The Geopolitics of Internet Data Routes

Spintercon, December 7-9 2023

IFG
Institut Français de Géopolitique

MATT BURGESS SECURITY 15.06.2022 12:00 PM

Russia Is Taking Over Ukraine's Internet

In occupied Ukraine, people's internet is being routed to Russia—and subjected to its powerful censorship and surveillance machine.

PHOTOGRAPH: ALEXEY FURMAN/GETTY IMAGES

DATAROUTES

Mapping Internet Routes for Geopolitics

Funded by
the European Union

European Research Council

Established by the European Commission

The Geopolitics of Data Routing : a double trend

Funded by the European Union

European Research Council
Established by the European Commission

DATAROUTES
Mapping Internet Routes for Geopolitics

- Fragmentation along national borders for strategic and sovereign control over data routes and traffic
- Concentration around a few major routing operators and private platforms guided by market forces

At the intersection of several bodies of litterature

- A **methodological contribution** through innovative methodologies to understand and represent the geography of cyberspace
- An **empirical contribution** through the elaboration of a series of case studies
- A **theoretical contribution**:
  - **How does geopolitics shape cyberspace?** Strategies and practices of territorialization of cyberspace by states and big corporations (Mueller; Lambach; de Nardis)
  - **How can the observation of cyberspace uncover strategies** of territorial control in cyberspace? The strategic dimension of Internet measurements (Salamatian et al., Fontugne et al.)
  - **How do socio-technical actors align (or not) with states** to co-construct and achieve their strategic goals? (Musiani et al.; Ten Oever)
  - **How can infrastructures** be leveraged or weaponized for geopolitical control? New dimensions of cyberpower and cyberwarfare (Nye; Farell)

The fragmentation of cyberspace

Recent incidents have demonstrated how states attempt to leverage the architecture of connectivity as a tool of geopolitical control :

- Iran cut off its network from the global Internet in November 2019
- In May 2022, Russia has diverted Ukraine's Internet traffic in occupied territories
- Ukraine's government asked Internet governance organizations to cut off Russia from the Internet

They raise a methodological question :

- **how can the analysis of the Border Gateway Protocol infer and document these strategies of territorialization and fragmentation of cyberspace ?**

MARCH 1, 2022 1:21AM ET

Exclusive: Ukraine Pushes to Unplug Russia From the Internet

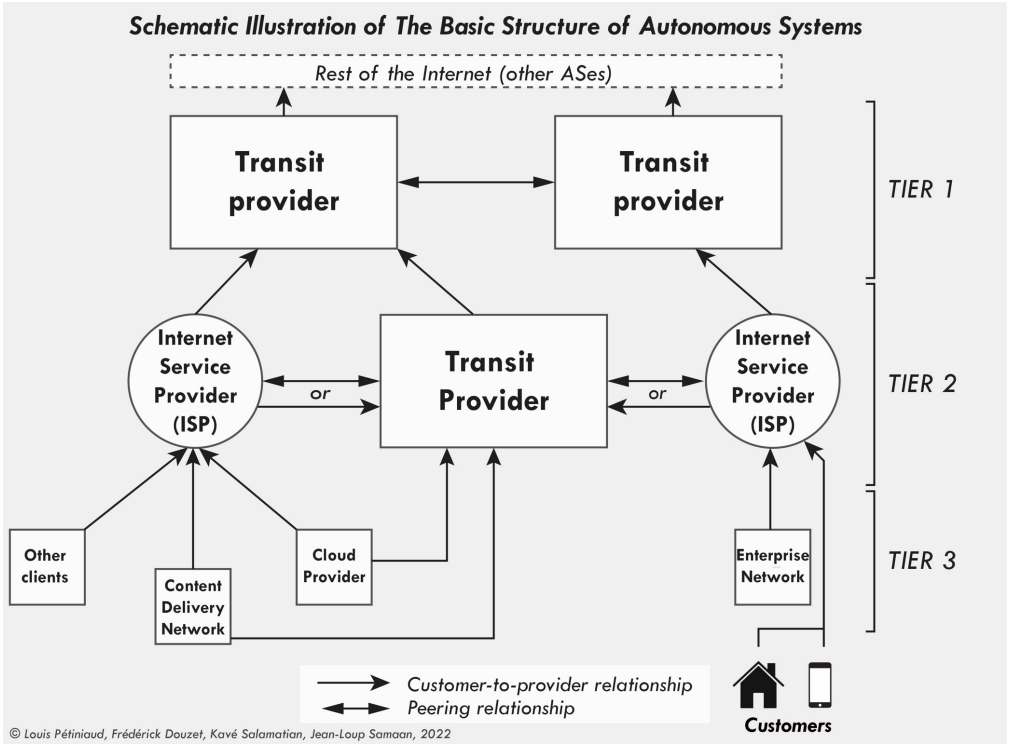
Disconnecting Russian sites would send a strong message to a regime pumping out digital propaganda. Experts say it could be a disaster

By KAT BOUZA & NOAH SHACHTMAN

Methodology

Data collection

- **AS level data**
  - Flows of BGP announcements
    - 65 feed : RIS, Routeviews
    - Clearing Packet House (CPH)
- **BGP Observatory**
  - Operational system
    - Over 15,000 lines of code in C++
    - Multi-thread

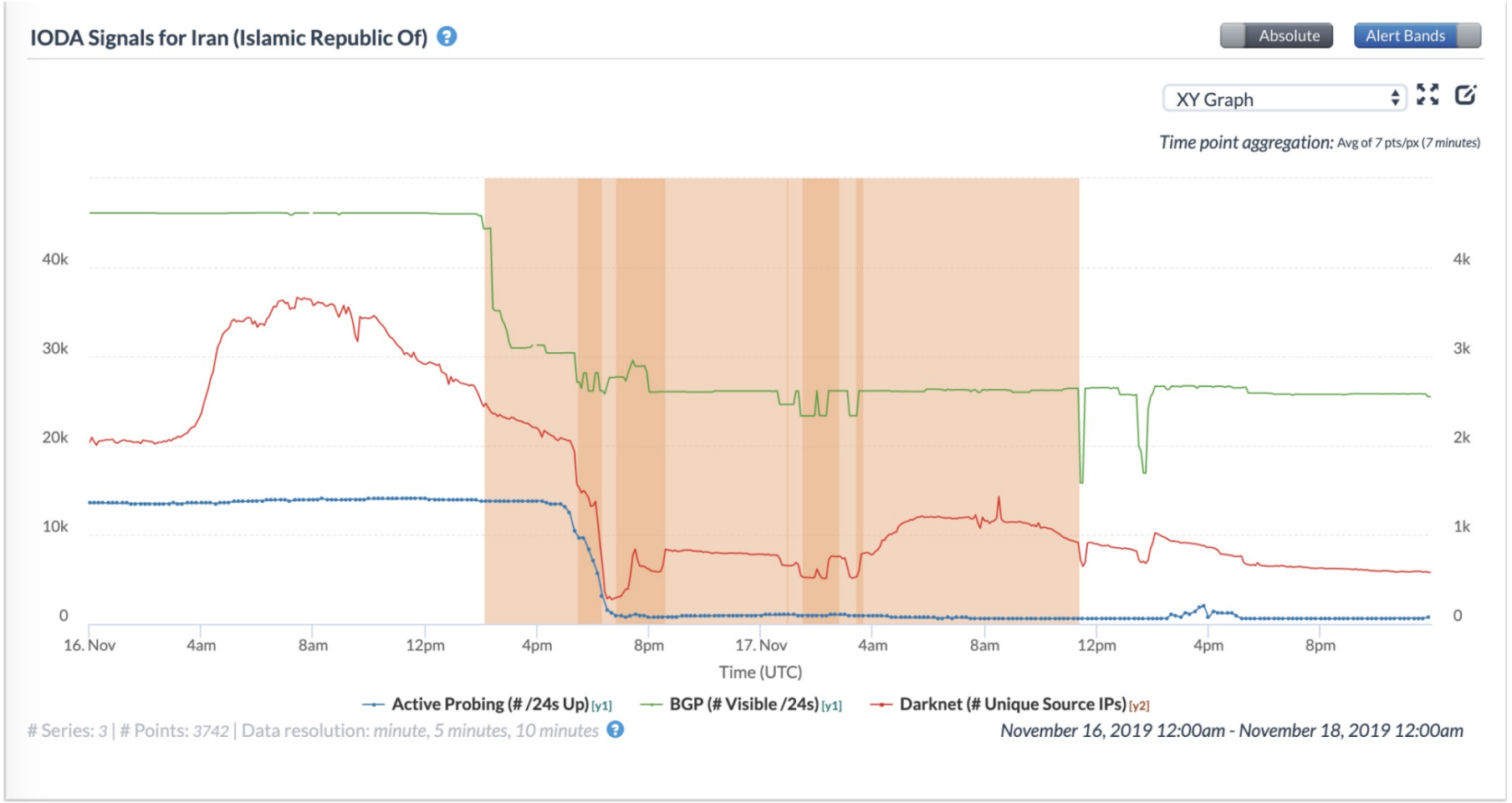


•collector': 'rrc19', 'message': 'announce', 'peer': {'address': '197.157.79.173', 'asn': 37271}, 'time': 1515110408, 'fields': {'asPath': ['37271', '6939', '52320', '23106', '23106', '23106', '262700'], 'prefix': '187.102.120.0/21', 'nextHop': '197.157.79.173'},

• 'flags': {'geoPath': ['ZA', 'US', 'CO', 'BR', 'BR'], 'names': ['Workonline Communications(Pty) Ltd', 'Hurricane Electric, Inc.', 'GlobeNet Cabos Submarinos Colombia, S.A.S.', 'Cemig Telecomunicações SA', 'Efibra Telecom LTDA - EPP'], 'risk': 9.262460855949895e-05, 'category': None}}

- **Every minute a snapshot of the global AS BGP graph**

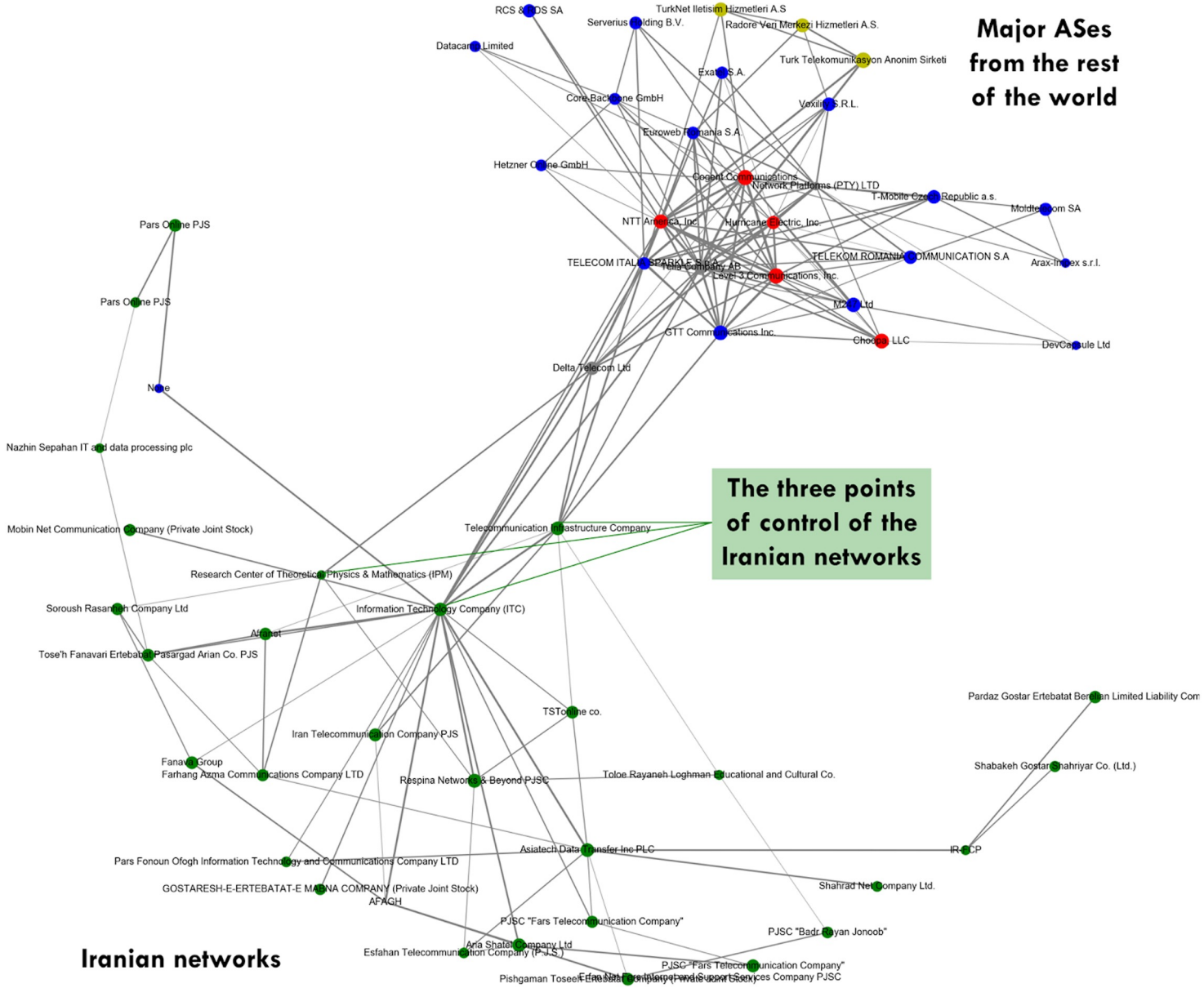
Iran: a network controlled at its borders



Source: Internet Outage and Detection Analysis (IODA): Iran (Nov 16 to Nov 18)

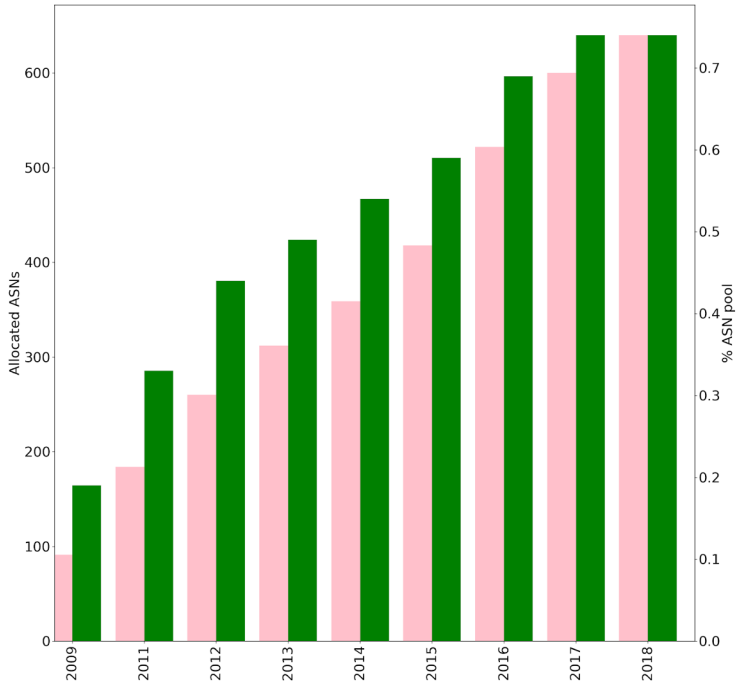
Loqman Salamatian, Frédérick Douzet, Kavé Salamatian, Kévin Limonier

The external connectivity of the Iranian network: A Strategic Bottleneck

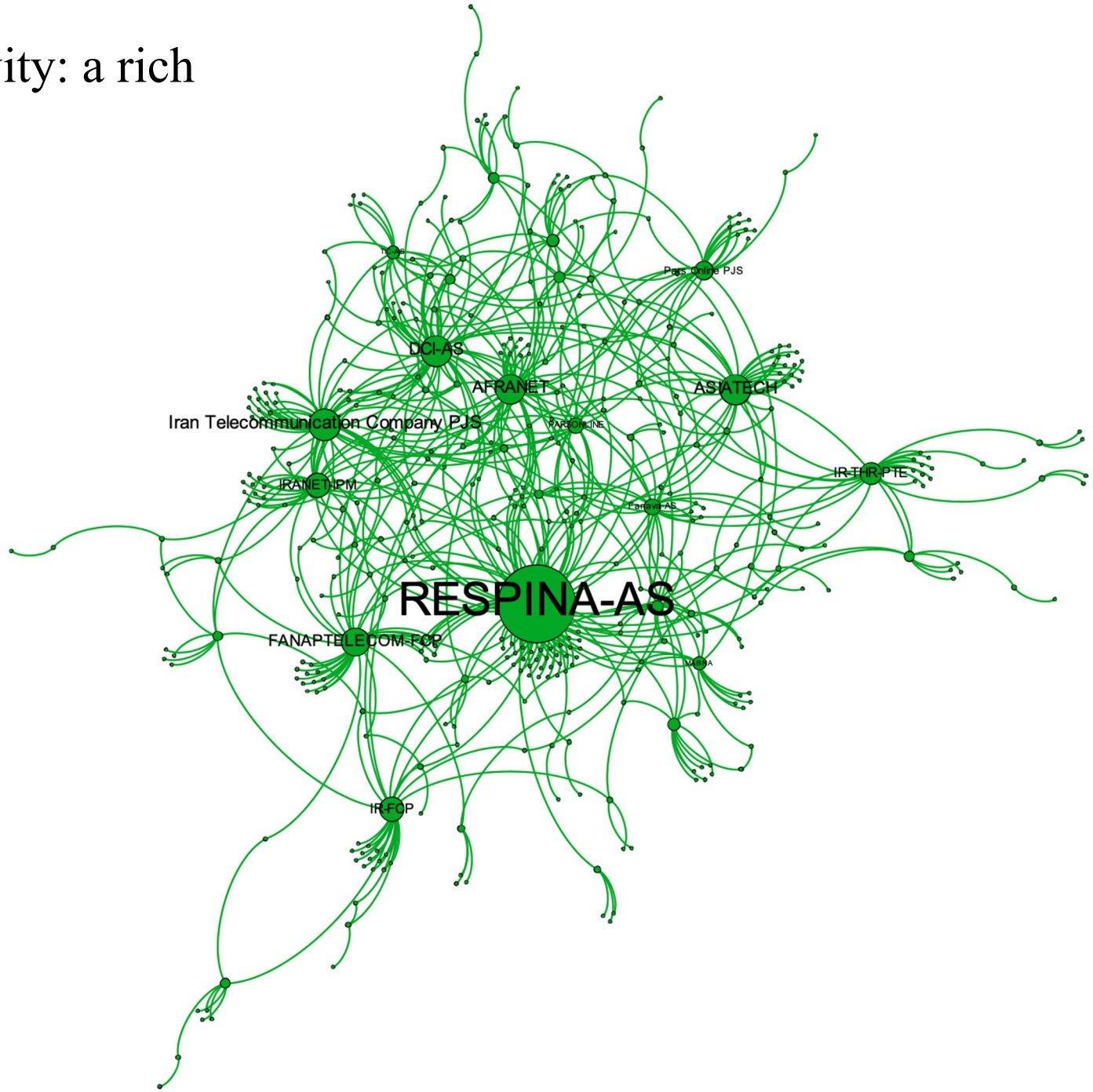


The Internal Structure of connectivity: a rich and decentralized network

The Iranian Network emerges after the Stuxnet attack



Number of Ases 2009-2018



Digital Routes and Borders in the Middle-East

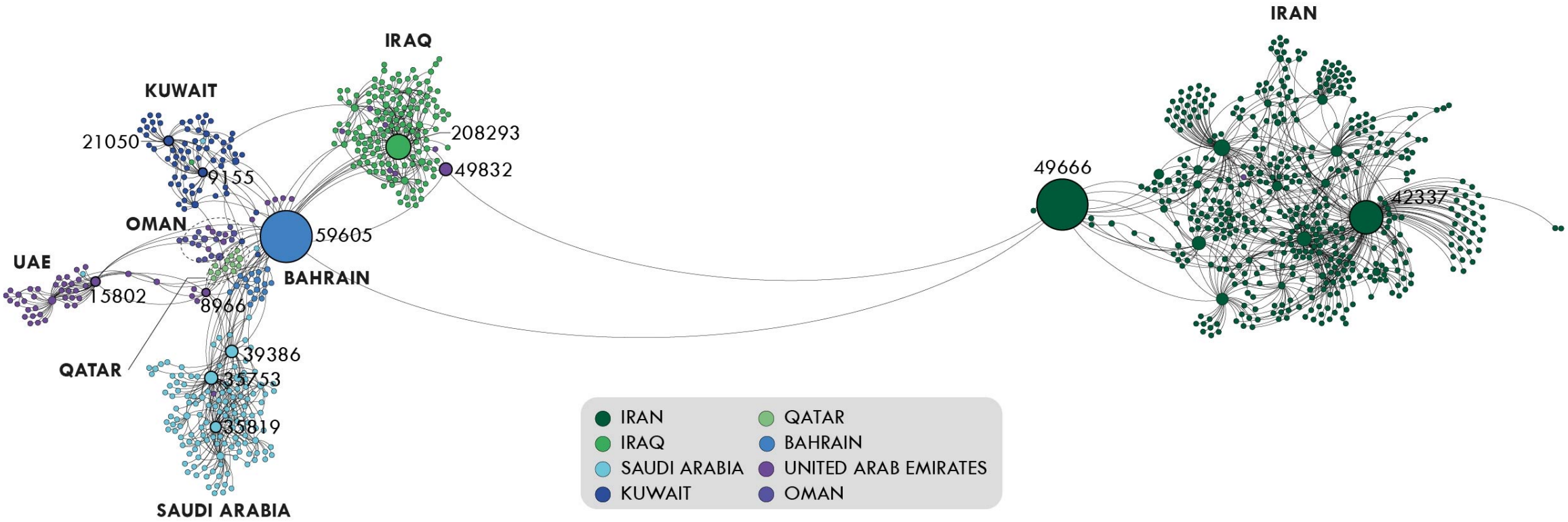
Over the past decade, the Gulf region experienced major foreign policy changes that suggested a reshuffling of the region as a security complex, particularly in the domain of cybersecurity cooperation.

1. Do these foreign policy shifts apply to cyberspace? Does the architecture of the network reflect them?

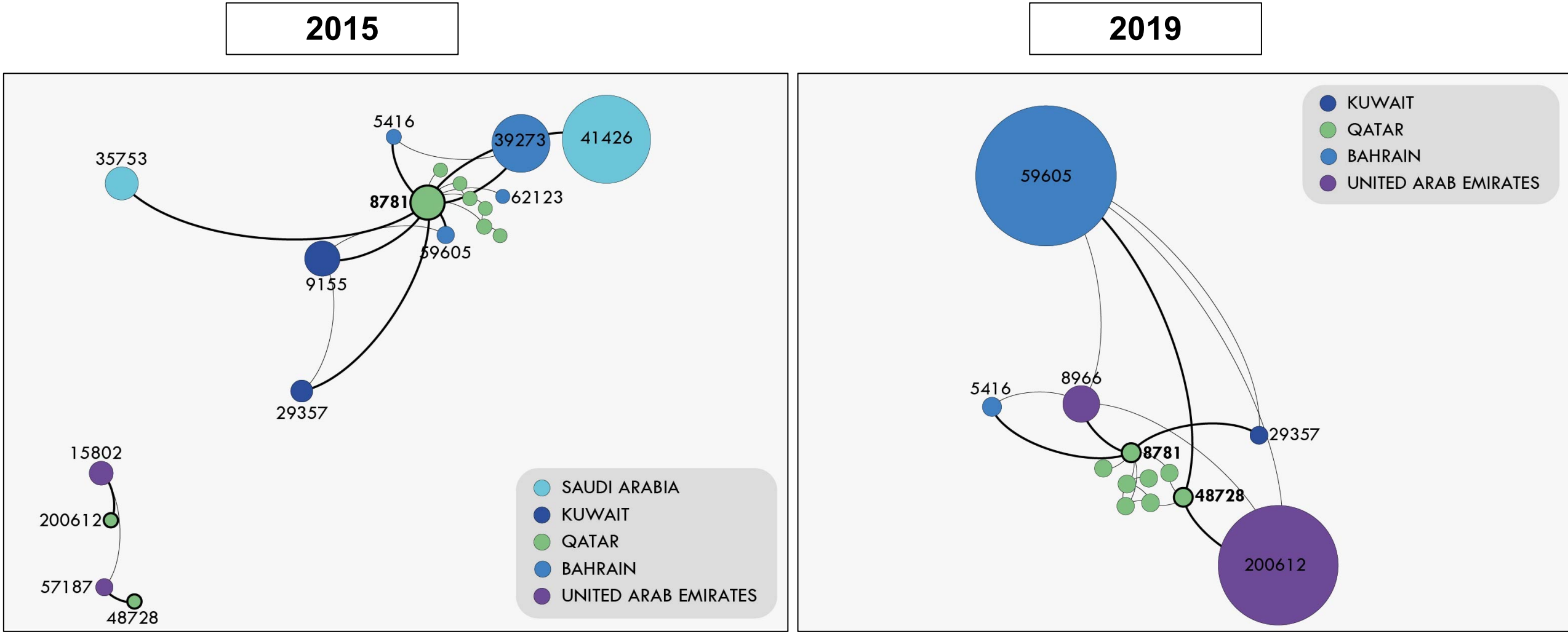
2. Related methodological question: How can the analysis of the topology of the network inform field work through the identification of relevant actors?

Source : F. Douzet, L. Pétiniaud, K. Salamatian, J.L. Samaan, Digital Routes and Borders in the Middle-East, *Territory, Politics, Governance*, 2023, Vol 11, n°6

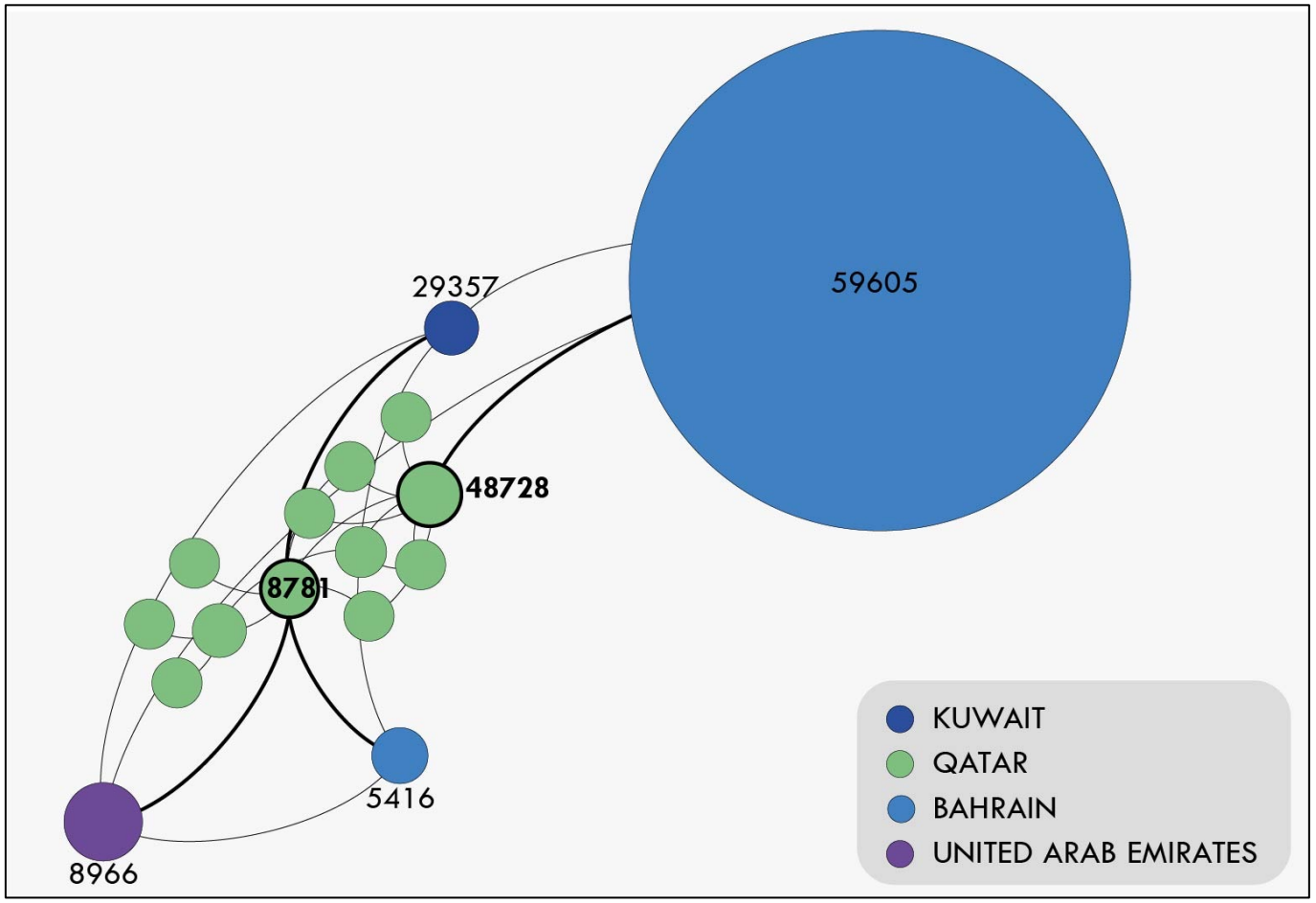
Internal Connectivity of The Gulf Region, 2021



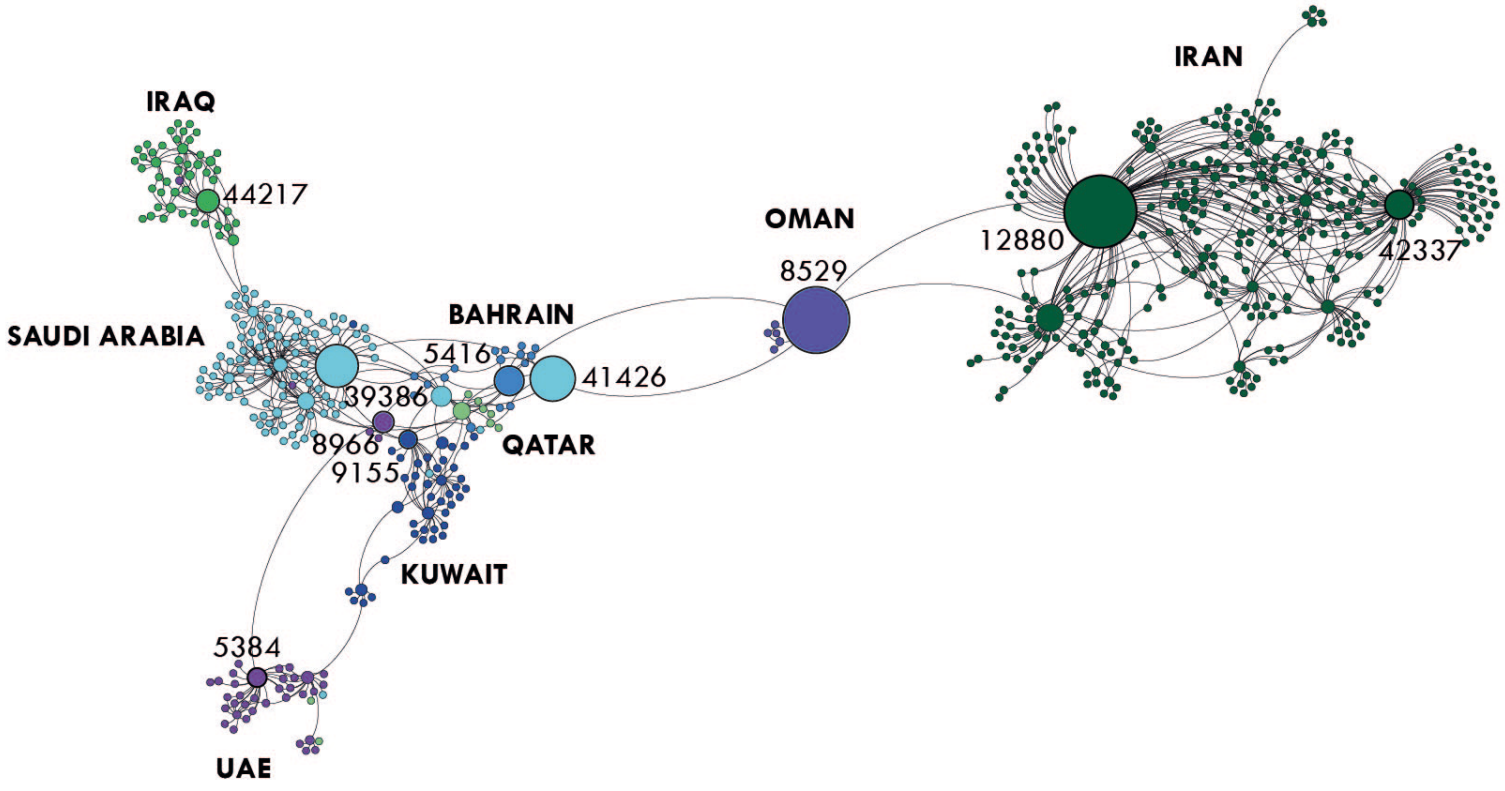
Connectivity of Qatar within the Gulf Region, 2015



Connectivity of Qatar within the Gulf Region, 2021

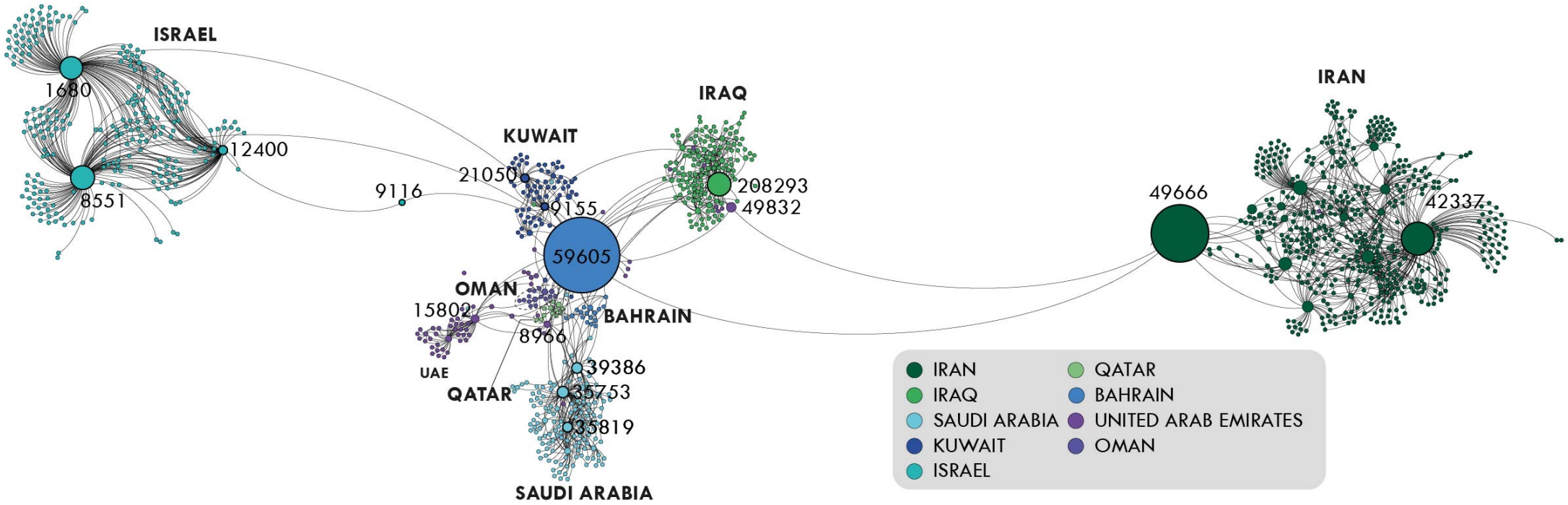


Internal Connectivity of The Gulf Region and Israel, 2015

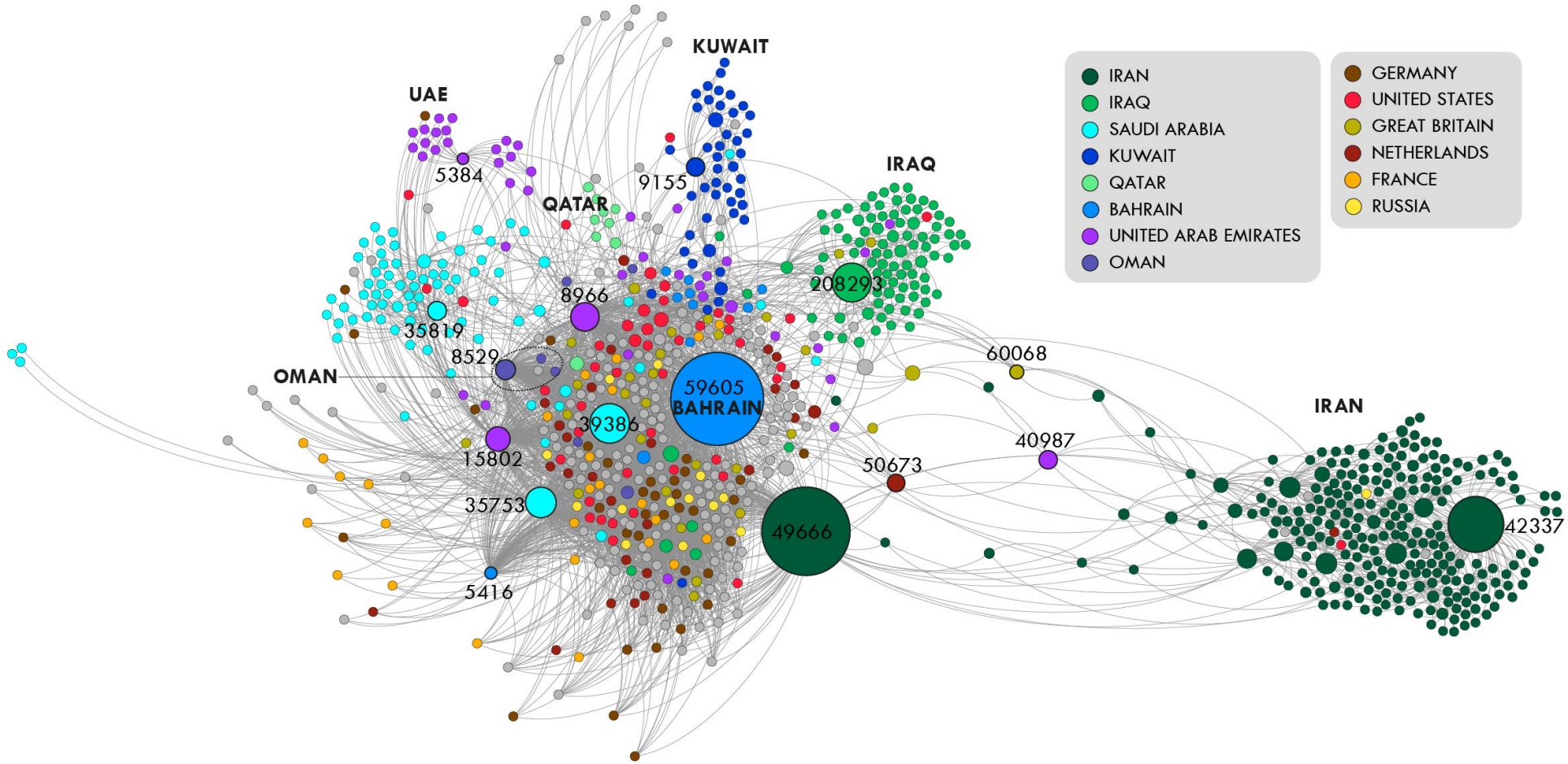


- IRAN
- IRAQ
- SAUDI ARABIA
- KUWAIT
- QATAR
- BAHRAIN
- UNITED ARAB EMIRATES
- OMAN
- ISRAEL

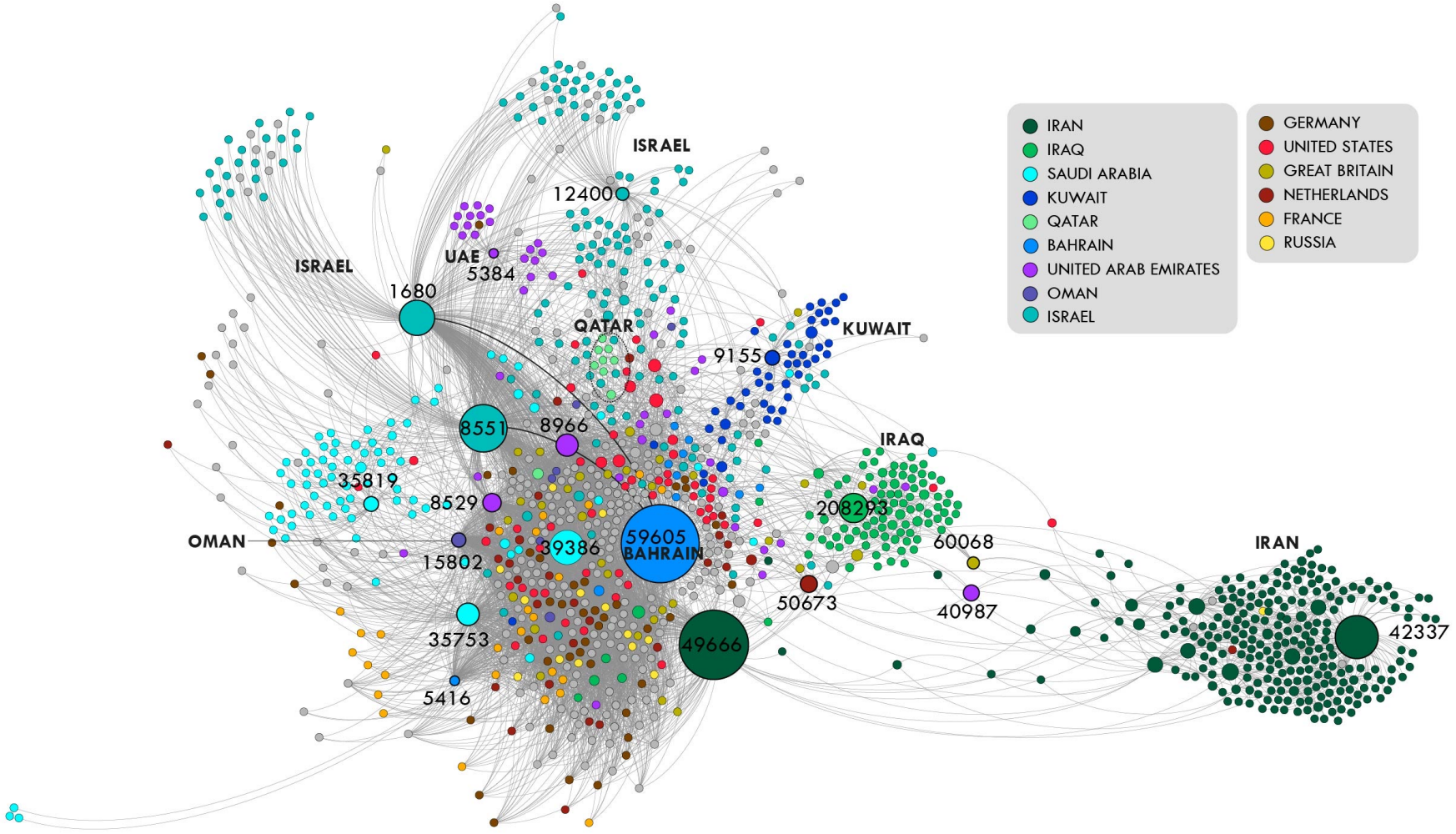
Internal Connectivity of The Gulf Region and Israel, 2021



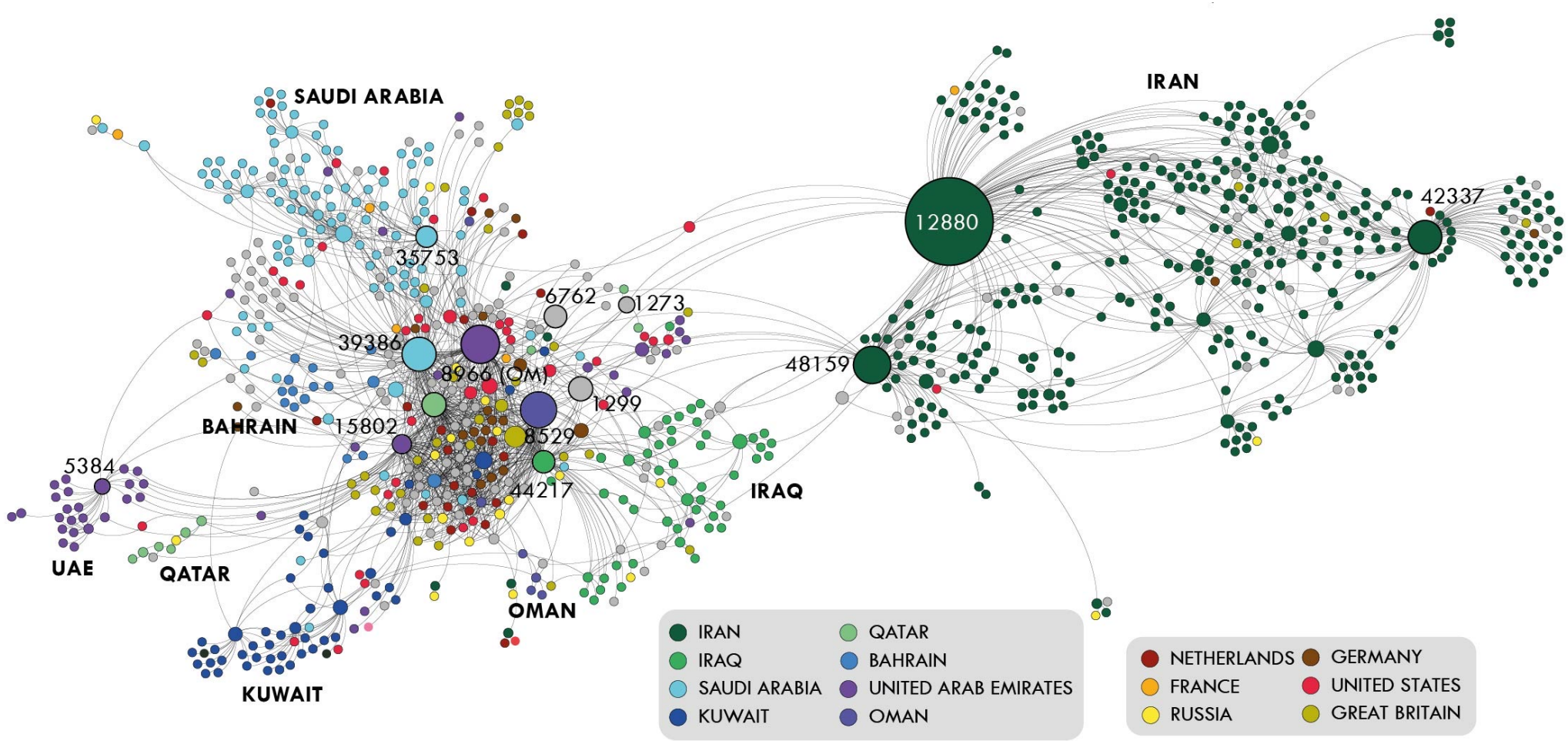
Connectivity of The Gulf Region and Their Neighbors, 2021



Connectivity of The Gulf Region, Israel, and Their Neighbors, 2021



Connectivity of The Gulf Region and Their Neighbors, 2015



The Fragmentation of Ukraine's Cyberspace

Our study shows actions on BGP implemented right after the 2014 Maidan Revolution, when Russian forces took control of the Crimean Peninsula and started to back separatist forces in Eastern Ukraine.

We observe three trends:

1. the break-up and progressive integration of Crimea into the Russian network;
2. the marginalization of Donbass;
3. the gradual increase in the distance between the two countries.

Source : Frédérick Douzet, Louis Pétiniaud, Loqman Salamatian, Kavé Salamatian, Kévin Limonier, Thibaut Alchus

Fig. 1 Representation of Ukrainian Autonomous Systems and their Direct Neighbors, June 2019

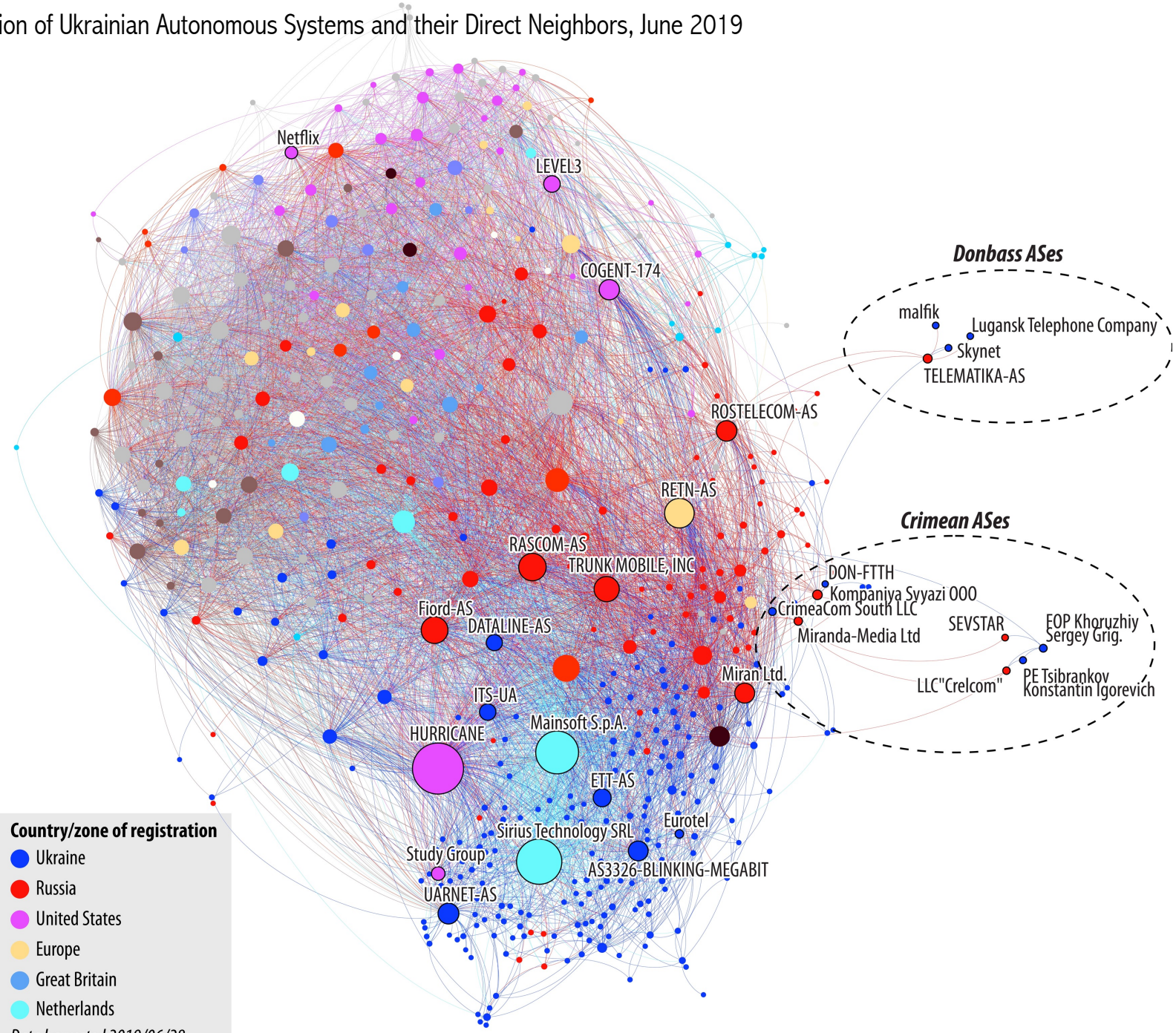


Fig. 5 - Representation of Ukrainian and Russian ASes, September 2013

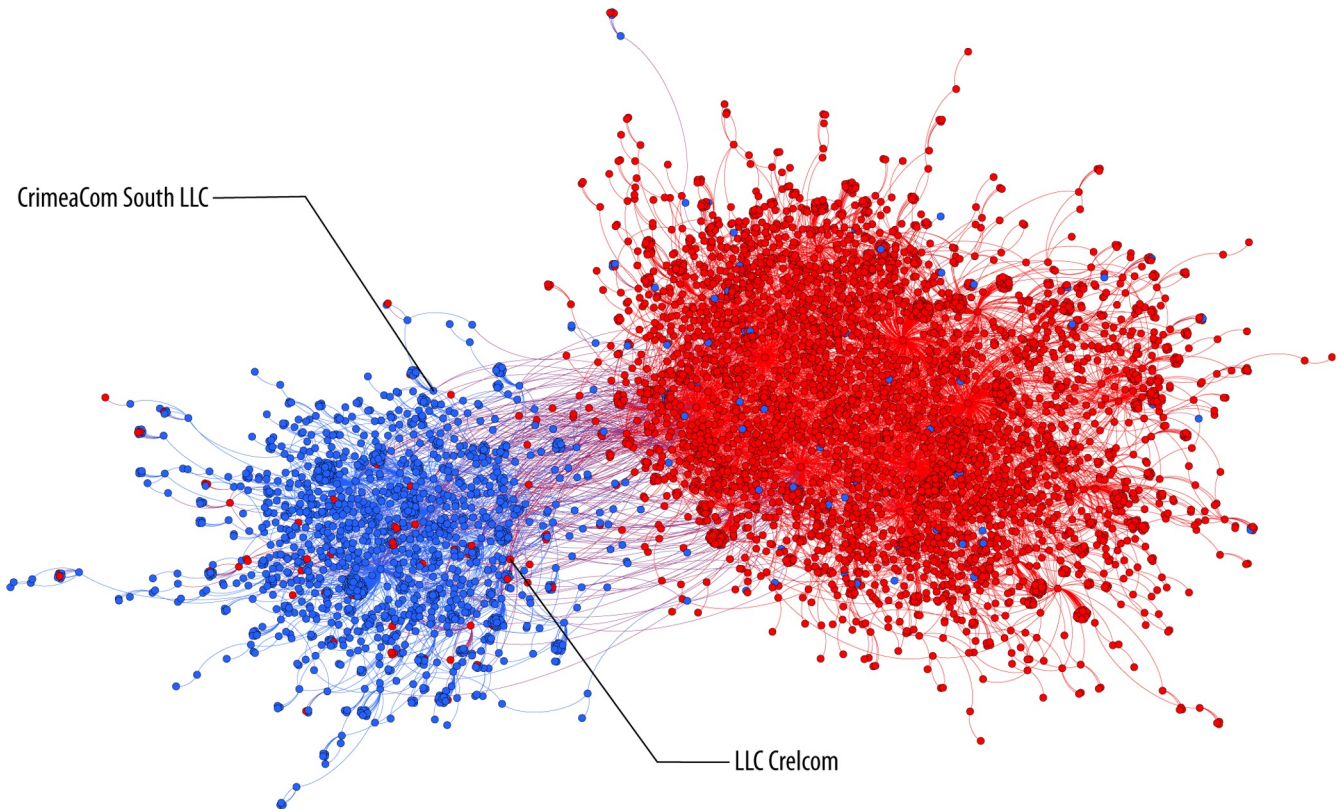


Fig. 6 - Donbass and Crimea : scattered "territories" of cyberspace, June 2019

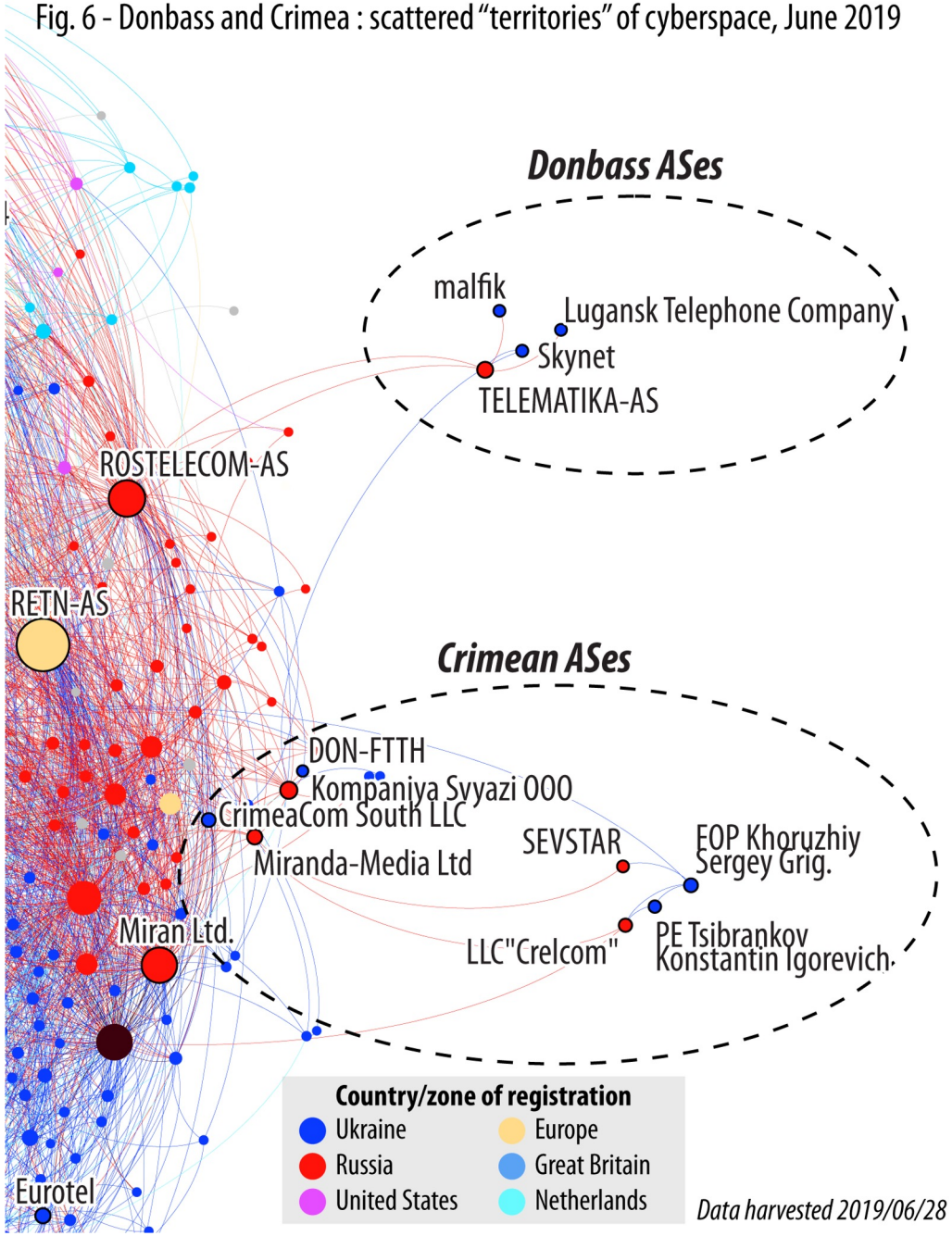
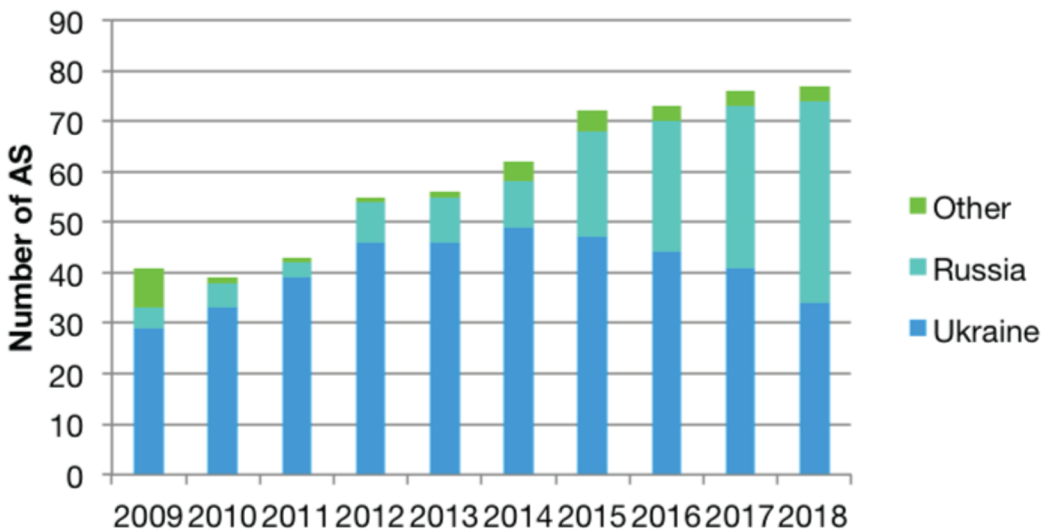


Fig. 7 - Distribution overtime of Crimea's ASes by country of registration



Source: Ksenia Ermoshina, 2018

Fig. 8 - Representation of Crimea ASes and their direct neighbors, June 2019

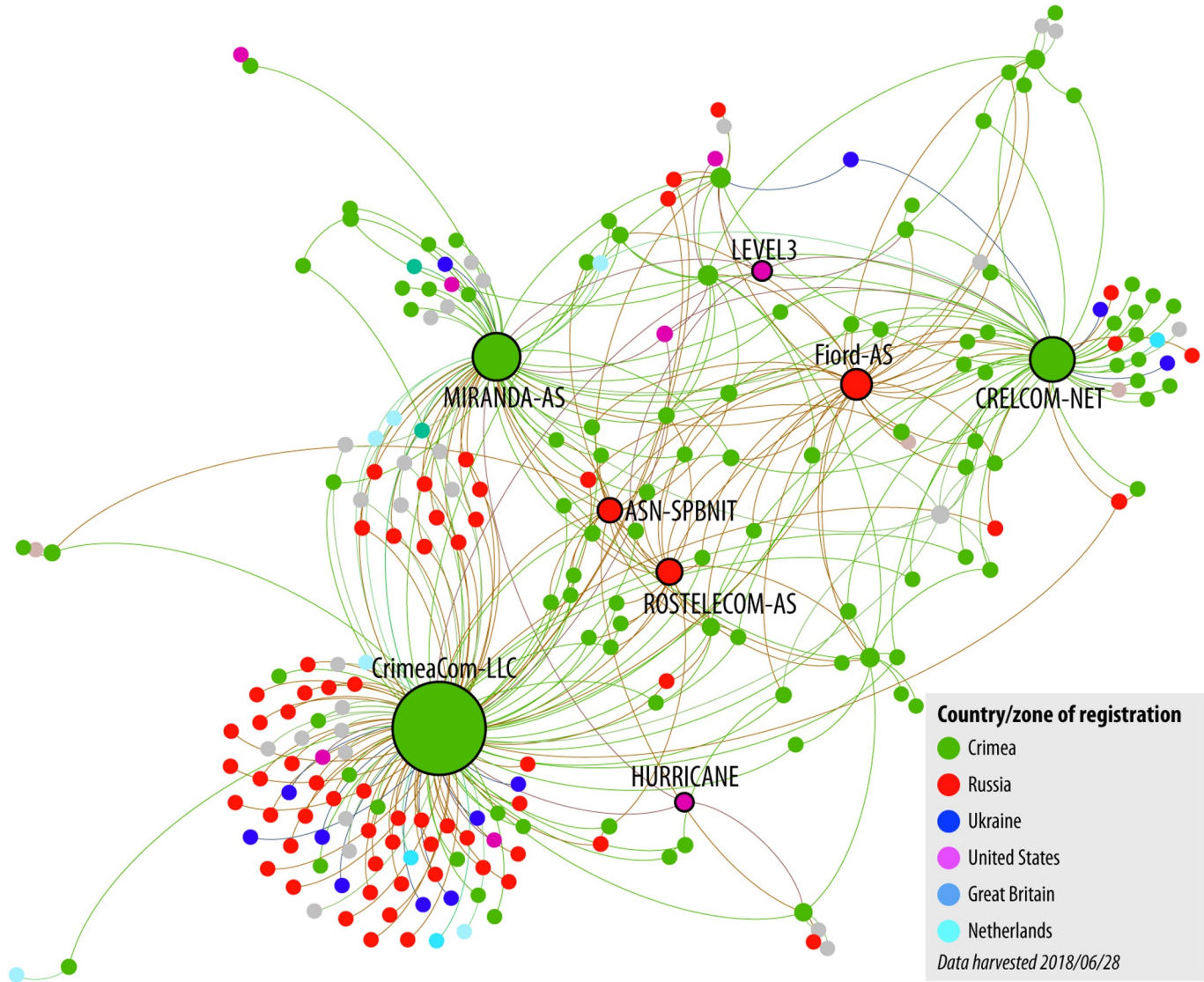


Fig. 11 - The fragmentation of Ukraine's Cyberspace 2014-2018

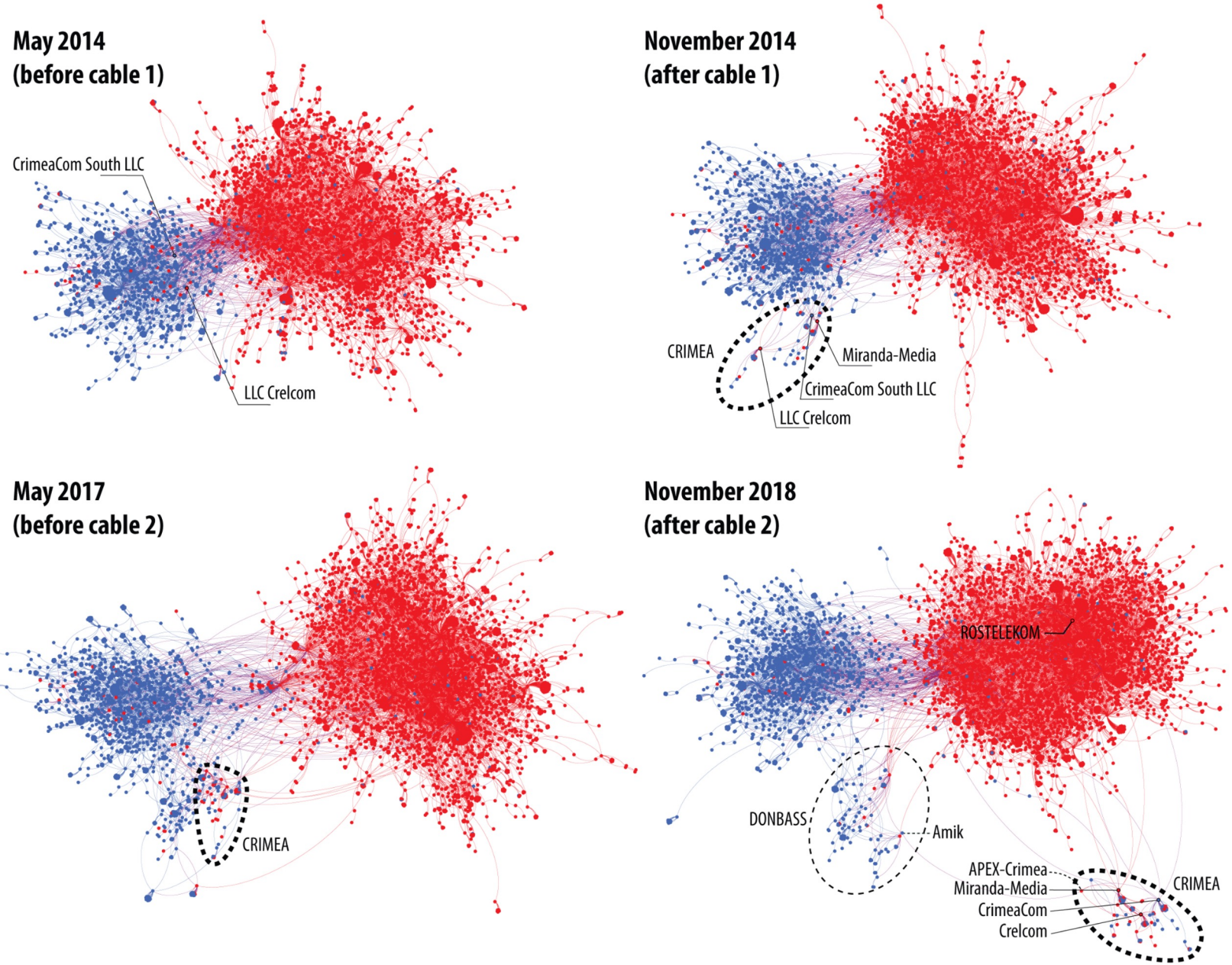
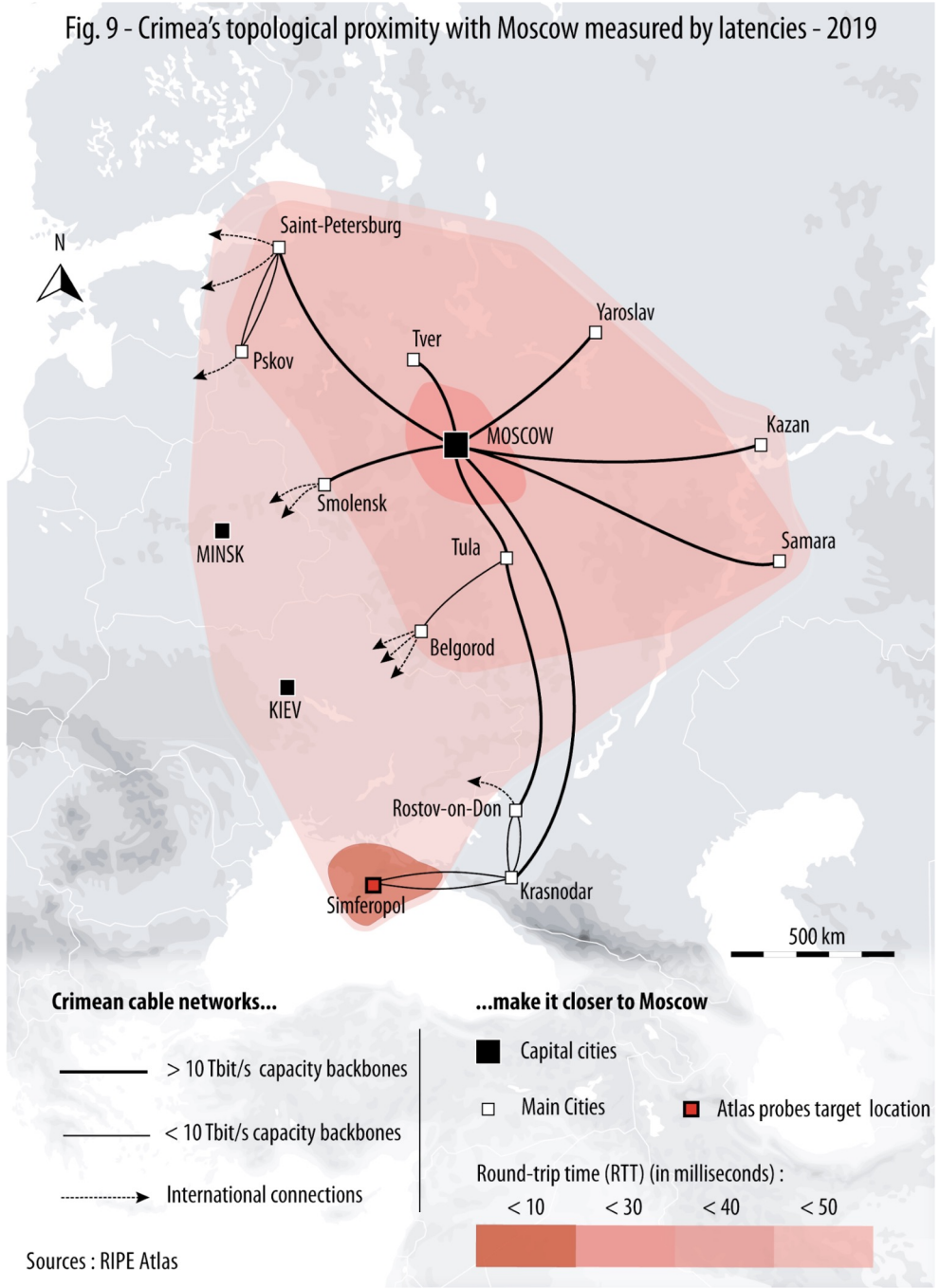
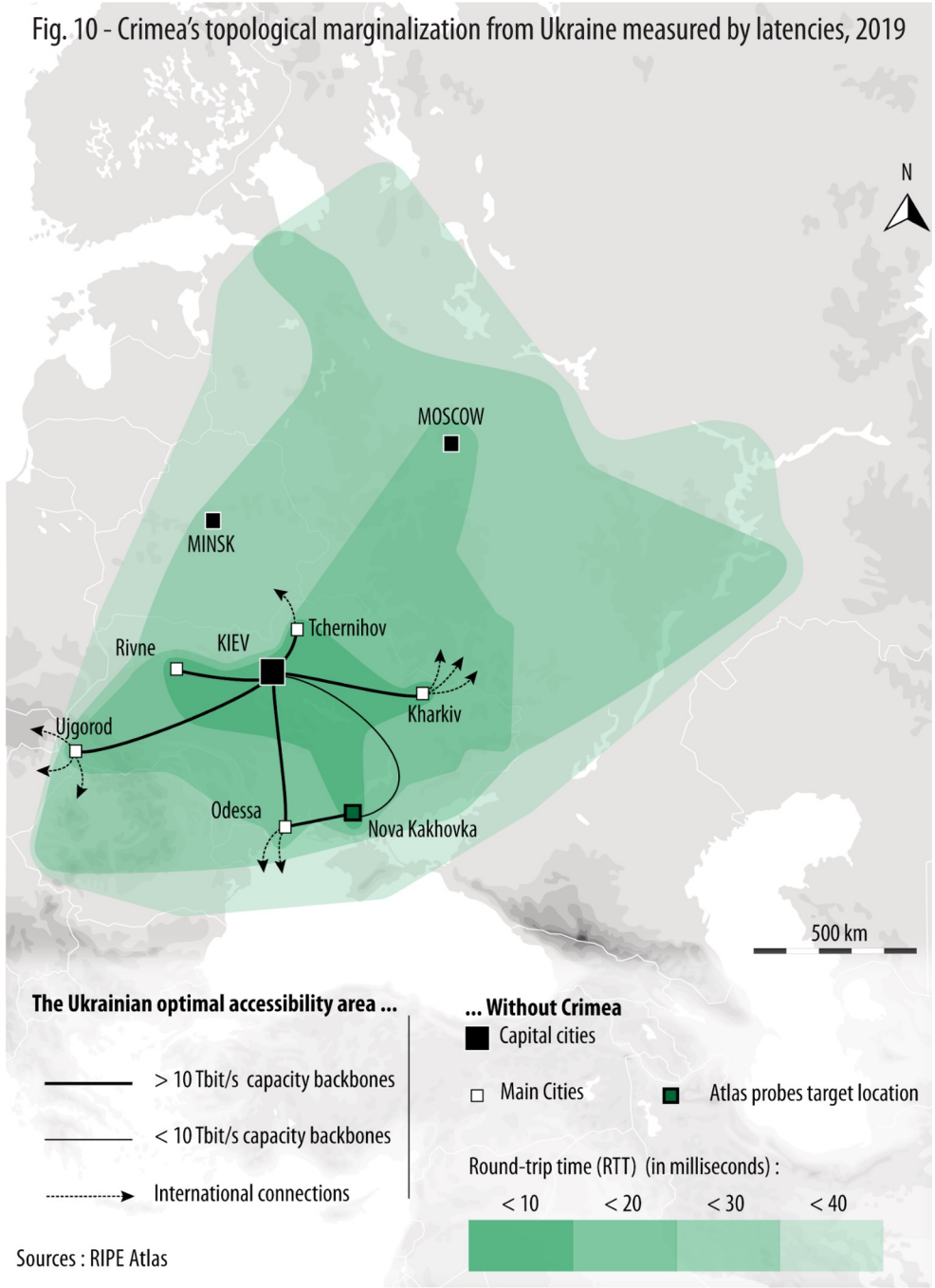


Fig. 9 - Crimea's topological proximity with Moscow measured by latencies - 2019



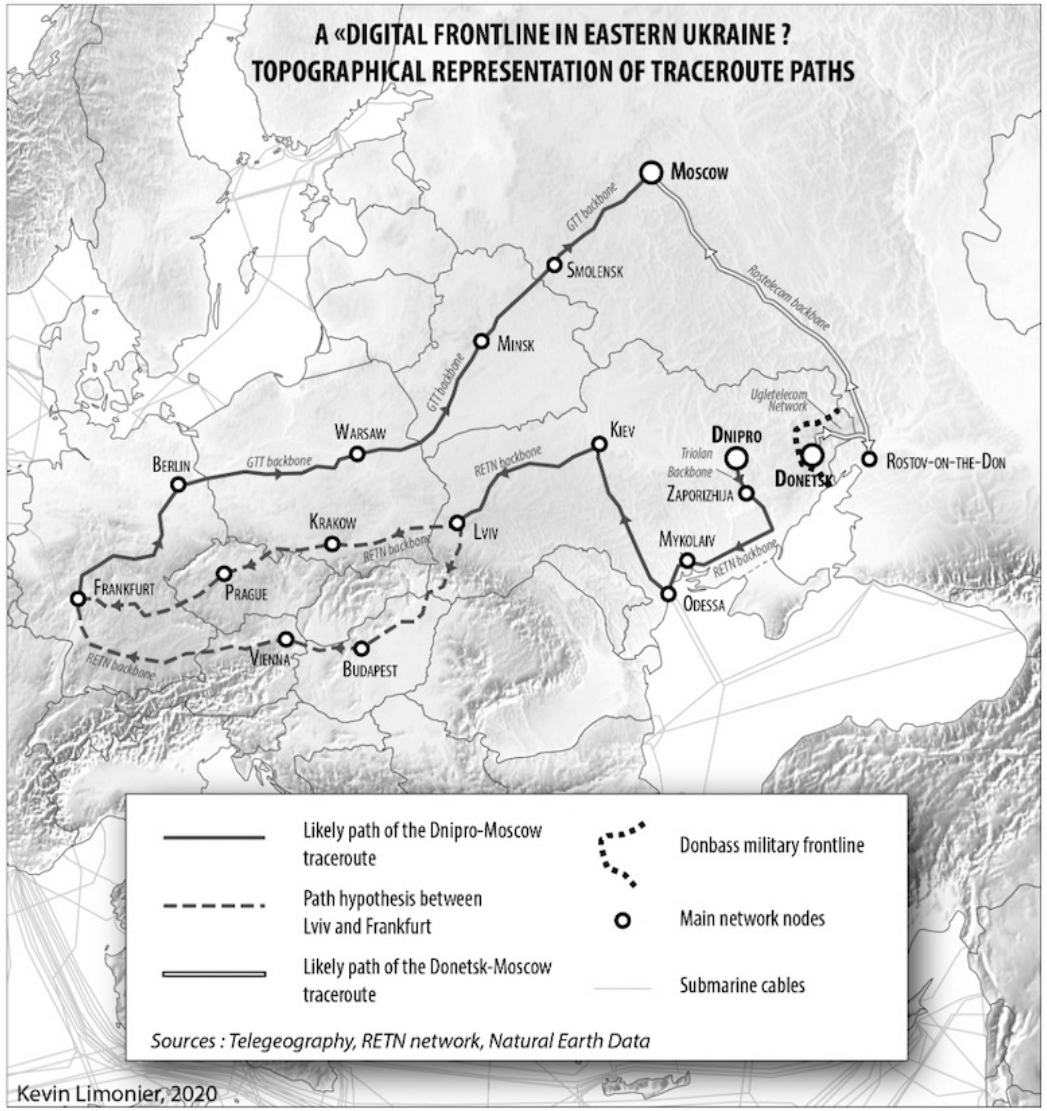
Sources : RIPE Atlas

Fig. 10 - Crimea's topological marginalization from Ukraine measured by latencies, 2019

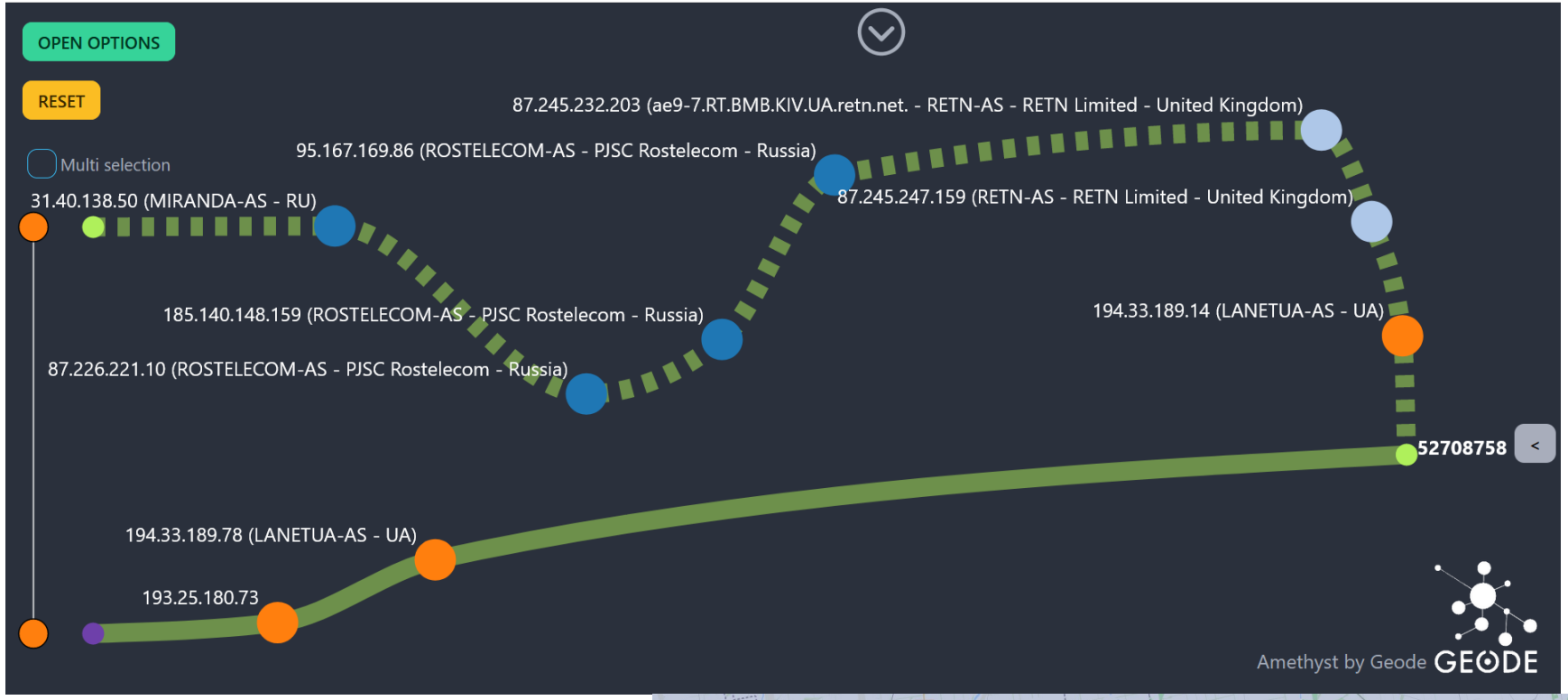


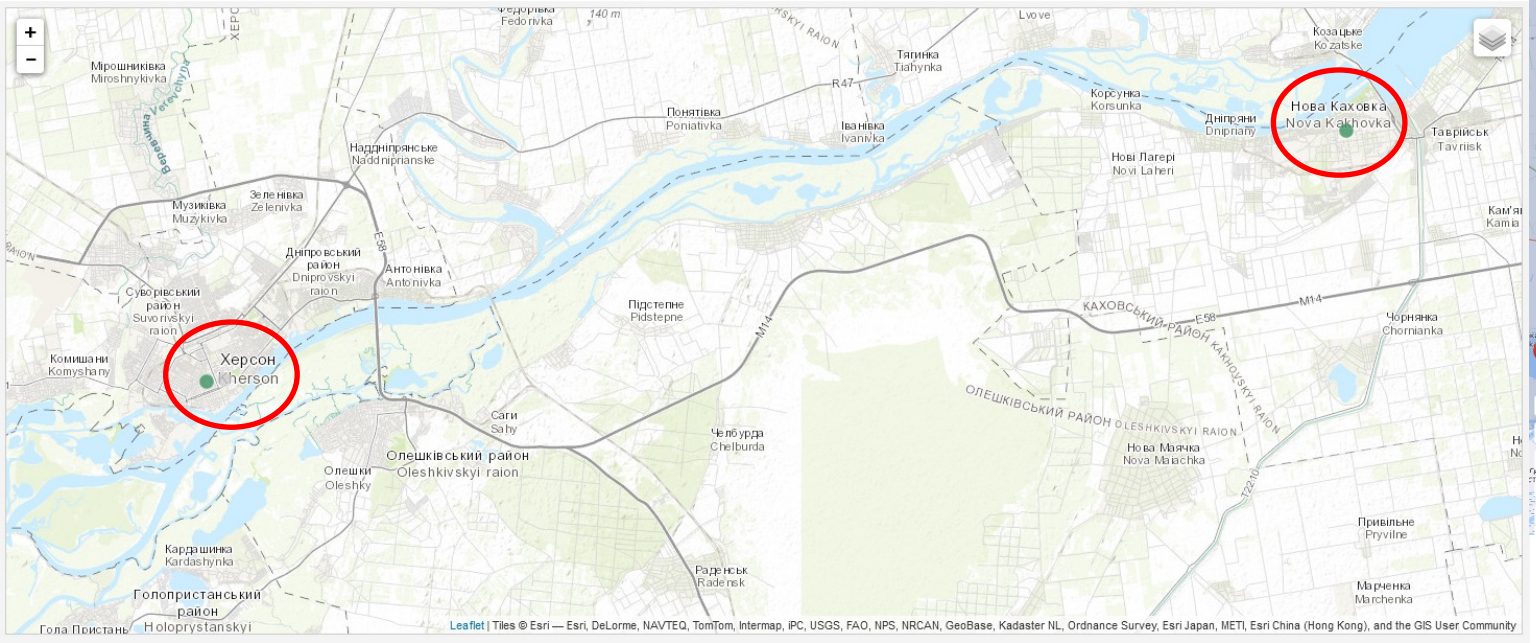
Sources : RIPE Atlas

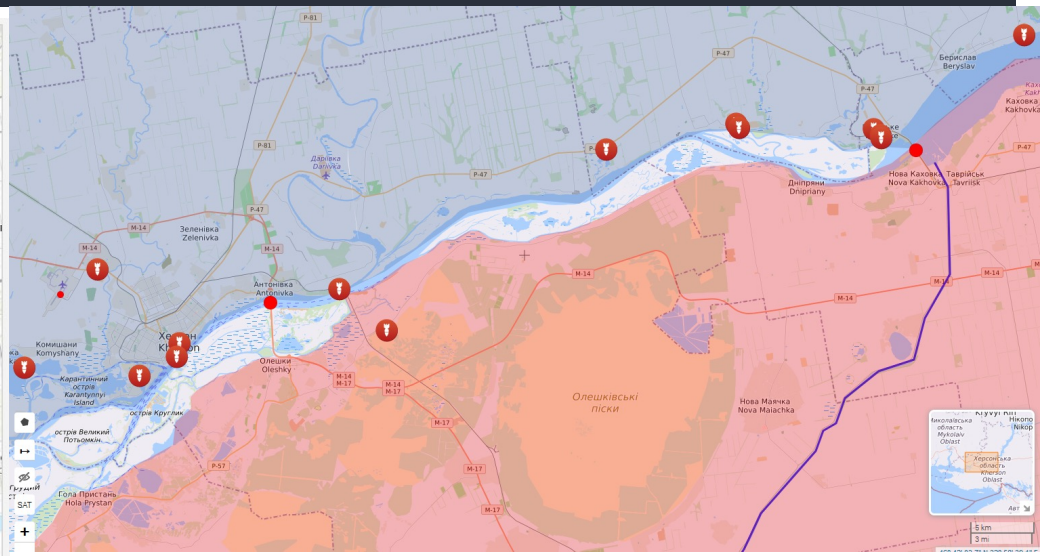
A Digital Frontline in Eastern Ukraine ?



2023: Traceroutes in Kherson and Nova Kakhovka through ATLAS probes







Liveuamap.com : airstrikes

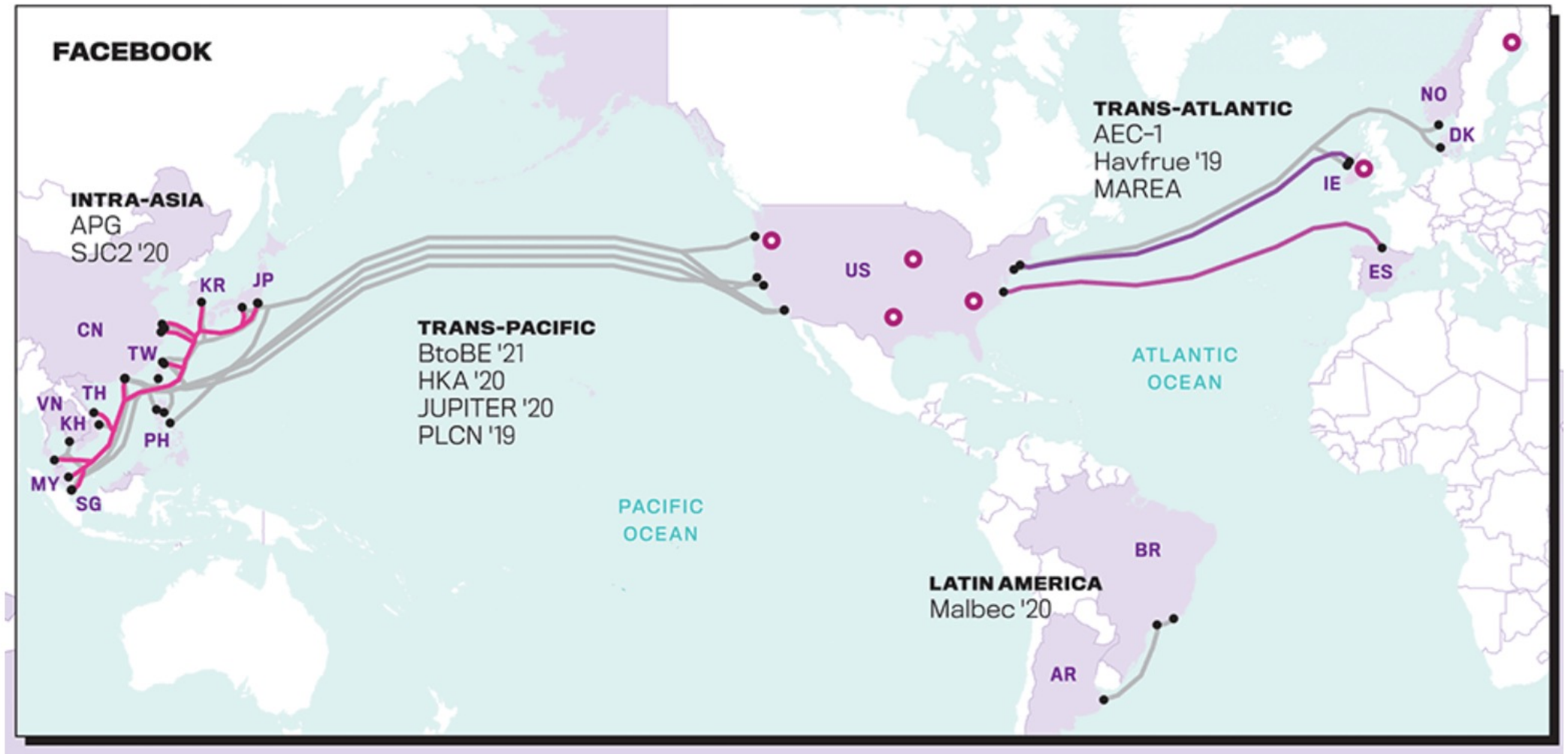
The contraction of cyberspace

ASRank CAIDA's ranking of Autnomous Systems

AS Rank ▲	AS Number ▽	Organization		cone size (ASes) ▽
1	3356	Level 3 Parent, LLC		46995
2	1299	Telia Company AB		36489
3	174	Cogent Communications		31695
4	3257	GTT Communications Inc.		21625
5	6762	Telecom Italia Sparkle S.p.A.		19933
6	2914	NTT America, Inc.		19432
7	6939	Hurricane Electric LLC		17954
8	6461	Zayo Bandwidth		15897
9	6453	TATA COMMUNICATIONS (AMERICA) INC		15777
10	3491	PCCW Global, Inc.		13767

https://asrank.caida.org

Facebook


FACEBOOK
INTRA-ASIA
APG
SJC2 '20
KR
JP
CN
TW
TH
VN
KH
PH
MY
SG
TRANS-PACIFIC
BtoBE '21
HKA '20
JUPITER '20
PLCN '19
US
TRANS-ATLANTIC
AEC-1
Havfrue '19
MAREA
NO
DK
IE
ES
ATLANTIC
OCEAN
PACIFIC
OCEAN
BR
LATIN AMERICA
Malbec '20
AR

Google's new subsea cable between the US and Europe is now online

Frederic Lardinois @fredericl / 6:23 PM GMT+1 • February 3, 2021

Comment

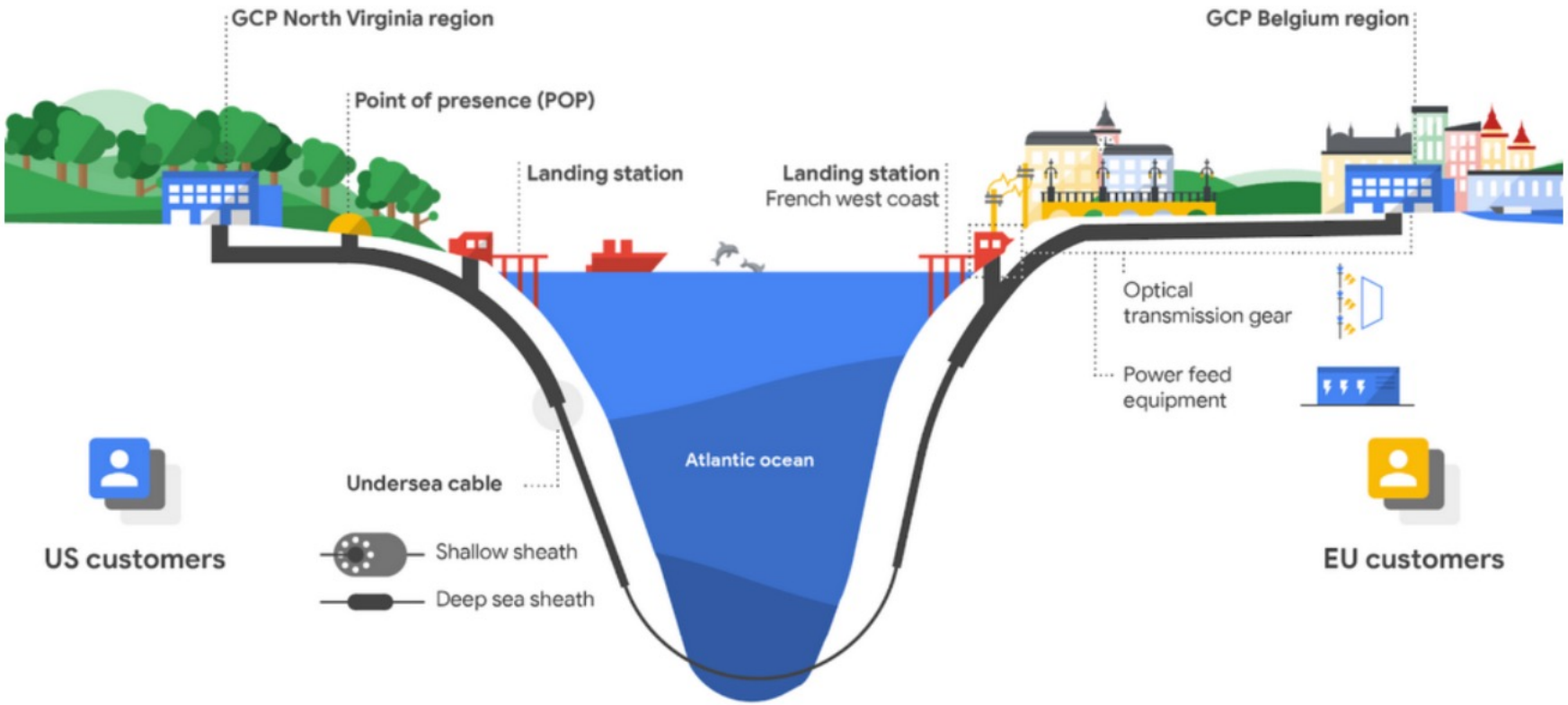
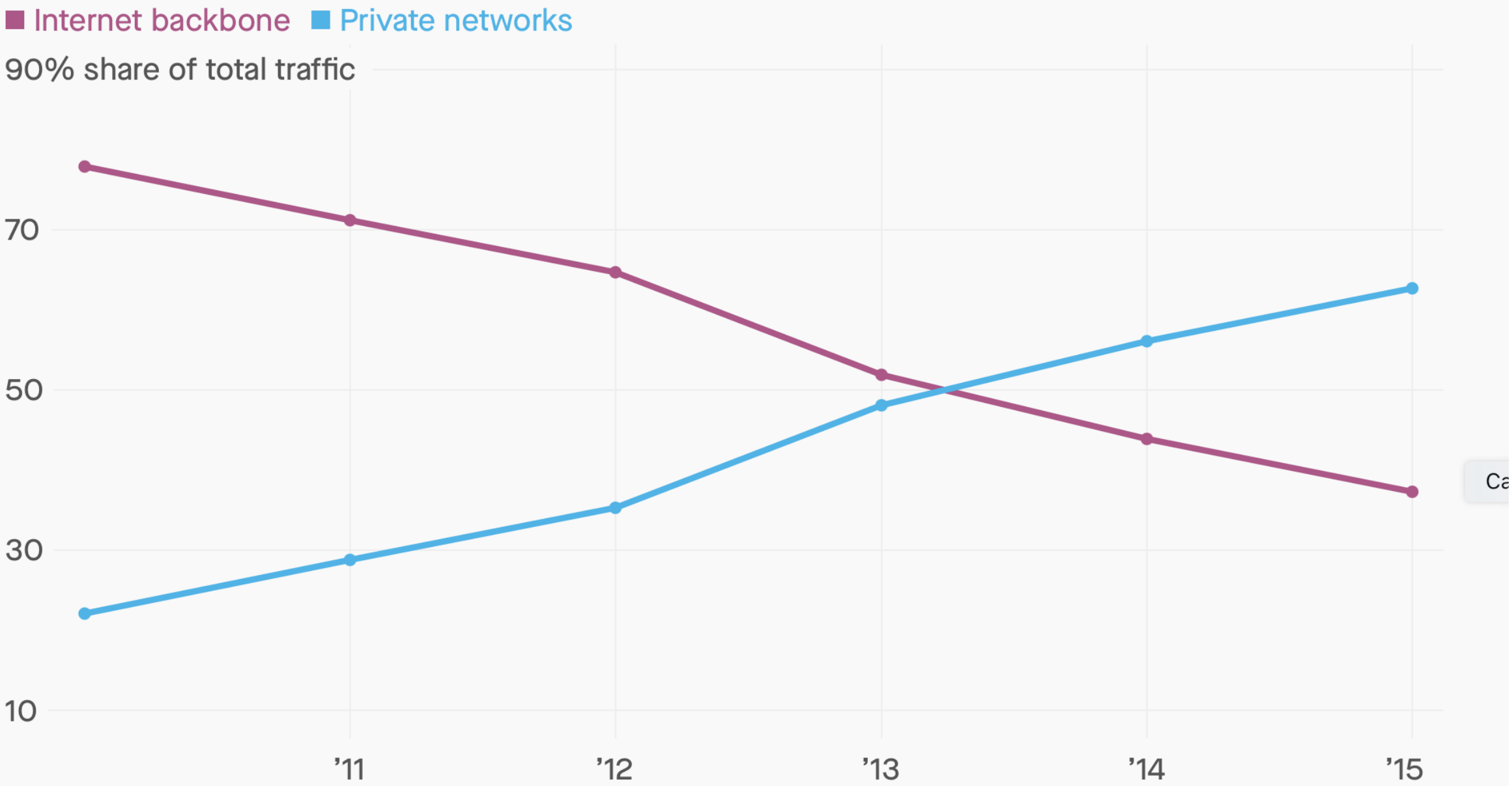
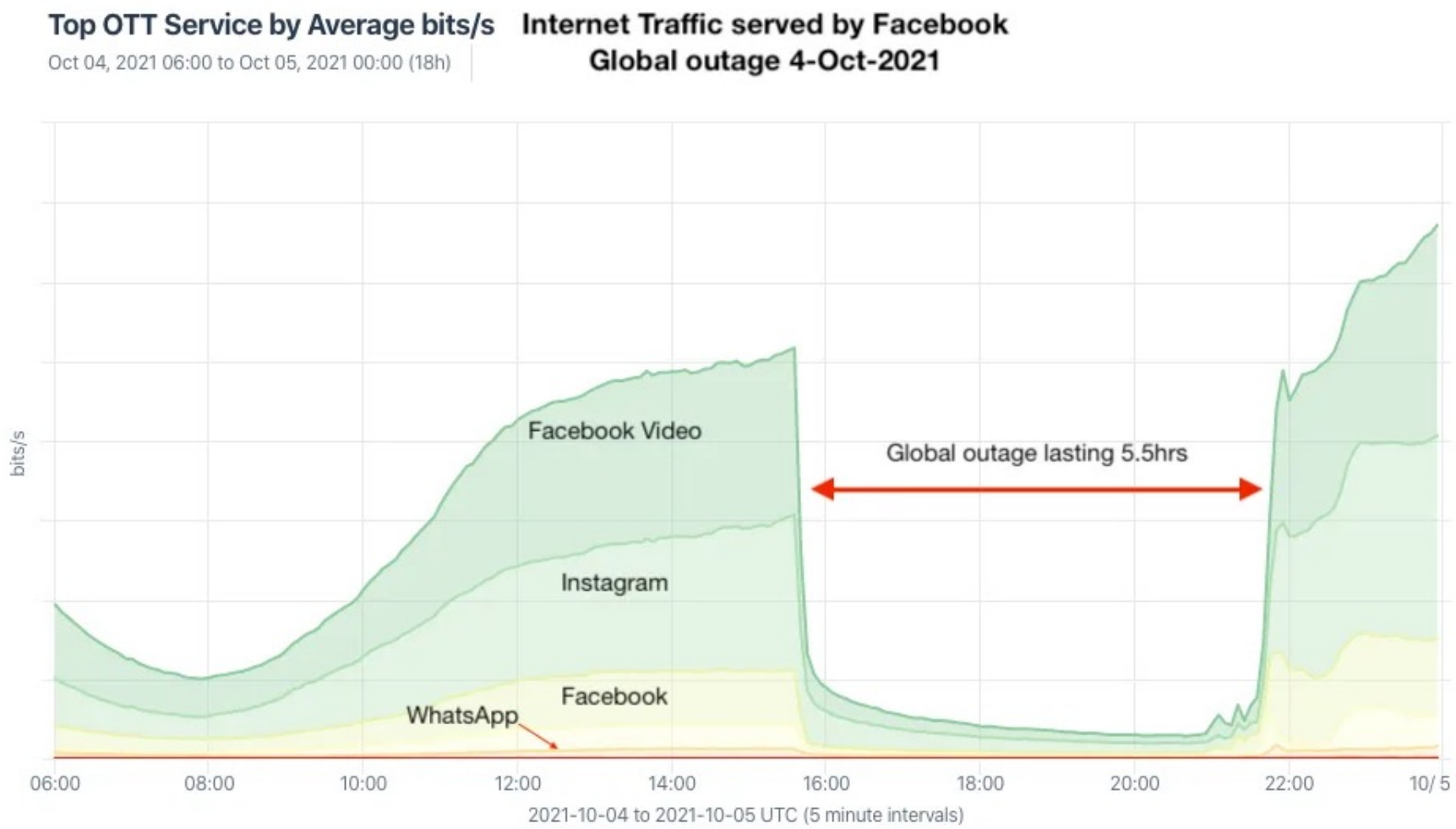


Image Credits: *Google*

How transatlantic data flows are split



On Oct. 4, 2021
Facebook disappeared from the Internet



What future for the Internet ?

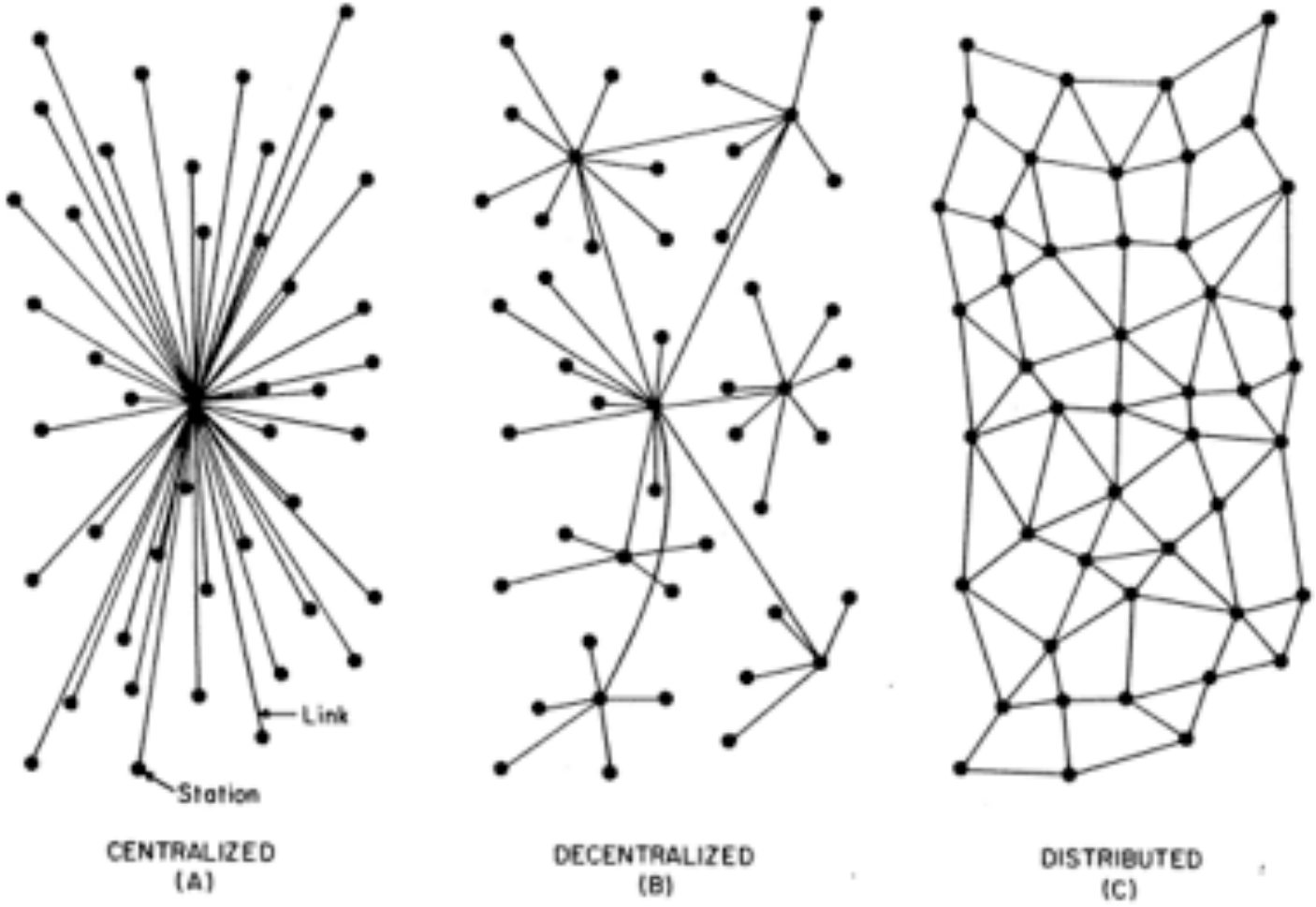


FIG. 1 — Centralized, Decentralized and Distributed Networks

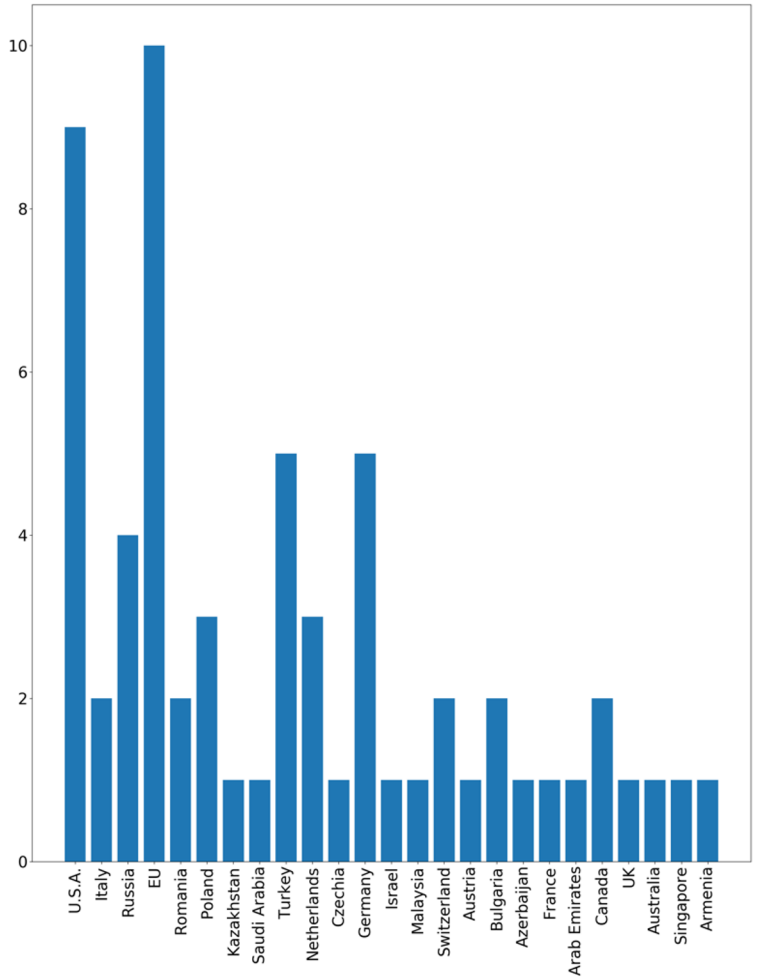
Thank you for your attention

Extra slides

A network highly connected inside, not outside

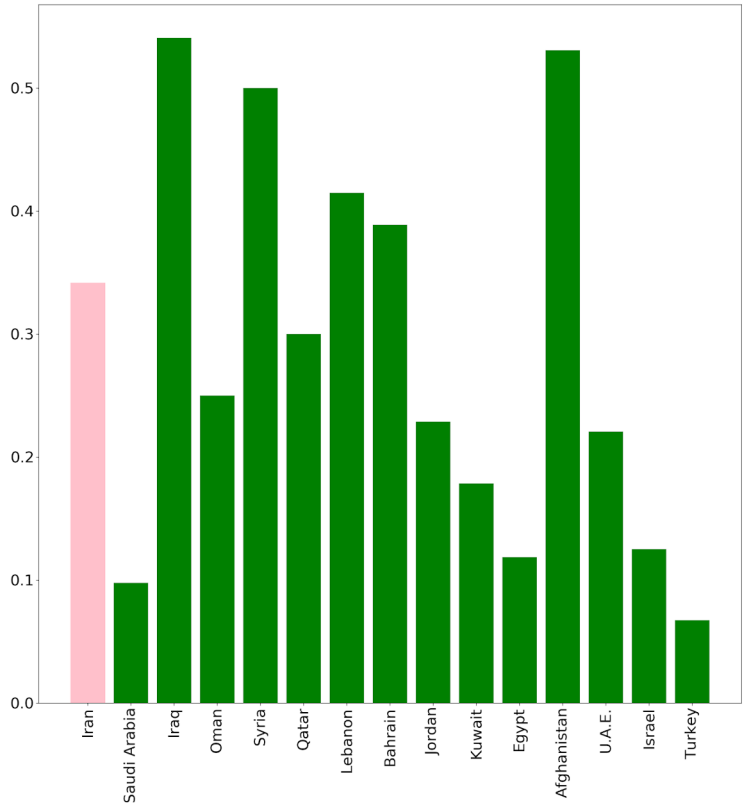
External connection	Internal connection	Total ASes observed	Country
79	643	472	Iran
113	191	140	Saudi Arabia
113	180	109	Iraq
97	12	12	Oman
52	11	10	Qatar
40	136	132	Lebanon
128	18	22	Bahrein
24	41	37	Jordan
26	74	61	Kuwait
162	93	63	Egypte
15	51	49	Afghanistan
83	67	76	U.A.E
395	326	261	Israel
130	567	473	Turkey

The “neighbors” of Iranian ASes



A complex, resilient and opaque network

The **points of control** measure the centralization of the network. They represent the minimal number of Ases required to connect 90% of all IP addresses of a country. The higher the value, the less centralized is the network.



The **complexity score** quantifies the difficulty to control the network within a country given the number of IP addresses and the diversity of their administrators. The higher the score, the most difficult it is to control the network

	Complexity		Control value		Number of ASes	
Country	2011	2019	2011	2018	2011	2019
Iran	**3.82**	**3.75**	**2%**	**34%**	**96**	**437**
Saudi Arabia	3.74	0.43	5%	10%	66	139
Iraq	6.46	4.93	75%	55%	4	107
Oman	1.06	0.05	50%	25%	2	12
Syria	0.85	0.00	33%	50%	3	2
Bahrain	10.20	0.26	22%	37%	18	19
Kuwait	4.70	0.52	20%	17%	30	61
Egypt	1.25	0.04	8%	9%	36	58
Afghanistan	NA	4.14	NA	52%	NA	46
UAE	0.58	0.31	20%	20%	8	65
Turkey	2.72	2.67	1%	7%	226	450
Israel	3.24	2.41	2%	10%	165	251
Qatar	1.55	0.02	40%	29%	5	9
Lebanon	11.99	7.81	22%	42%	32	133