Multi-Service Networks Workshop
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THE INTERNET SPEAKS

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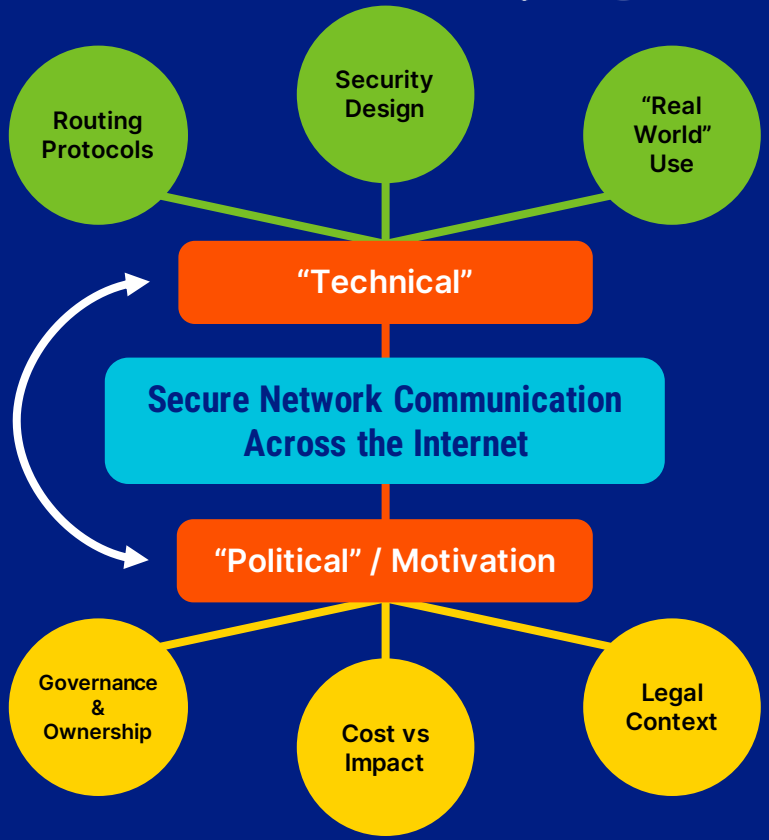
Our Research Directions

- How can we overcome technical limitations?
- What are the political constraints, policies and motivations?



Why have solutions not been adopted?

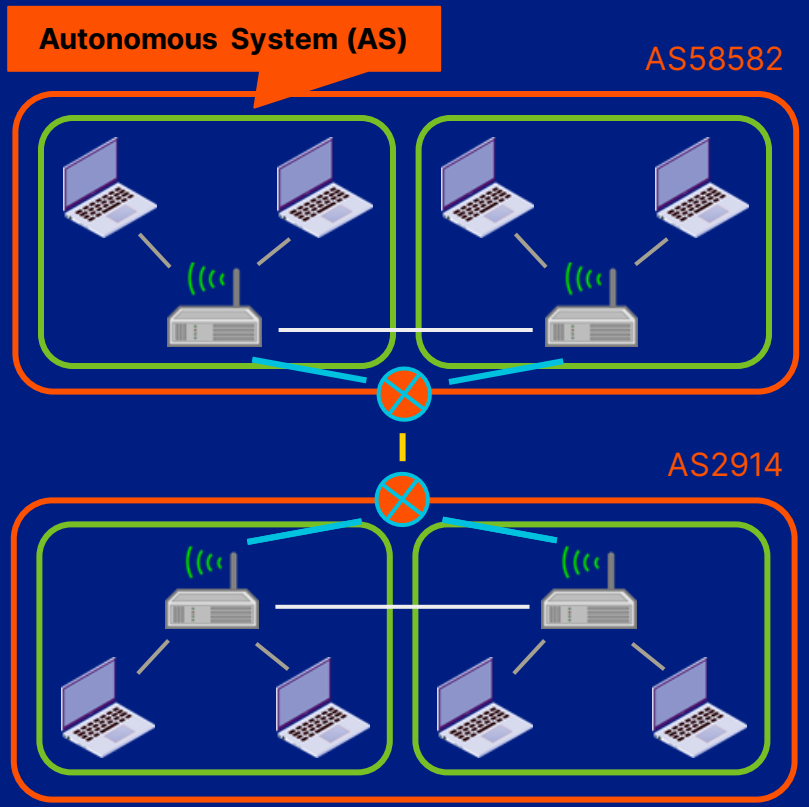
Who are the key 'stakeholders' in the Internet?

What are their motives?

How do these relate to the development of the Internet?

Border Gateway Protocol (BGP)

- Path-vector routing protocol
- Exchanges routing and reachability information
- Attribute **as_path**
  - [58682 2914 174 11172 17072 265566]
  - [14041 11164 3491 7602]

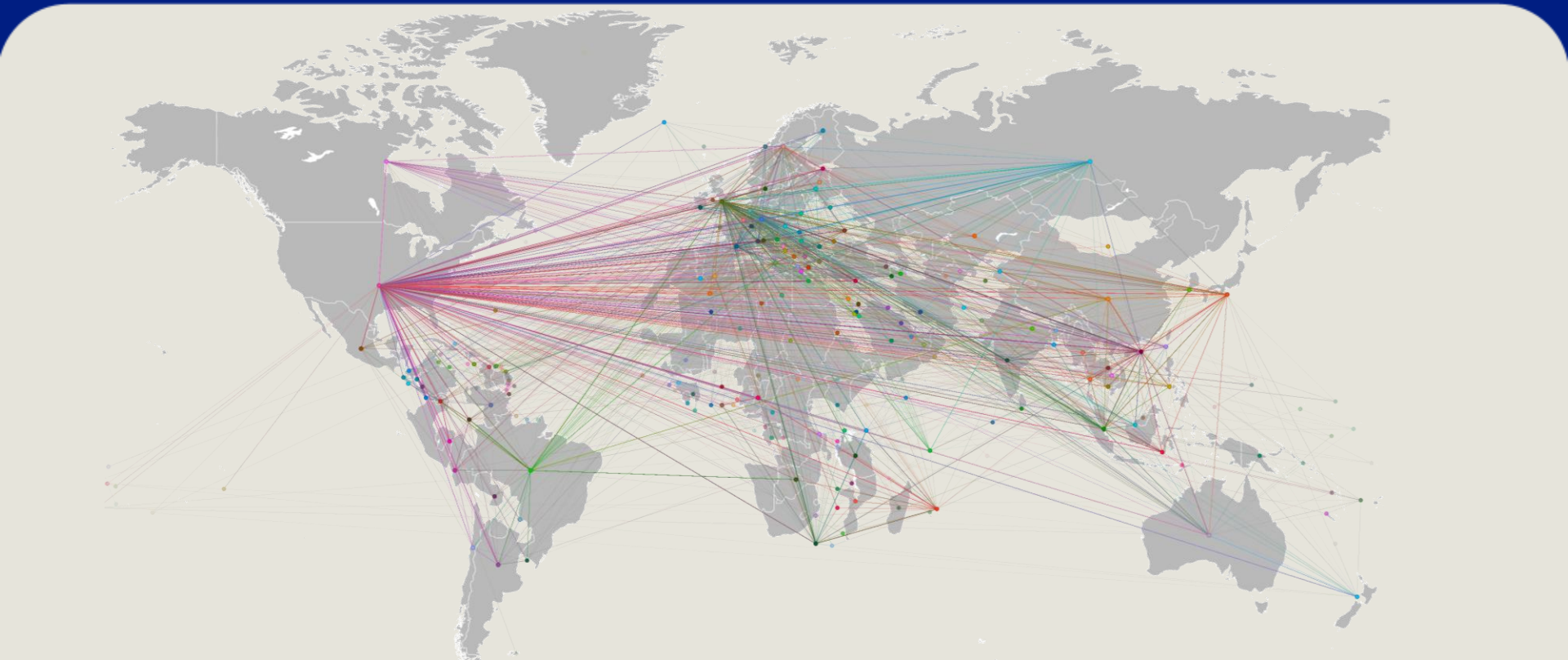


Observing the Internet

- **RouteViews Project**
  University of Oregon
  - Running since 1997
  - 41 live BGP collectors
- **Routing Information Service**
  RIPE NCC
  - Running since 1999
  - 23 live BGP collectors

Mercator Projection of the Internet

Simplified by Resource Registration Country



Force-Directed Projections

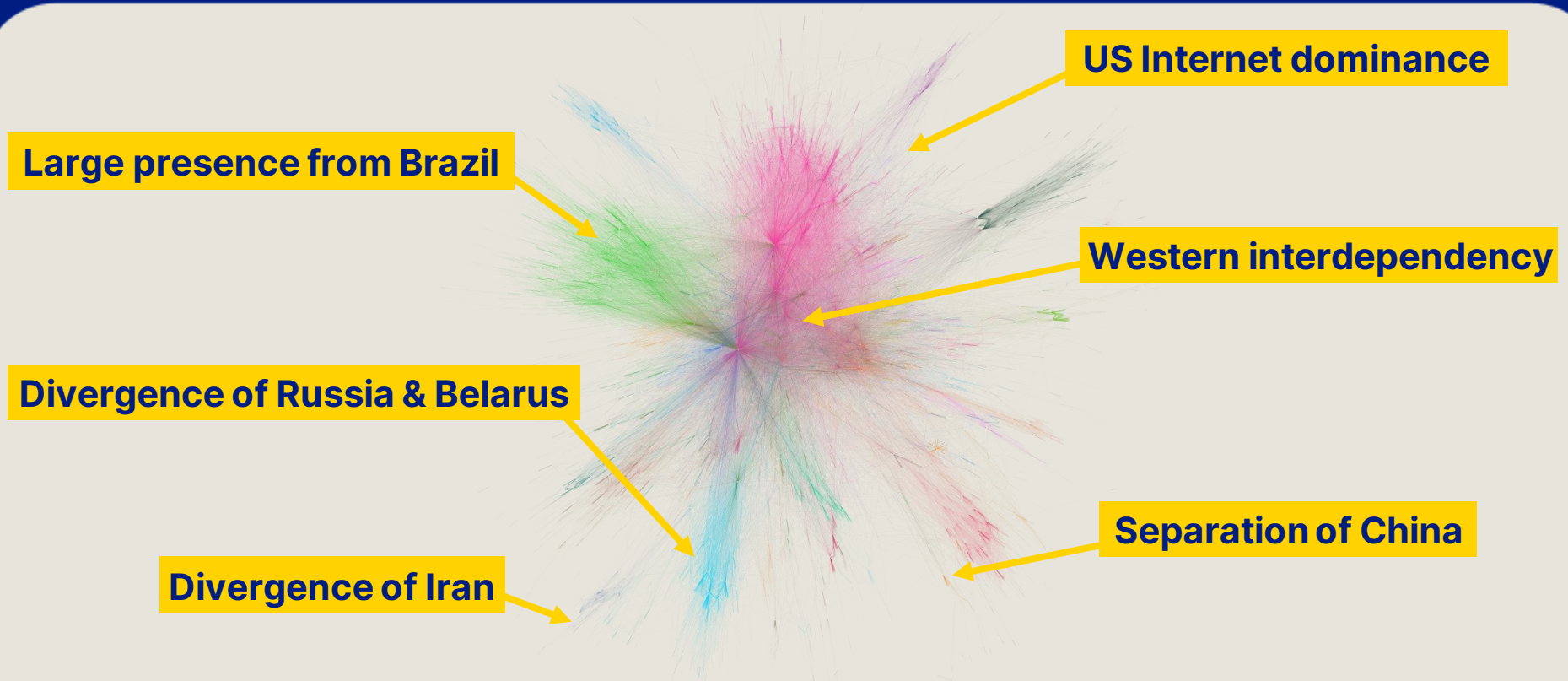
- Placing closely-connected ASes within close proximity
- Disconnected AS communities repel furthest

We use ForceAtlas2

Jacomy, et al. “ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software”

Force-Dynamic Internet Projection

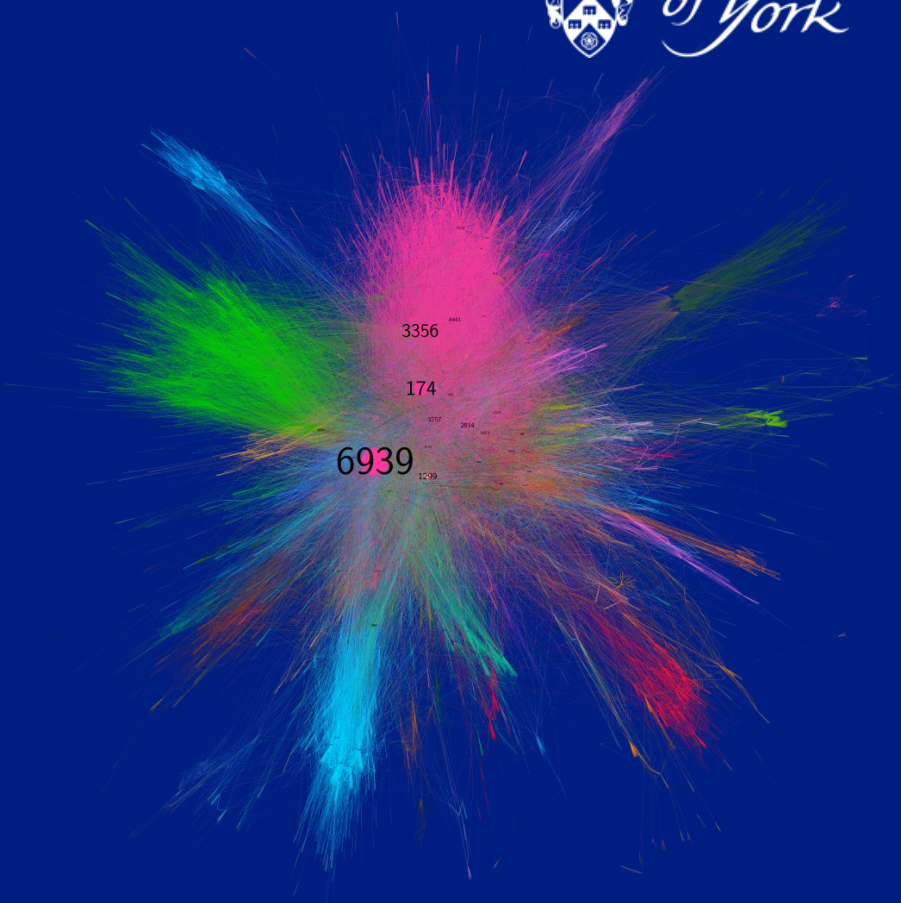
ForceAtlas2 at 180 iterations, peering only



Considering Influential ASes

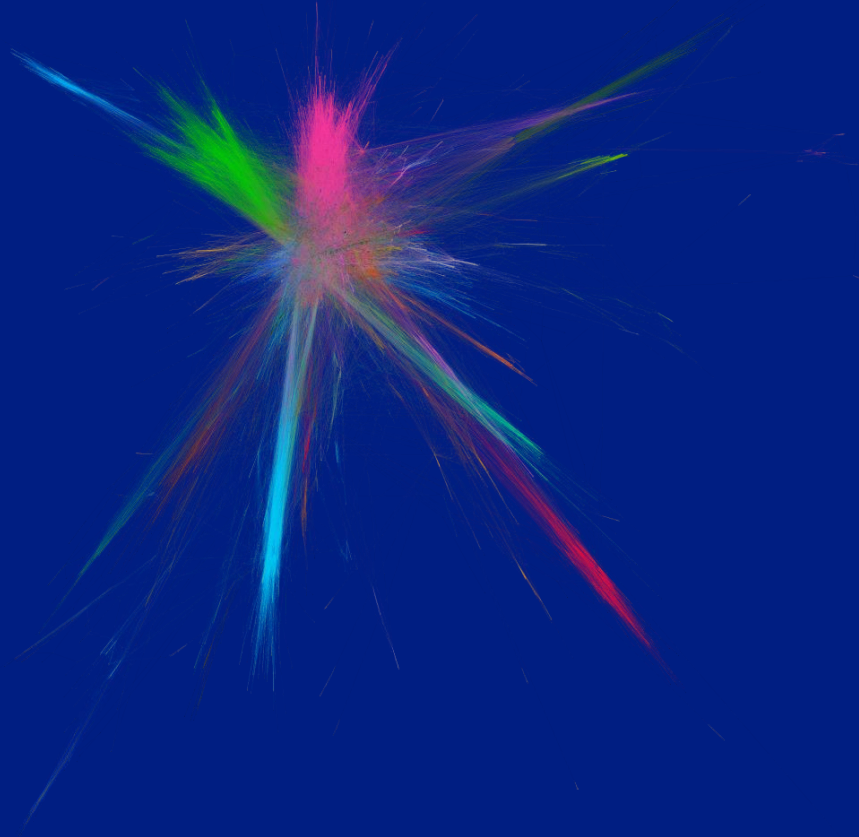
We calculate the **eigencentrality** of each node, and scale accordingly.

6939	US	Hurricane Electric LLC
174	US	Cogent Communications
3356	US	Lumen (Level 3)
1299	SE	Arelion (formerly Telia)
2914	US	NTT



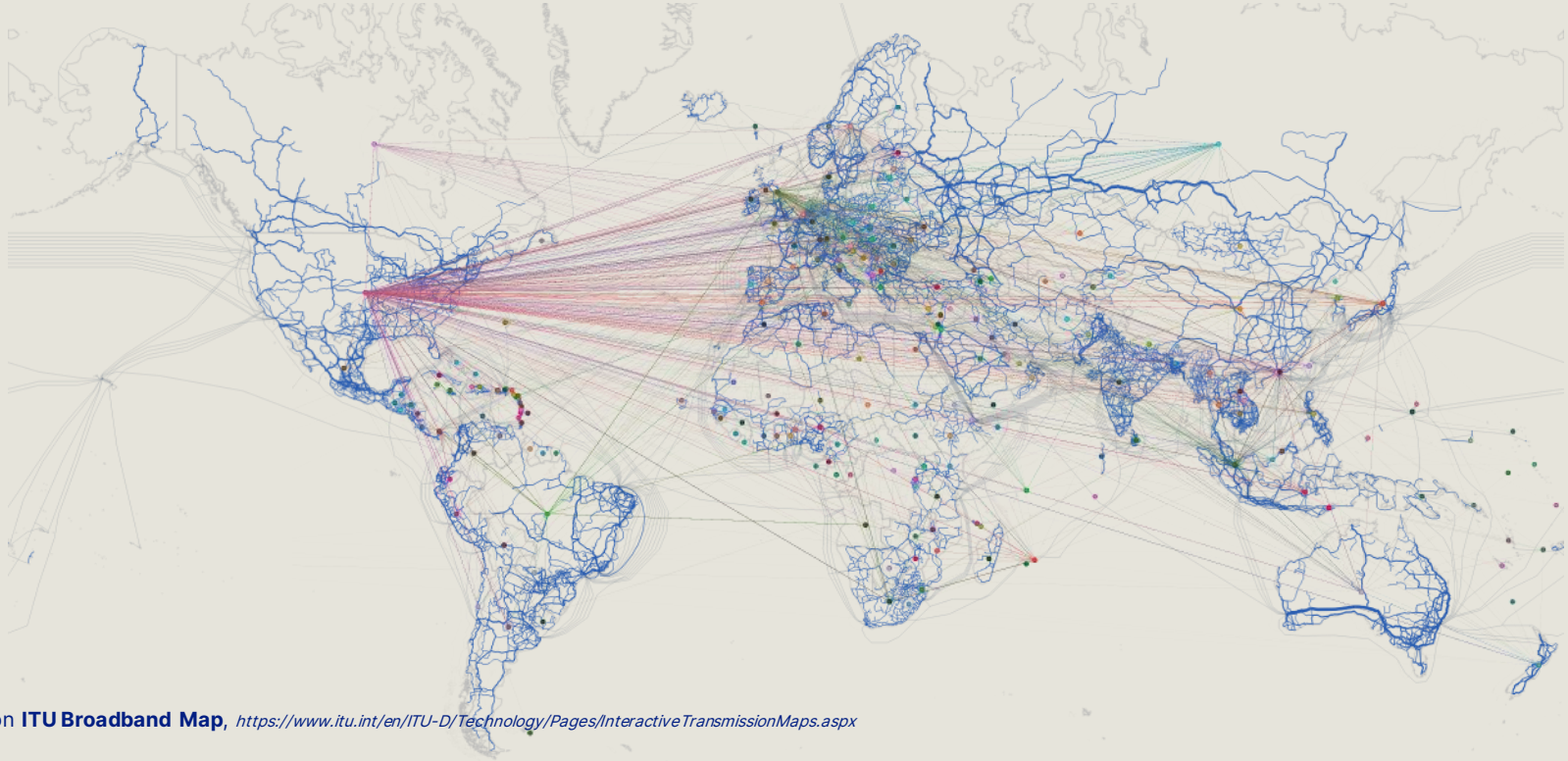
A Splintering Internet

- Where ForceAtlas2 converges, the Internet has fragmented
- Countries are increasingly self-sufficient internally:
  Is this Internet sovereignty?
  What is the role of regulation?



Internet vs Broadband

How does underlying infrastructure impact fragmentation?



Overlay on **ITU Broadband Map**, *https://www.itu.int/en/ITU-D/Technology/Pages/InteractiveTransmissionMaps.aspx*

The EU: A “Utopian” Internet?

Viewing only the connectivity of EU member states

Countries with high levels of **political** and **economic** cooperation appear more highly interconnected.

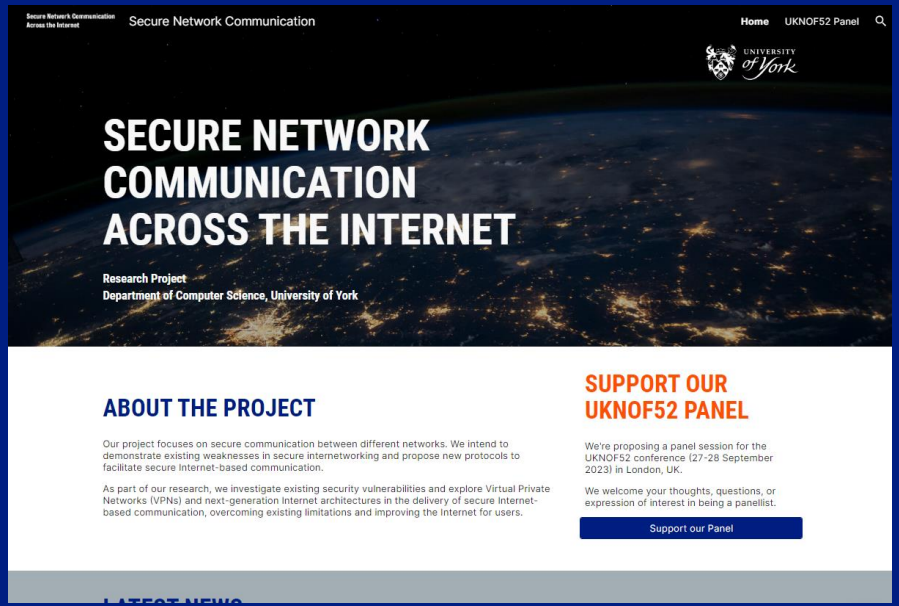
Next Steps…

- Can we increase specificity to MRS /24?
- How do architectural dynamics relate to policy decisions?
- What are the motivations of network operators?

UKNOF52 Panel

- Ensuring privacy
- Facilitating a secure Internet
- Governance and motivation

bit.ly/
uknof52-panel



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