A Decade of Evolution in Telecommunications Infrastructure

simulamet

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Countries at different stages of telecommunications infrastructure development face different challenges. Hence, knowledge of a country's relative standing and the temporal evolution of its telecommunications maturity can help inform telecommunication policy, learning from strategies of successful nations.

Methodology and Dataset

Characterize a country's network/digital infrastructure development, network interconnectivity preferences and Internet traffic transit dependencies using 13 metrics. We feed these features to an unsupervised agglomerative clustering algorithm to group similar countries. These metrics are grouped below with their data sources:

❖ **Network Infrastructure** metrics : count of large ISPs(lisp), small ISPs(stub) from CAIDA [1], submarine cables and landing points per country from TeleGeography [2].

❖ **Network interconnectivity** metrics: count of Internet Exchanges/datacenters(IXP), ISP peering % inside/outside country from PeeringDB [3].

❖ **Digital/IT services infrastructure**: mobile cellular subscriptions, fixed broadband subscriptions, individuals using the Internet from World Bank [4].

❖ **Global transit influence**: AS weight country score is proportion of transit networks connecting with country, provider country score quantifies number of foreign networks a country provides transit to [5], country hegemony score [6] quantifies centrality of country's networks with respect to providing global transit.
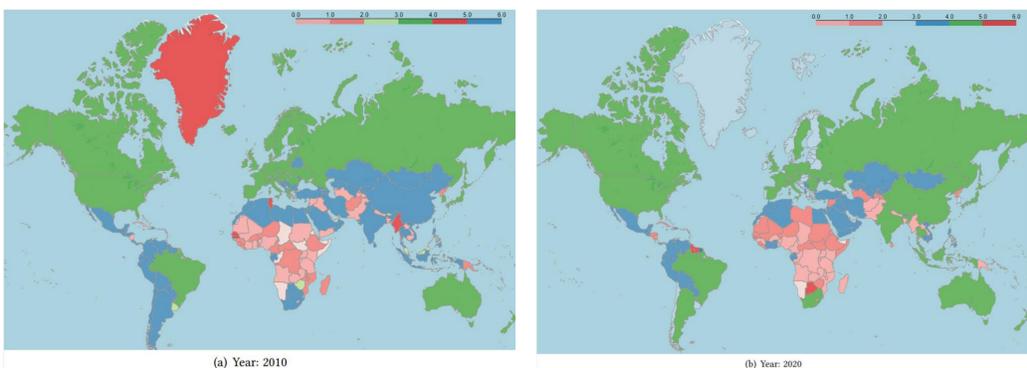
Country-level Clustering Evolution

(a) Year: 2010   (b) Year: 2020

Figure 1: Country clusters for 2010 (a) and 2020 (b)

Figure 1 shows how countries cluster based on selected features in 2010 (fig. 1(a)) and 2020 (fig. 1(b))
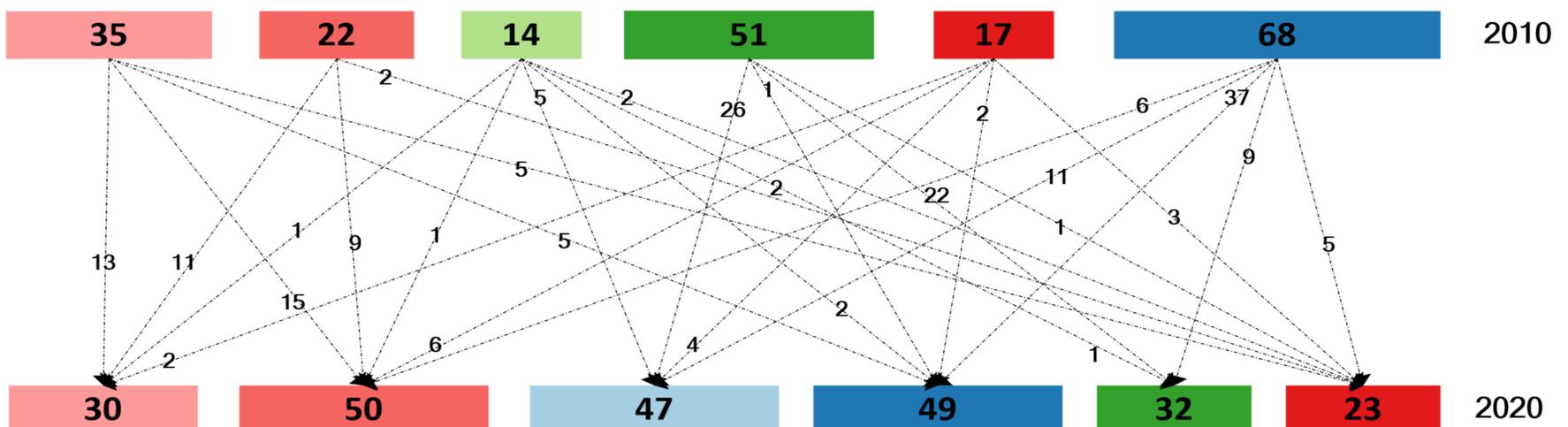
Figure 2 shows how countries jump to different higher/lower clusters in a decade with scores on arrows showing the number of countries that shift to each cluster . Some countries jump to better clusters while some remain within similar weak clusters as 2010. **Most developed cluster** shrinks from 51 to 32, has high scores across all metrics. Highest peering density and IXPs with hierarchical telecom structure of lisps with global transit influence. **Weak clusters** increase from 74 to 103 countries signaling widening gap. From almost no peering infrastructure to some improvements in a decade. **Heterogenous cluster** biggest with high variability in features.

Figure 3 shows profiles of each cluster in terms of the 13 metrics.
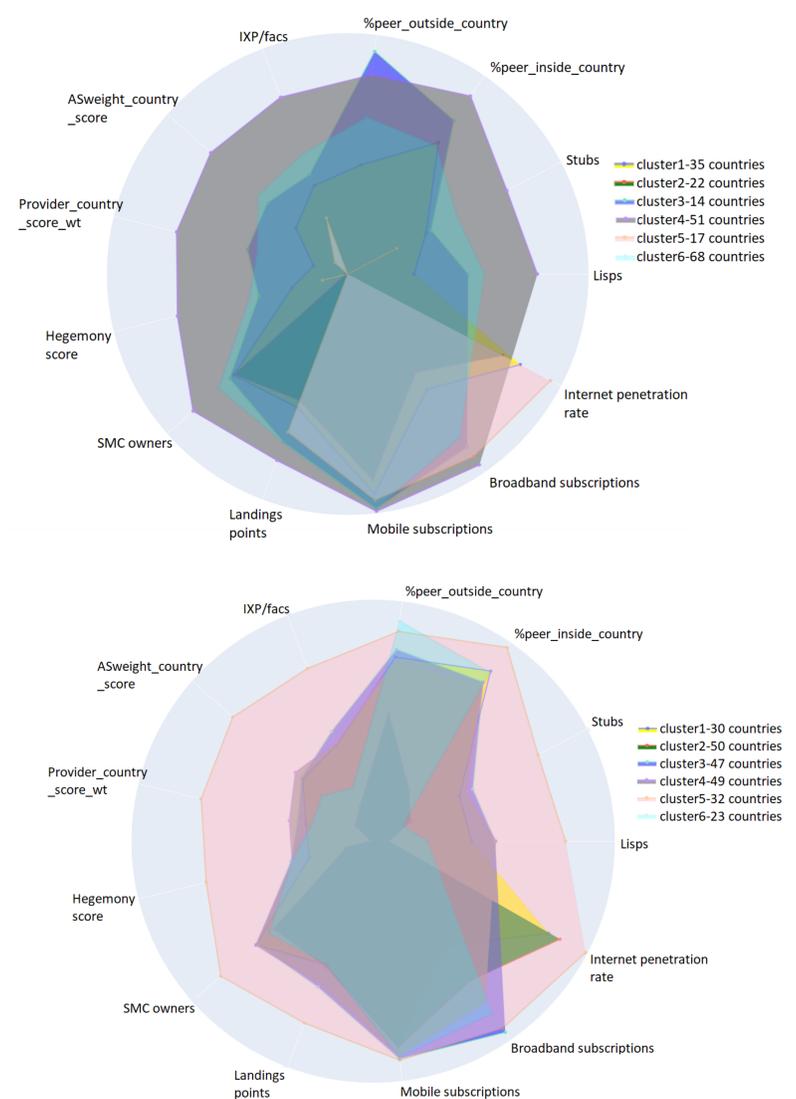

Figure 3: Cluster feature profiles 2010(top) to 2020(bottom)

References:
1. https://asrank.caida.org/
2. https://github.com/telegeography/www.submarinecablemap.com
3. https://www.peeringdb.com/apidocs/
4. https://datatopics.worldbank.org/world-development-indicators/
5. https://publicdata.caida.org/datasets/as-relationships/
6. Fontugne, R., Shah, A. and Aben, E., 2018, The (thin) bridges of AS connectivity.*Conference on Passive and Active Network Measurement*

Figure 2: Country shifts from 2010(top) to 2020(bottom)