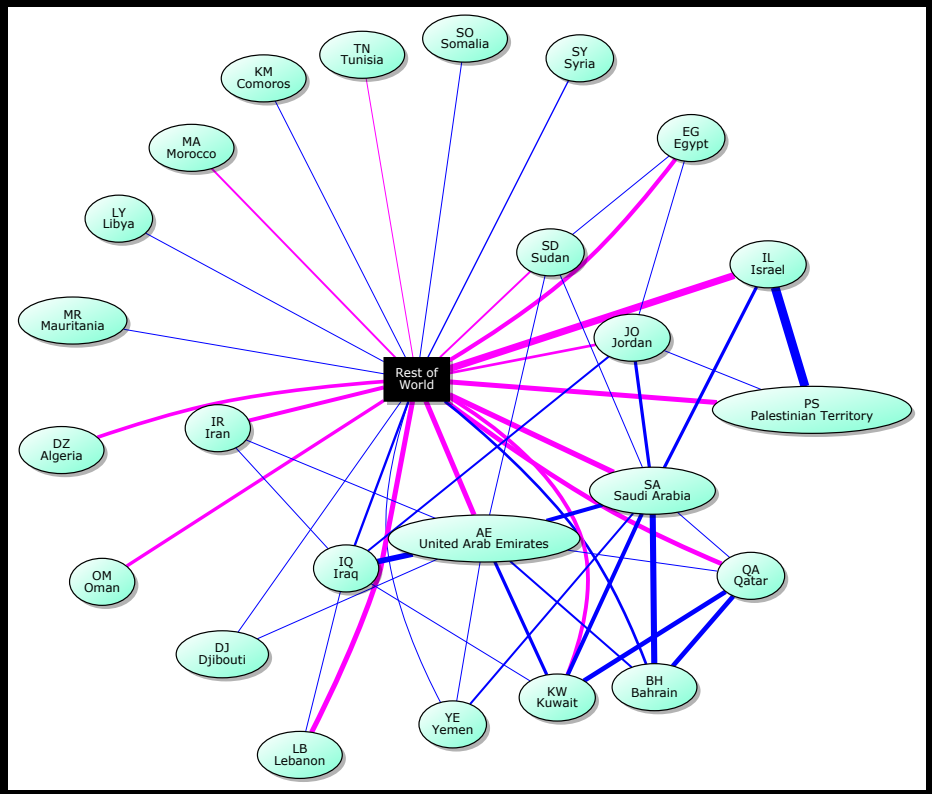


Caveat: Not all links will show within these graphs

Visualizing IPv4/IPv6 routing within the Middle East

- Methodology:
  - Look at all ASNs within one country and map ASN-to-ASN connections seen between countries
  - Thickness of lines shows number of adjacencies seen between countries
  - Only countries that have in-continent IPv4/IPv6 interconnections are shown



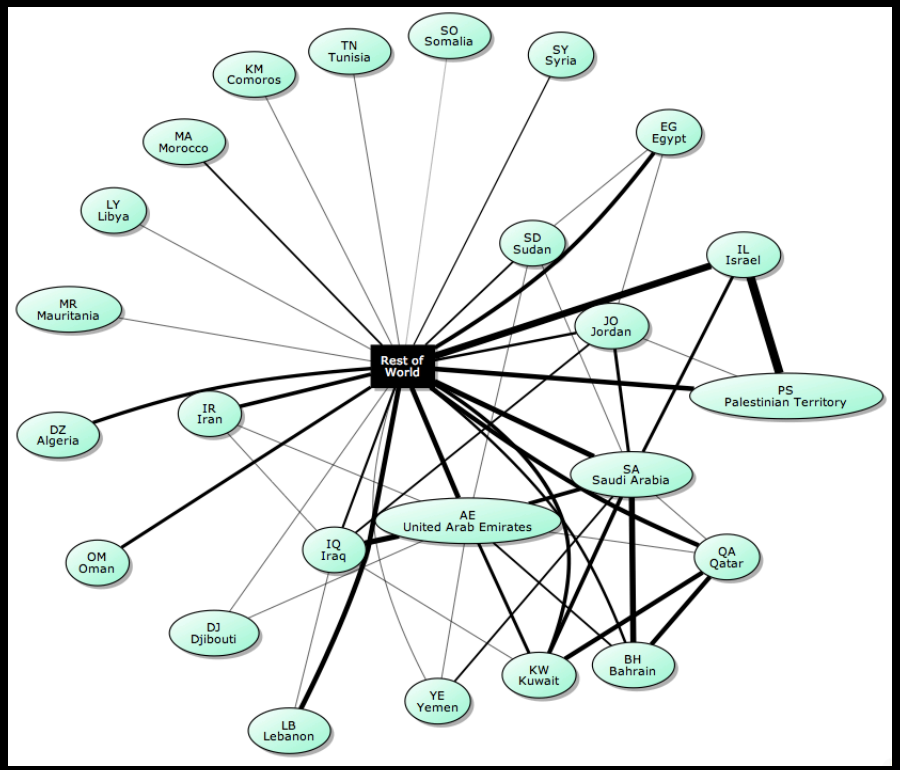


Caveat: Not all links will show within these graphs

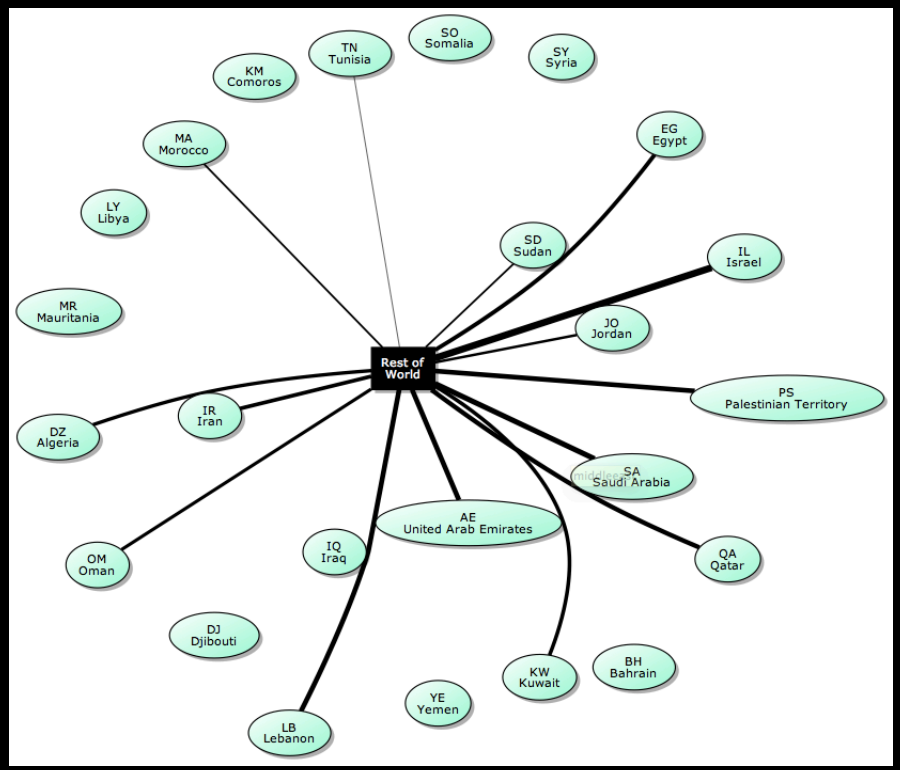
Visualizing IPv4/IPv6 routing within the Middle East

NATIVE IPv6 EVERYWHERE

- Now with IPv4 & IPv6 split



IPv4

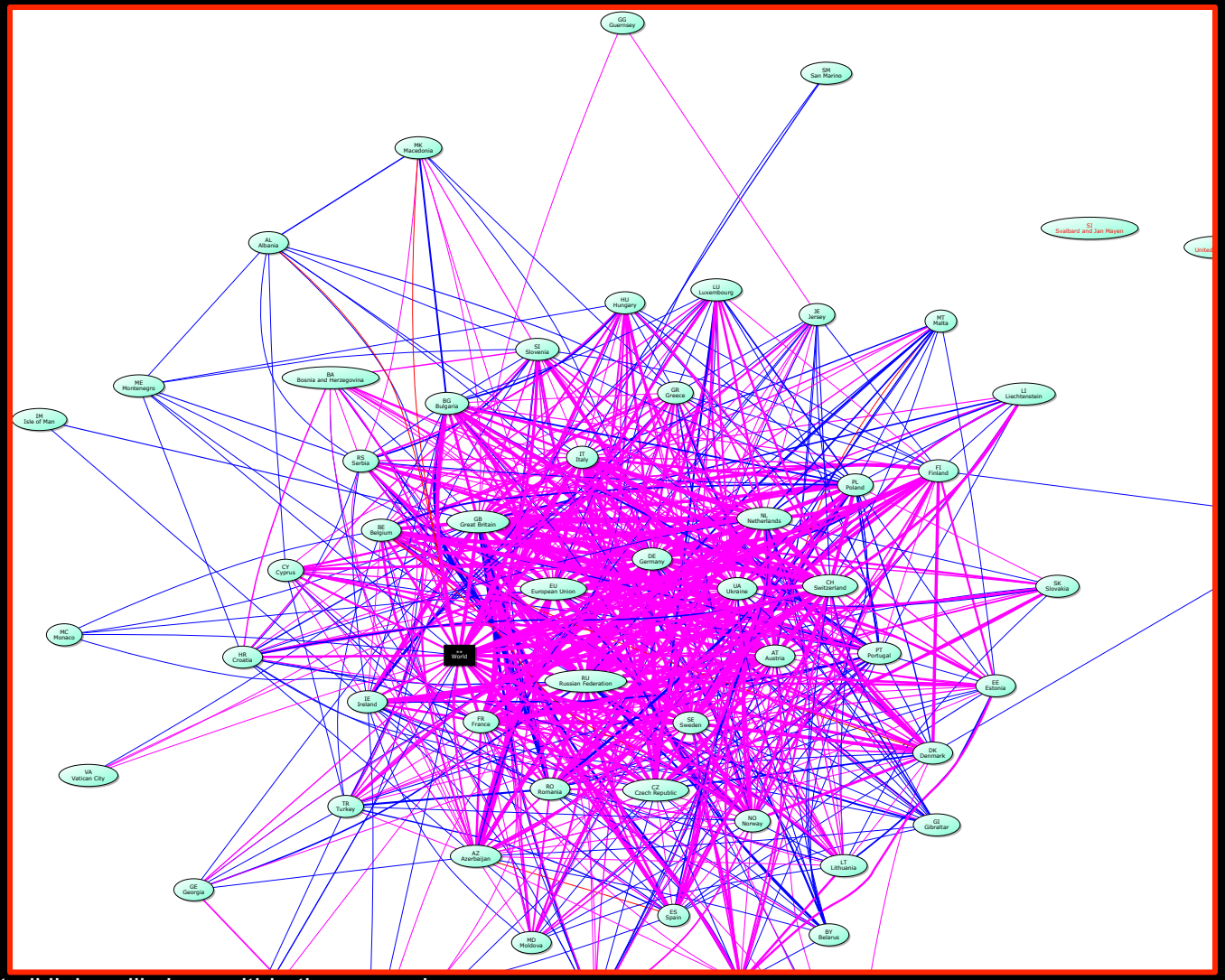


IPv6

Caveat: Not all links will show within these graphs

Examples from elsewhere in the world

- European interconnection
  - Massive number of country-to-country relationships – very rich interconnections



Caveat: Not all links will show within these graphs

The data collection and quality issue

- Without data; there's no analysis
- Two deployment methods for collectors
  - In region (should be associated with IXs)
  - Out of region (existing collectors from RIPE etc at major IXs)
- Why is there very little data?
  - BGP route collectors are not well deployed with the Middle East
  - Very few operators (that extend from the Middle East towards Europe or Asia) feed existing collectors
- Is this an issue?
  - YES! The region is not being measured or reported correctly

Review of the RIPE RIS collector locations

- Europe:
  - RRC00 -- RIPE-NCC Multihop, Amsterdam
  - RRC01 -- LINX, London
  - RRC02 -- SFINX, Paris
  - RRC03 -- AMS-IX / NL-IX / GN-IX, Amsterdam
  - RRC04 -- CIXP, Geneva
  - RRC05 -- VIX, Vienna
  - RRC07 -- Netnod, Stockholm
  - RRC10 -- MIX, Milan
  - RRC12 -- DE-CIX, Frankfurt
  - RRC13 -- MSK-IX, Moscow

Carriers with connections to Europe that feed RIPE RIS:

AE	AS8966	Emirates Telecommunications Corporation
IL	AS8551	Bezeqint Internet Backbone
IR	AS49065	Homa Idea Process Co.

This is the key issue for today

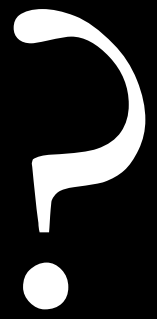
- Middle East:
- Asia:
  - RRC06 -- DIX-IE, Tokyo
- North America:
  - RRC11 -- NYIIX, New York
  - RRC14 -- PAIX, Palo Alto
  - RRC16 -- Terremark - NOTA, Miami
- South America:
  - RRC15 -- PTTMetro, Sao Paulo
- Africa:

SUMMARY

Does this produce valid BGP diagrams?

- Can you question the collected BGP data?
  - Yes - There's a need for more participating ASNs
- Can you question the quality of the data?
  - Yes - BGP is BGP – it's only "best path"
- Can you question the processing?
  - Yes - It only takes one route to show an adjacency exists
- Can you question a connection from CC_1 to CC_2?
  - Yes – in some cases peering could be in CC_3 (ie: USA)

Q&A



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