

# The Internet in Ukraine

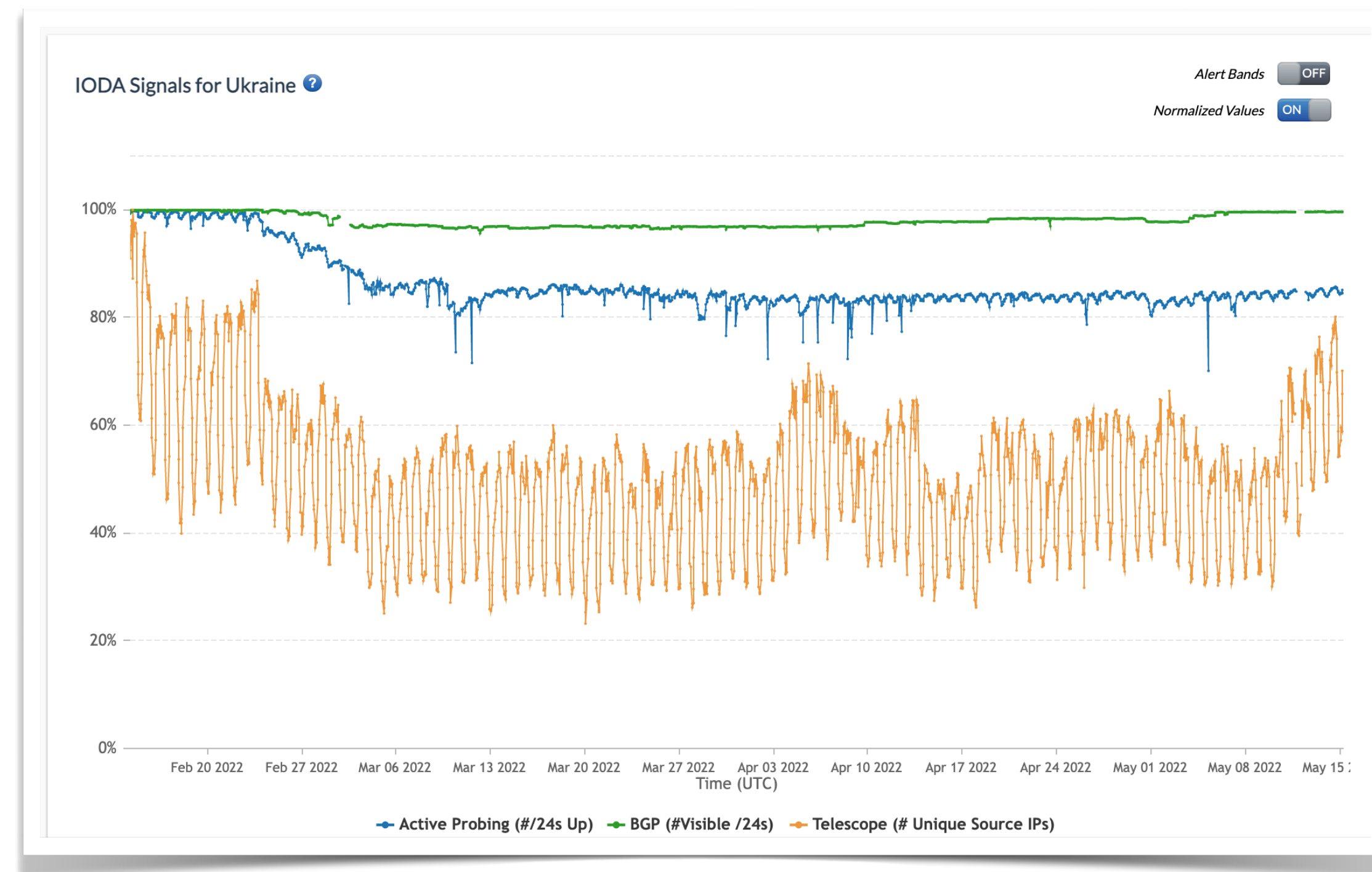
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# Internet and War



- **Expectation: Rapid deterioration of Internet in Ukraine**
- **Reality: Damaged, but functioning**



<https://ioda.live/>

# RIPE Atlas Probes in Ukraine



- Slow decline

Connected RIPE Atlas probes

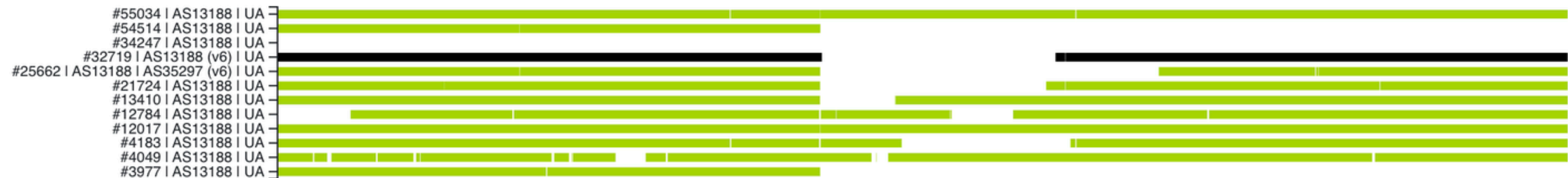


<https://observablehq.com/@ripencc/internet-outages-as-seen-by-ripe-atlas>

# Triolan Outage



Connected RIPE Atlas probes



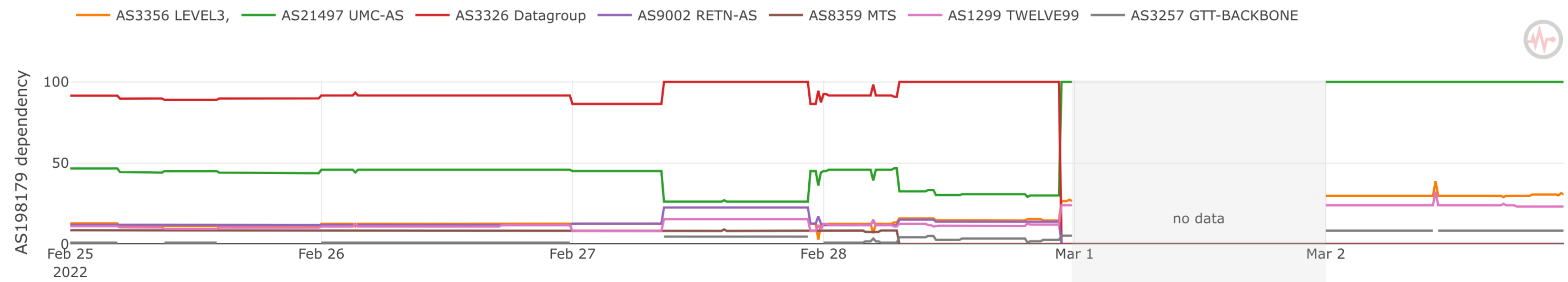
- The number of RIPE Atlas probes online in Triolan (AS13188). Top graph is the number of connected probes, the lower graph shows for each individual probe when it was online or offline.
- <https://labs.ripe.net/author/emileaben/the-ukrainian-internet/>



# Mariupol



- Under extreme circumstances things break
- ILYICH-AS Ilyich Iron and Steel Works - AS Hegemony:





# Elements Of Resiliency



# Title Text





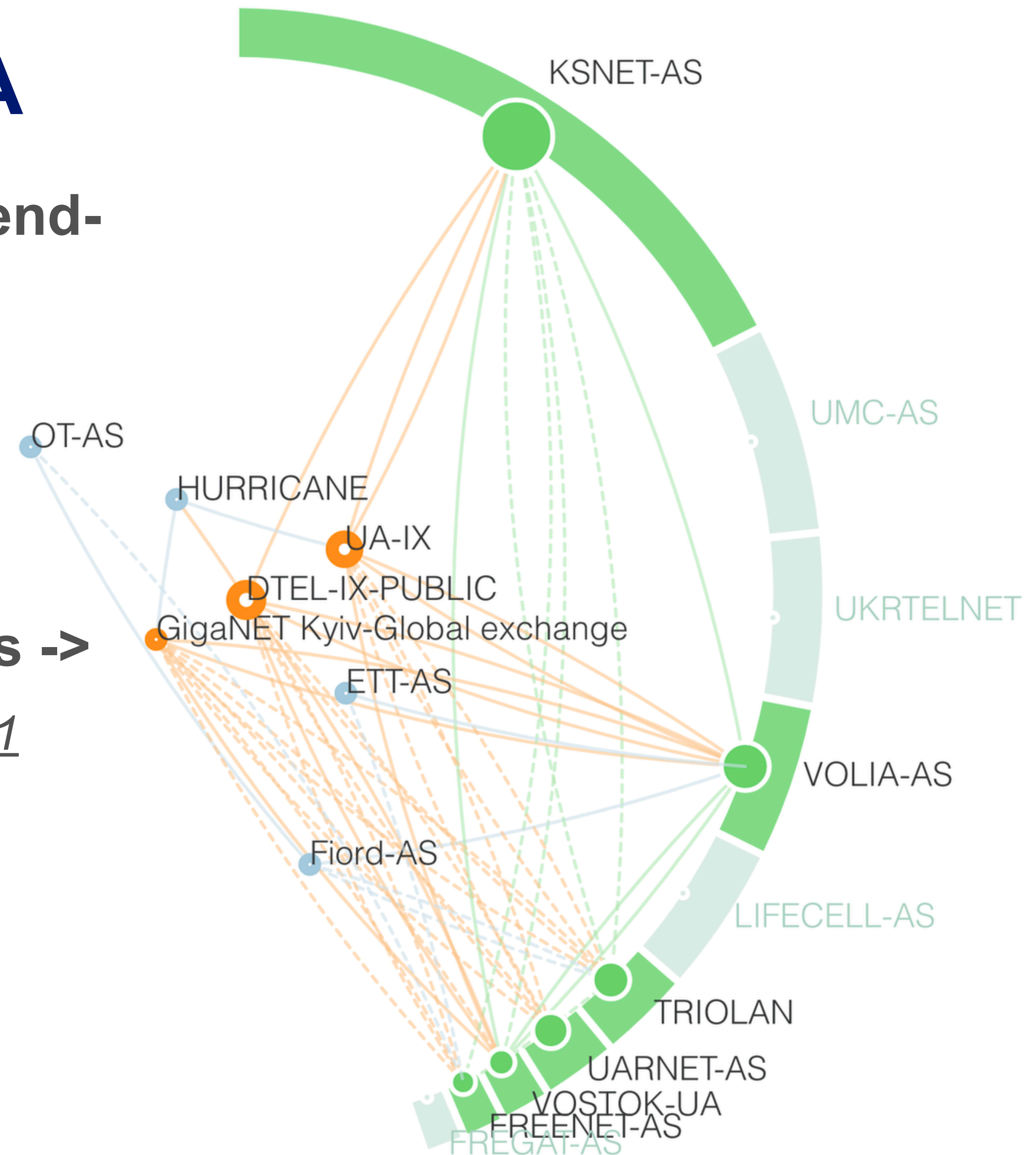
# Elements of Resiliency

- Human Connections, Dedication, Courage, Perseverance
- ISP Decentralisation (absence of market consolidation)
- Diverse interconnections (abundance of IXPs)
- High independence, at transit networks level, according to IHR
  - <https://ihr.ijilab.net/ihr/hegemony/countries/UA>
- Diverse fibre paths, from multiple organisations
  - <https://blog.telegeography.com/what-to-know-about-fibers-role-in-ukraines-information-war>



# ISP Decentralisation in UA

- **Absence of market concentration at end-user networks level**
  - UA: 4th in the world! HH Index of 0.052
  - an economic indicator for market concentration (on the scale 0-1)
- **How Ukrainian end-user networks interconnect, as seen from RIPE Atlas ->**
  - <https://jedi.ripe.net/peer-to-peer/ua/2022/03/01>
  - <https://atlas.ripe.net>
- **55% ISPs serve <1% of the market!**
  - not visualised (left half of the circle)





# IXP Abundance

- **19 IXPs!** (Internet eXchange Point)
  - as seen in PeeringDB
- **13 visible by RIPE Atlas**
  - visualising the paths between probes
  - <https://jedi.ripe.net/latest/UA/>
- **Not one single dominant IXP!**





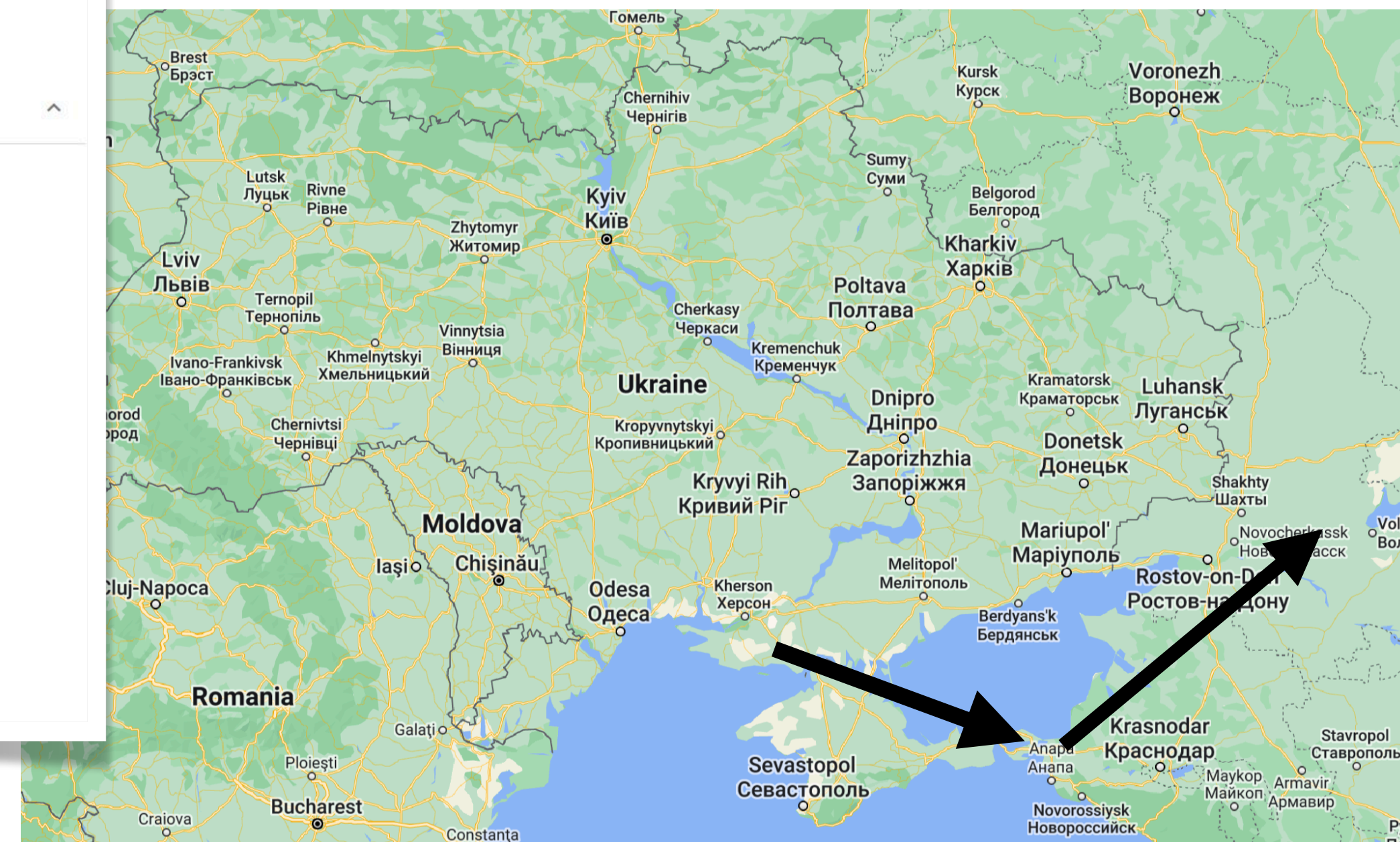
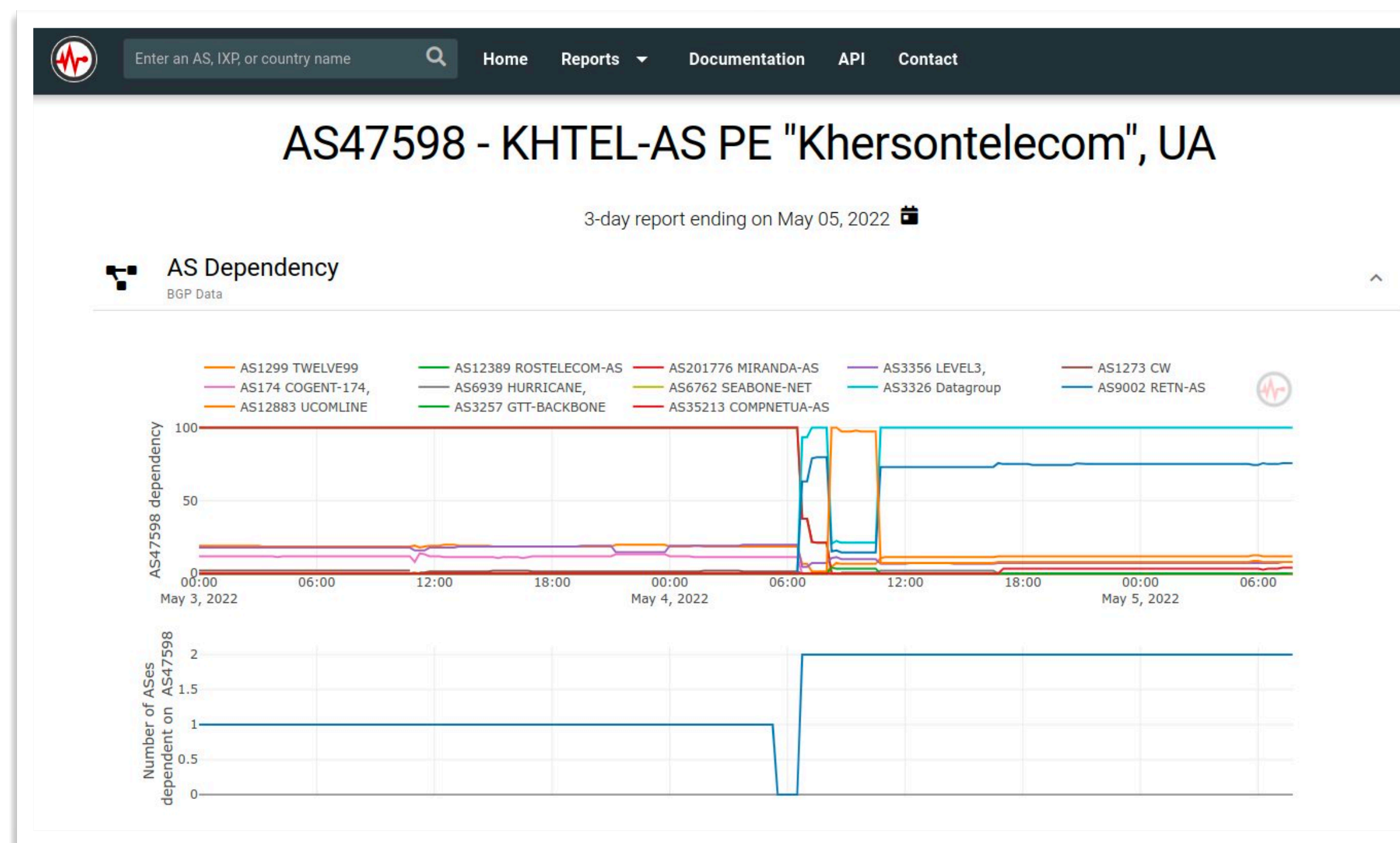


# Crimea & South

# Kherson - Some Routes via Crimea?



- [https://twitter.com/romain\\_fontugne/status/1522198122885132291/photo/1](https://twitter.com/romain_fontugne/status/1522198122885132291/photo/1)



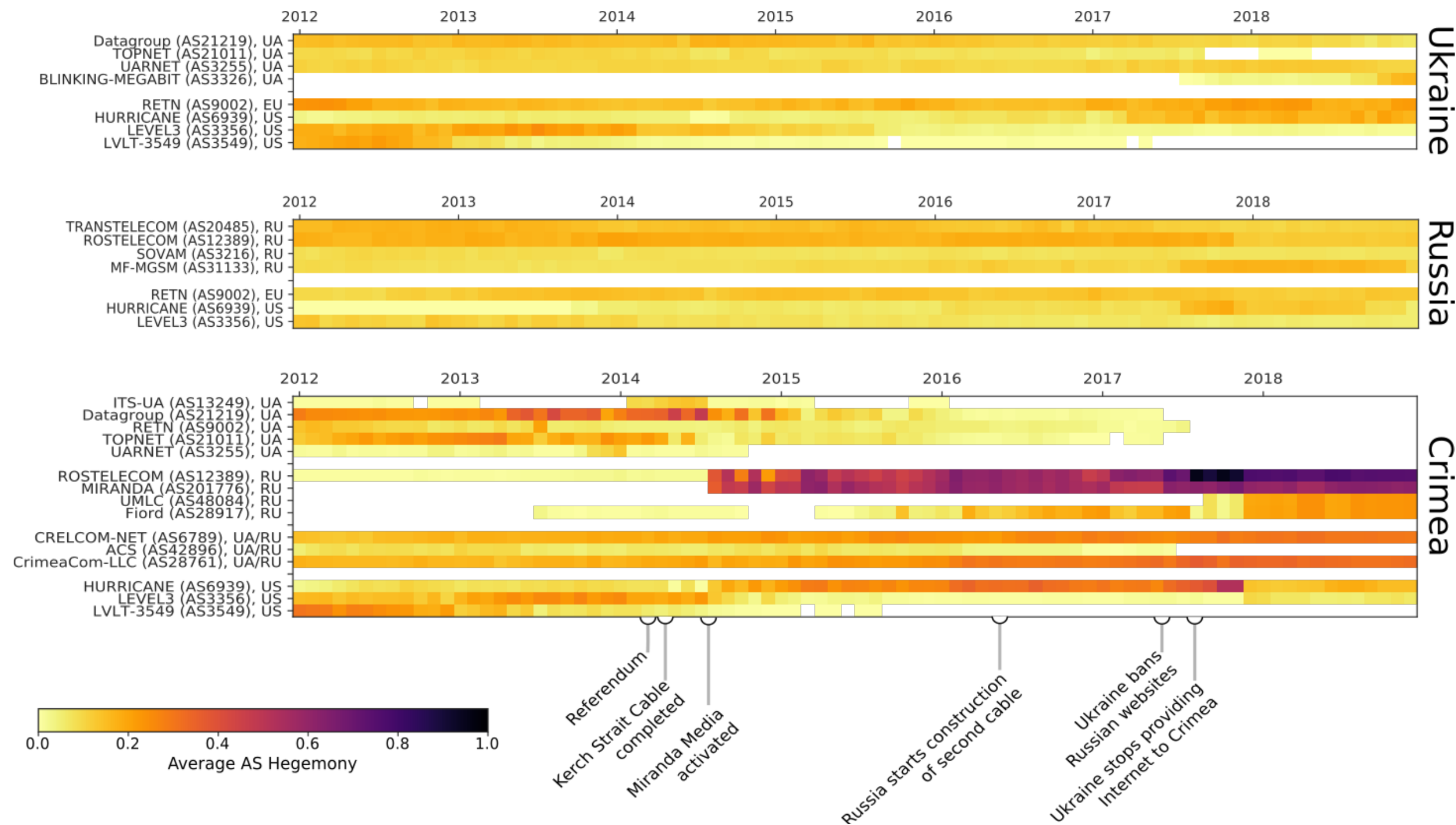




# Internet in Crimea

- **Case study of an Internet “Interregnum” (2014-2017)**
- **Sociological fieldwork combined with Internet measurements:**
  - <https://hal.archives-ouvertes.fr/hal-03100247>
  - Collaboration with Romain Fontugne (IIJ) and Ksenia Ermoshina (CIS)
  - Uses “AS-Hegemony”
    - To what extent does an AS depend on another AS?
    - Per AS data at IHR: Ex. <https://ihr.iijlab.net/ihr/en-us/networks/AS3333/>
    - Depends on BGP data in RIPE RIS

# Crimea Interregnum (2014-2017)



# Interregnum conclusion



- **Significant changes to Crimea's Internet connectivity**
- **Long transition (3+ years)**
- **Good match with compiled timeline**
- **Paths are going through Miranda Media/Rostelecom or UMLC/Fiord**
- **Topological chokepoint reflecting geo-politics in the region**



# Conclusion



# Take Aways



- **Interfaces/data built on top of RIS/Atlas**
  - IHR
  - AS Hegemony
  - IXP-country-jedi
  - Observable notebooks
- **Open source: Open to tinker with and improve!**

# Take Aways



- **The Ukrainian Internet is a very resilient Internet**
  - Many redundancies in many layers
- **.. but any human-made system has a breaking point**
- **Observable with data we collect**
  - RIPE Atlas: data plane (ping,traceroute,...)
  - RIPE RIS: control plane (BGP)

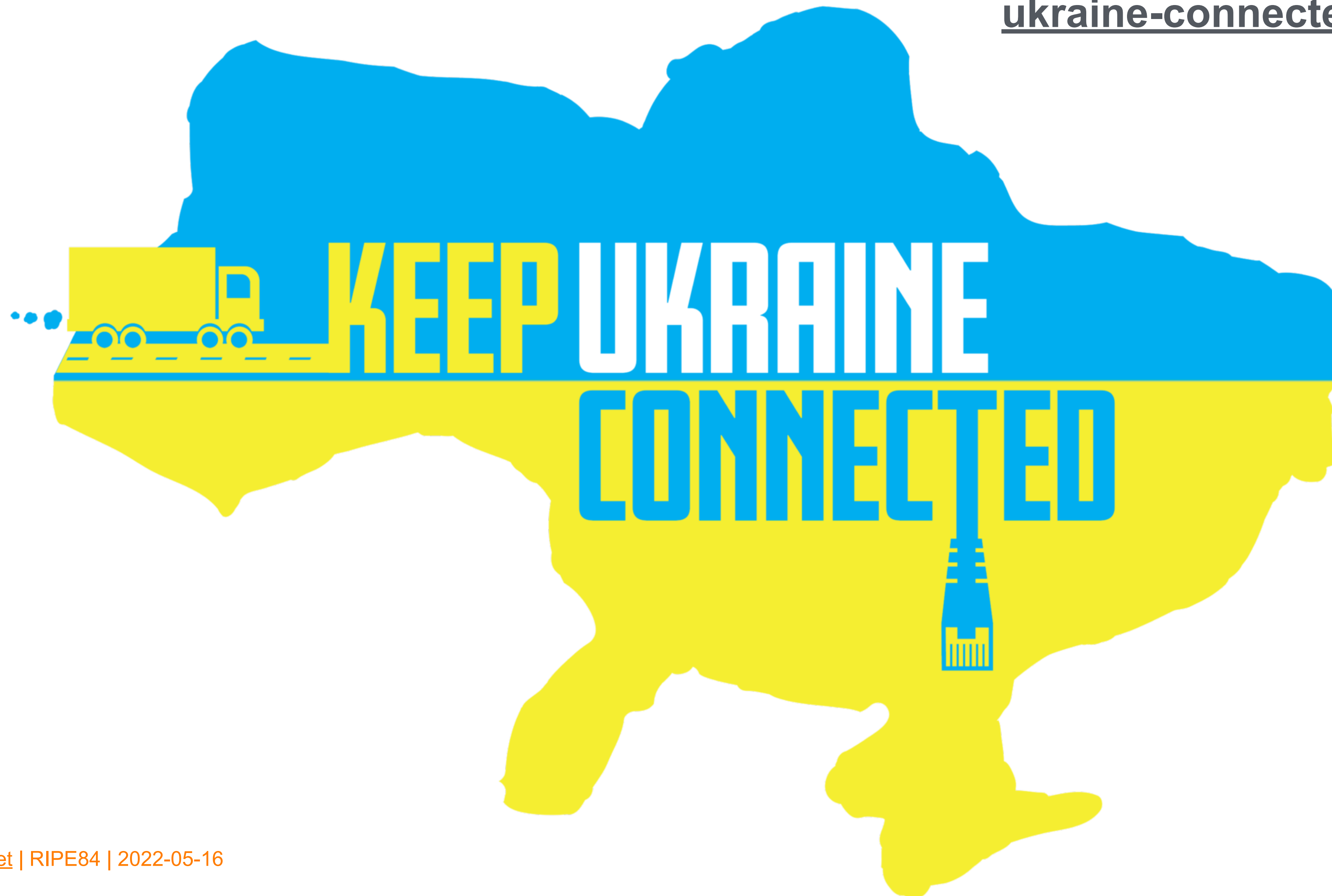


# Support

The Internet in Ukraine

# NOGs for Networkers

[https://nogalliance.org/  
our-task-forces/keep-  
ukraine-connected/](https://nogalliance.org/our-task-forces/keep-ukraine-connected/)







# Questions



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# More Articles

- <https://www.forbes.com/sites/thomasbrewster/2022/03/15/internet-technicians-are-the-hidden-heroes-of-the-russia-ukraine-war/?sh=1a709c9c2884>
- <https://9to5mac.com/2022/03/16/ukraine-mobile-carriers-work-together/>
- <https://www.platformer.news/p/the-internet-is-a-force-multiplier>
- <https://techcrunch.com/2022/02/28/ukrainians-turn-to-encrypted-messengers-offline-maps-and-twitter-amid-russian-invasion/>
- [\*\*https://labs.ripe.net/author/waehlisch/secure-personal-communication-in-the-event-of-crisis/\*\*](https://labs.ripe.net/author/waehlisch/secure-personal-communication-in-the-event-of-crisis/)



# More Info: in Original Articles

- **“The Resilience of the Internet in Ukraine” (2022-03-10)**

- <https://labs.ripe.net/author/emileaben/the-resilience-of-the-internet-in-ukraine/>

- **“The Ukrainian Internet” (2022-02-28)**

- <https://labs.ripe.net/author/emileaben/the-ukrainian-internet/>

- **2019, Kyiv: “State of the Internet in Ukraine”**

- [https://www.ripe.net/participate/forms/uploads/fobi\\_plugins/file/ripe-ncc-days-kyiv/2019-09-26%20NCC%20Days,%20State%20of%20Internet\\_v3\\_b0e1fc0b-eed7-417b-813c-0dbc83f3e82c.pdf](https://www.ripe.net/participate/forms/uploads/fobi_plugins/file/ripe-ncc-days-kyiv/2019-09-26%20NCC%20Days,%20State%20of%20Internet_v3_b0e1fc0b-eed7-417b-813c-0dbc83f3e82c.pdf)

- **“You are Not Alone: RIPE Community Resilience” (2021)**

- <https://labs.ripe.net/author/becha/you-are-not-alone-ripe-community-resilience/>



# More Measurements

- [https://labs.ripe.net/author/stephane\\_bortzmeyer/internet-network-shutdowns-in-russia/](https://labs.ripe.net/author/stephane_bortzmeyer/internet-network-shutdowns-in-russia/)
- <https://blog.mozilla.org/data/2022/03/09/mozilla-opens-access-to-dataset-on-network-outages>
- <https://ooni.org/post/2022-russia-blocks-amid-ru-ua-conflict/>



# More Refs

- Internet Health Report (IHR)
- AS Hegemony
- IXP-country-jedi
- ObservableHQ
- <https://observablehq.com/@emileaben>
- <https://observablehq.com/@aguformoso>
- <https://observablehq.com/@ripencc>