Ecosystem Evolution and Digital Infrastructure Policy Challenges

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Insights & Reflections from an Economics Perspective

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About Us

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Telecommunications and Internet industry economist and consultant with over twenty-five years of experience

The Internet Ecosystem has Changed … And Continues to change

Range of applications & services is evolving

Seismic shift in the way the Internet is **interconnected**, **where servers are positioned**, **data is stored and processed**

Service provision is based on a **complex** and **evolving amalgam** of interconnected and complementary **networked computing & communication network resources**

Value chain constellations have grown more **complex, diverse** & **dynamic**

Changing **ownership and governance structures**, **industry structures**, as well as **competitive & innovational dynamics**

UNPRECEDENTED DIVERSITY & COMPLEXITY
→ NOVEL CHALLENGES REQUIRE NOVEL RESPONSES

Ecosystem Evolution – (Some) Reflections

- Essential digital infrastructure required for our digital economy future is about more than connectivity
  - ISP access is not all that is needed for our digital future, lots of other investment needed (upstream & downstream)
  - Digital economy future better be about Smart-X (and not just video/entertainment) or why invest?I
  - Need to consider co-dependencies and co-evolution of different investments/components owned and managed by different entities
- Majority of the requisite investment will be private (market!)
  - Access ISPs, CAPs, CDNs, upstream ISPs, and end-users are all investing
- More and new forms of resource sharing will be needed
  - Architectures and services are evolving and emphasize importance of cooperation and coordination
  - Growing roles of digital platforms and edge clouds
  - More network sharing agreements; active & passive sharing arrangements and optimal models are evolving

The Future is Already Here…. Some Challenges

- Legacy telecom/network regulation challenged at all levels: Three perennial telecom regulatory concerns
  - Network Management & Interconnection: Net neutrality in a world of 5G means slicing (3D chess problems?)
  - Universal Service in post-Broadband (5G+) world: Access to Essential Infrastructure – But: What is it and who should pay for?
    - What Digital Divides matter? Broadband: When tail elongates: does everyone need 1Gbps, or 10Gbps? Beyond broadband: Not even clear what it means to have access to cloud/edge computing
    - (Re-)Design of subsidy mechanisms: Who contributes? What is subsidized?
  - Competition in Complex Ecosystem (Today & Future): Need to reconcile ISP (legacy telecoms) and digital platform (GANFAM) regulation and fundamental re-examination of industry structure
    - Market-friendly (light-handed, not heavy-handed PTT or utility style) regulation needed. Markets better than command-and control-style public utility regulation, but markets require information…
- Other:
  - Cybersecurity: Privacy and Lawful access collision over encryption
  - Blockchain/crypto and financial regulation (FinTech): Soundness of payment systems and monetary policy (first-order macro economic policy)
  - AI regulation: What are the limits of automation and how will humans retain control?

Challenges & Paths Forward

- Multidisciplinary Engagement & Feedback
  - Economists/social scientists/policymakers need to collaborate with technical experts to craft good policy – and vice versa, technical experts need to engage with economists/social scientists/policymakers to impact direction of technological progress
  - Good design enables good policy and good policy encourages good design (aka innovation)
  - Technical, economic, and institutional flexibility needed in light of growing complexity and speed of change
- Asymmetric Information & Measurements: Metrics and Data
  - Need for real-time situational awareness to manage real-time systems. If decisions matter and have different implications for different parties, then the entire process is inherently strategic
  - Asymmetric information is fundamental in game theory and so need to design measurement ecosystem (including metrics, data management policies, etc.) holistically
- Capacity to Detect and Act
  - Complex systems cannot be controlled on basis of ex ante design constraints (since state space is too large)
  - Need to be able to detect when bad (good) things are happening and be capable (have knowledge, authority, institutional capacity, etc.) to act to retard (encourage) to reduce (amplify) harms (benefits)
  - Difficult and fundamental governance challenge that requires all-hands-on-deck responses

Thank you very much!

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Find out more...

- Lehr, W. (2023), "Getting to the Broadband Future Efficiently with BEAD funding," white paper prepared with support from WISPA, January 2023, available at https://www.wispa.org/docs/Lehr_White_Paper_Final.pdf
- Lehr, W. (2022), "5G and AI Convergence, and the Challenge of Regulating Smart Contracts," in Europe's Future Connected: Policies and Challenges for 5G and 6G Networks, edited by E. Bohlin and F. Cappelletti, European Liberal Forum (ELF), pages 72-80, available at https://liberalforum.eu/publication/europes-future-connected-policies-and-challenges-for-5g-and-6g-networks/.
- Lehr, W. and V. Stocker (2023), "Next-generation Networks: Necessity of Edge Sharing," forthcoming Frontiers in Computer Science: Networks and Communications, Summer 2023
- Oughton, E., W. Lehr, K. Katsaros, I. Selinis, D. Bubley, and J. Kusuma (2021), "Revisiting Wireless Internet Connectivity: 5G vs. Wi-Fi 6," Telecommunications Policy, 45 (2021) 102127, available at https://authors.elsevier.com/sd/article/S0308-5961(21)00032-X.
- Stocker, V. and W. Lehr (2022), "Regulatory Policy for Broadband: A Response to the 'ETNO Report's' Proposal for Intervention in Europe's Internet Ecosystem," white paper, available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4263096.
- Stocker, V., Smaragdakis, G., and Lehr, W. (2020). The state of network neutrality regulation. SIGCOMM Comput. Commun. Rev. 50, 1 (January 2020), 45–59. https://doi.org/10.1145/3390251.3390258

Work in progress

- Frias, Z., Mendo, L., Lehr, W. and Stocker, V. (2023), "Measuring NextGen Mobile Broadband: Challenges and Research Agenda for Policymaking", 32nd European International Telecommunications Society Conference (EuroITS2023), June 19-20, Madrid, Spain.
- Lehr, W., D. Sicker, D. Raychaudhuri, V. Singh (2023), "Edge Computing: digital infrastructure beyond broadband connectivity," TPRC51: Annual Research Conference on Communications, Information and Internet Policy, September 22-23, 2023, American University, Washington DC
- Stocker, V. Bauer, J., and Pourdamghani, A. (2023). "Innovation Dynamics in the Internet Ecosystem & Digital Economy Policy",, 32nd European International Telecommunications Society Conference (EuroITS2023), June 19-20, Madrid, Spain.