Machine-to-Machine, Internet of Things, Big Data, Cloud Computing and New Business Opportunities

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The Main Points

Market and technological convergence haves become a reality.

Many more stakeholders and constituencies involved in a broadband-mediated ecosystem.

Traditional planning, policy making and regulatory regimes cannot keep up with change and increasingly fail to anticipate and resolve conflicts.

Marketplace factors tend to support large ventures accruing economies of scale and scope; real potential for near monopoly intermediaries/platform operators.

No likelihood of a cyberlibertarian, “unfettered” marketplace.

Many new challenges involving trust, security and privacy add to the burden and scope of governmental concerns previously emphasizing competition policy, standard setting, spectrum management and licensing.

Immediate challenges: regulatory asymmetry, Internet of Things, transparency, disclosure and open access requirements.

How Did We Get Here?
The First 4 Phases in Internet Development

1) Incubation--government as anchor tenant and underwriter, first through the United States Defense Department and later through the United States National Science Foundation along with research institutes throughout the world (1980s-1995);

2) Privatization--governments eliminate financial subsidies obligating contractors to assess whether and how to operate commercially (1995-1998);

3) Commercialization—private networks proliferate as do ventures creating software applications and content that traverse the Internet. The “dotcom boom” triggers excessive investment and overcapacity (1998-2001); and

4) Diversification—after the dotcom bust and market re-entrenchment, Internet survivors and market entrants expand the array of available services and ISPs offer diversified terms, conditions and rates, including price and quality of service discrimination needed by “mission critical” traffic having high bandwidth requirements, e.g., full motion video content. ISPs and even content providers can use deep packet inspection to identify traffic for “better than best efforts” routing and other forms of prioritization at one extreme and blockage/throttling at the other.

An Evolving 5th Phase

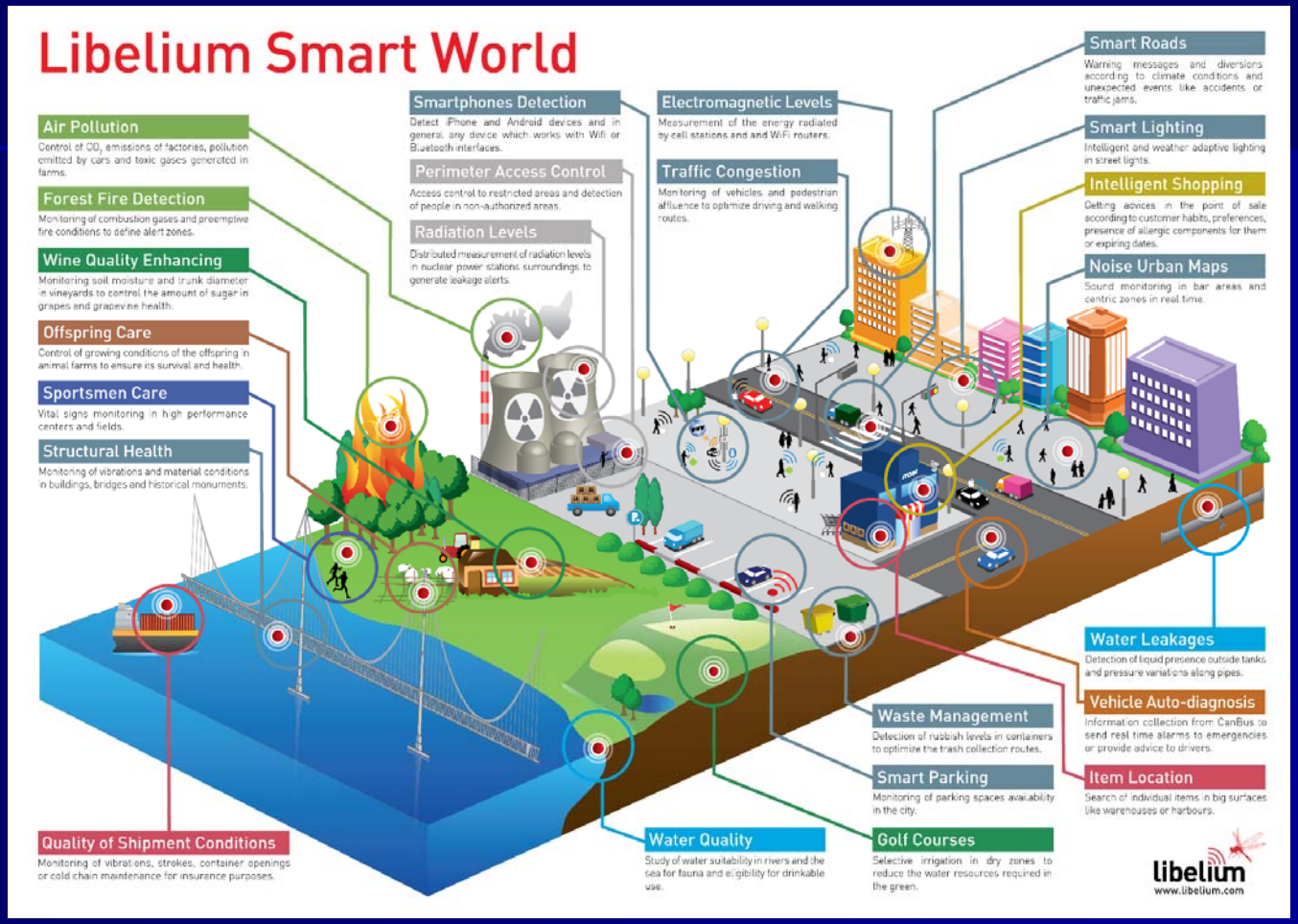
- Widespread diffusion of broadband infrastructure and increasing consumer demand for anytime, anywhere access to IPTV content, plus Internet of Things reaches critical mass.

- Even as the Internet bit transmission marketplace concentrates, the number and type of applications expands significantly. More machines communicate with each other than P2P and P2M.

- Widespread migration from reliance on only 2 interconnection and compensation models: 1) peering; 2) transit.

- Increasing disputes over interconnection and compensation terms; claims that last km. ISPs abuse bottleneck control.

Diversifying Applications and Stakeholders



Diversifying Applications and Stakeholders (cont.)

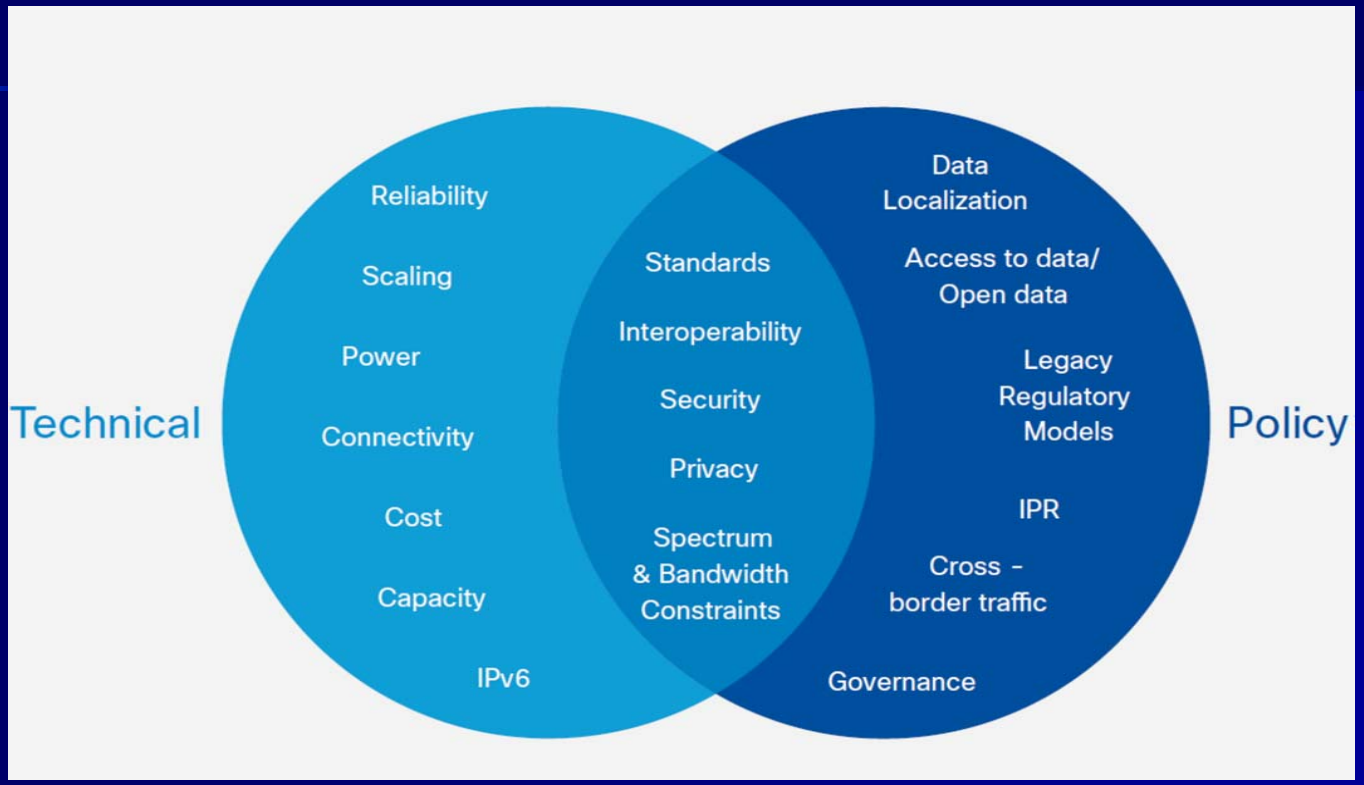
Source: E. Stephens, Adopting the IoT Paradigm: Challenges and Opportunities (18 Jan. 2016); available at: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/iot/20160118/Documents/Presentations/Session1/Session1-4-Erick%20Stephens-18Jan16.pdf.

Evolving Utopia or Dystopia?

- The optimist anticipates an Internet ecosystem ever faster, better, smarter, cheaper and more convenient.
- A golden age where machines gain insight, spot trends and enhance their agility to achieve goals; algorithms can anticipate and serve the wants, needs and desires of consumers, citizens and stakeholders.
- The pessimist worries about ever increasing surveillance, loss of privacy and biased decision making that harms civil society and threatens social compacts.

A Pressing Need for More Cooperation

Expanding categories of stakeholders and conflicting incentives risk delaying and reducing progress



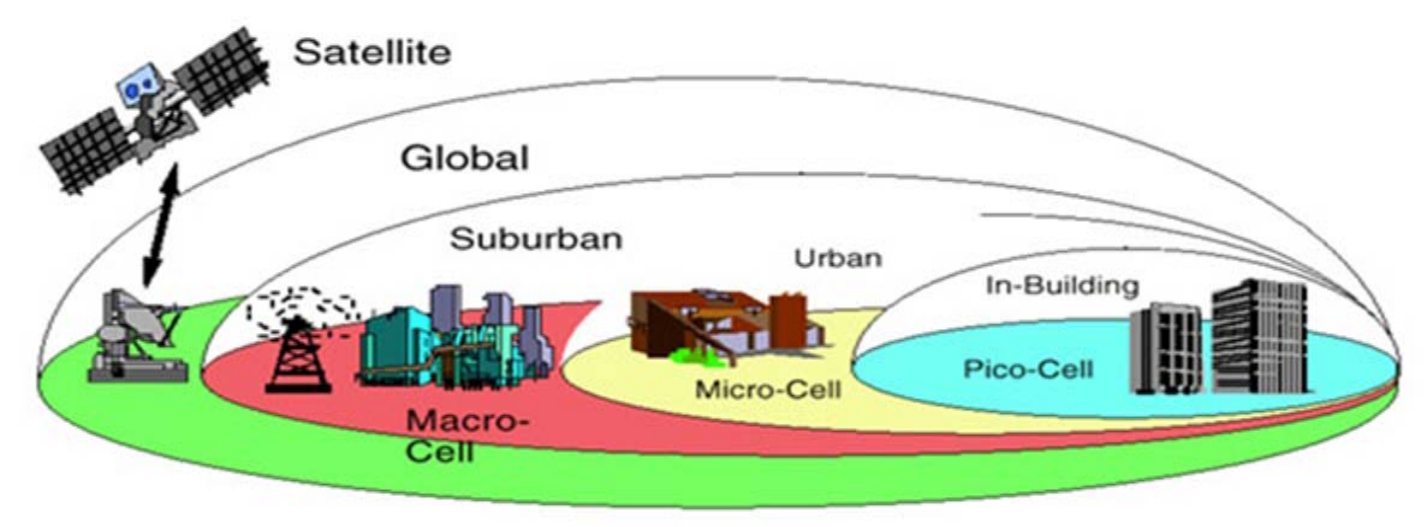
Source: R. Pepper & J. Garrity, The Internet of Everything: How the Internet Unleashes the Benefits of Big Data (2014); available at https://www.itu.int/en/action/broadband/Documents/Harnessing-IoT-Global-Development.pdf.

Challenges to Legacy Cooperation Models

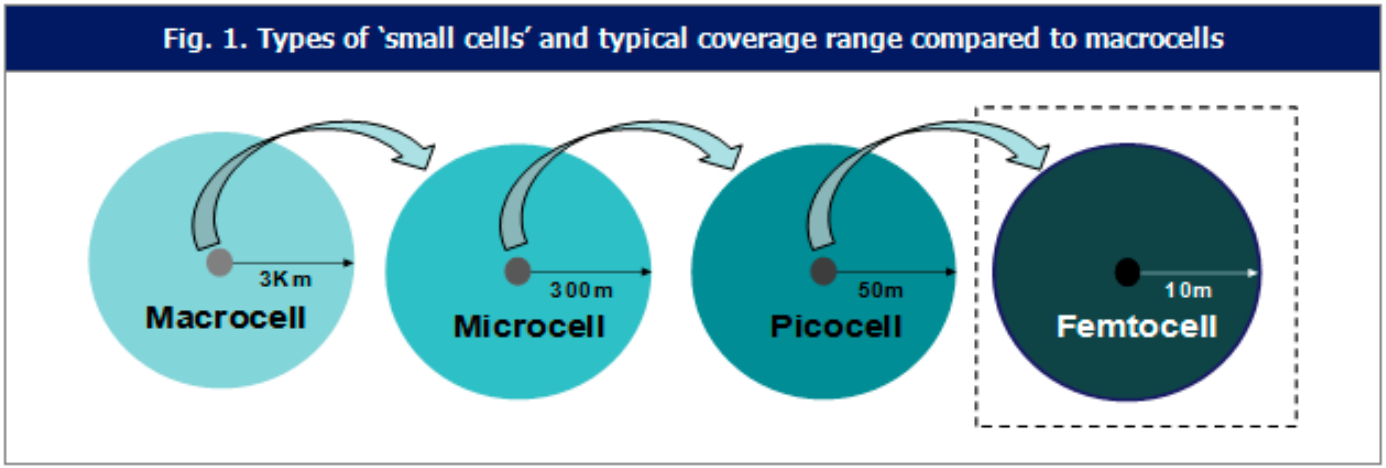
Inter-governmental forums and voluntary NGOs have achieved largely favorable consensus standards, including spectrum allocations.

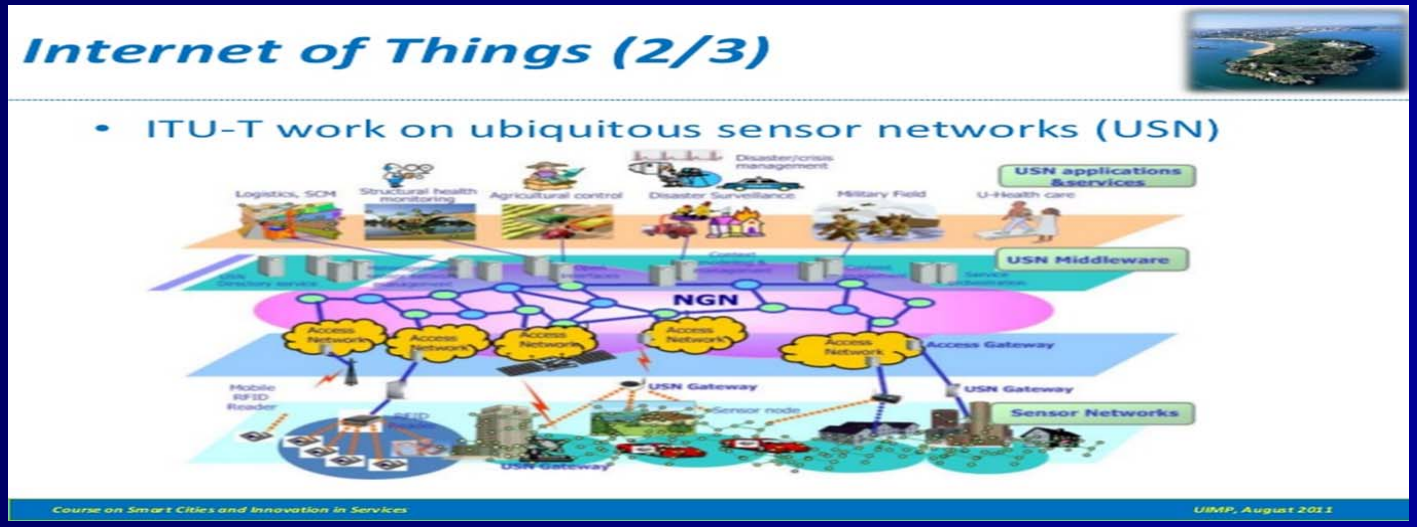
Can this model extend to the diverse current and future Internet-mediated transactions, such as fintech, drones, autonomous vehicles, intelligent roads and cities, telehealth, e-government, etc.?

On the positive side, private and public stakeholders have largely agreed on flexible and sustainable technical protocols for both the Internet and wireless applications. Cloud, big data and IoT need ubiquitous and overlapping radio footprints of various contours.



Legacy Cooperation Models (cont.)

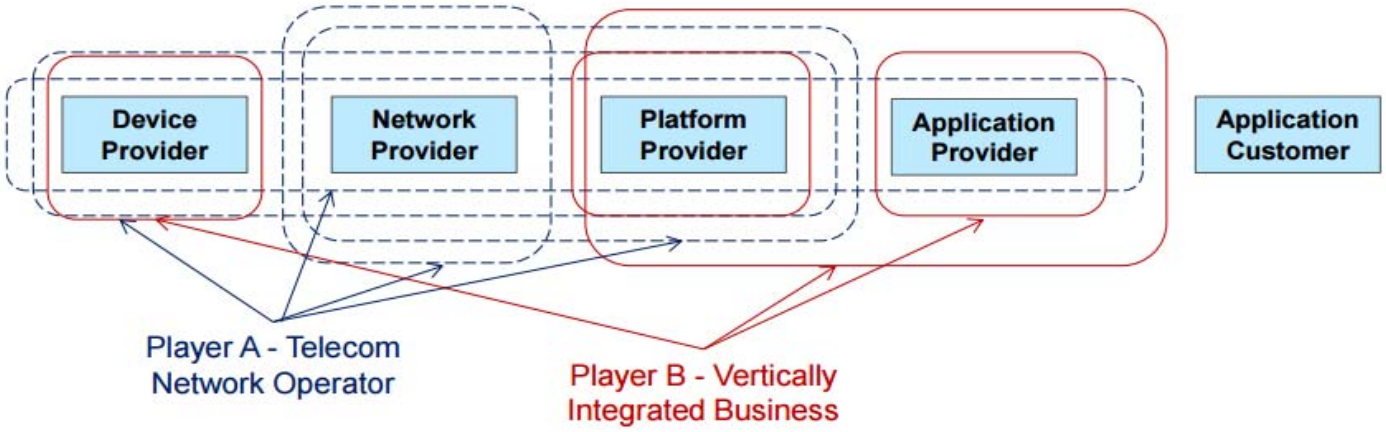




New Players and Fragmenting Roles

- The IoT/Cloud/Big Data Analytics ecosystem generates greater complexity and growing incentives not to cooperate.

- Variety of roles in the IoT ecosystem from the perspective of telecom service & network operators



- Telecom network operators as Players A
  - Network & Platform Providers in access and control of IoT, and device management
- Vertically integrated businesses as Players B
  - Provision of reliable and secure IoT devices for communication, sensory and actuation functions in the delivery of data and content
  - Provision of IoT applications to application customers

Source: A. Chia, Adopting the IoT Paradigm: Challenges and Opportunities for Regulators (18 Jan. 2016); available at: https://www.itu.int/en/ITU-T/Workshops-and-Seminars/iot/20160118/Documents/Presentations/Session1/Session1-2-AileenChia-18-01-2016.pdf.

Case Study: Conflicts Between Content Providers and Last Km ISPs

In the current Internet generation, commercial exigencies (like the need to invest in more bandwidth) and the elimination of gov't subsidies create incentives for profit maximization and identifying who has triggered higher service costs (cost causation).

ISPs serving the last kilometer will seek to erect a double-sided platform with demand for payments from upstream ISPs and content providers in addition to downstream broadband subscribers.

Retail ISPs may try to ration capacity, maximize revenues from both sides and offer "better than best efforts" traffic prioritization/specialized networks.

With two sources of revenues available, Retail ISPs can offer end users new subsidized (free-rider) access such as "zero rating" and "sponsored data" much like credit card companies offering no annual fee options.

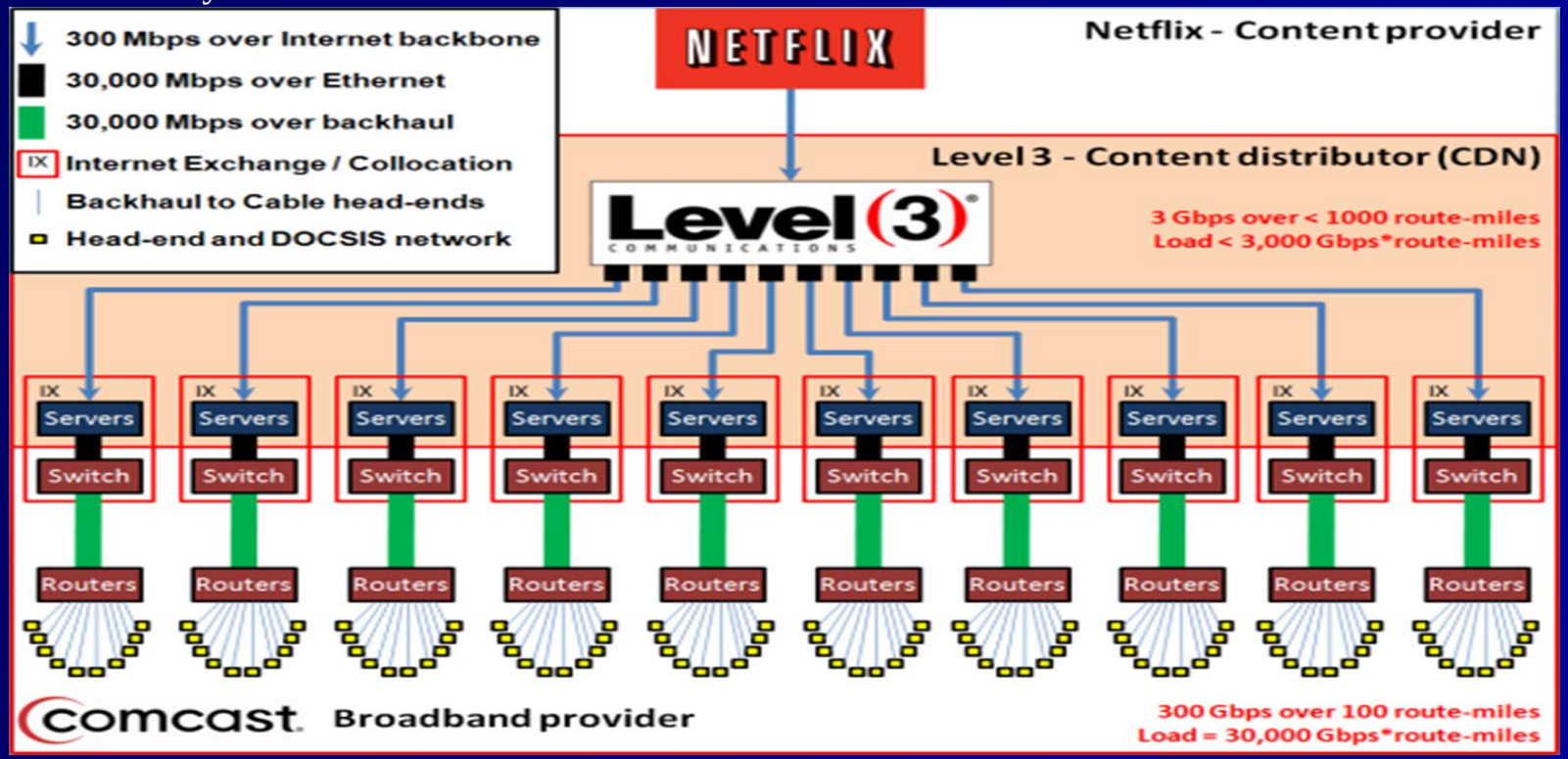
Commercially-driven interconnection and compensation negotiations can benefit consumers without harming competition.

However, the potential exists for Retails ISPs to abuse a bottleneck in the absence of sufficient competition; consumers suffer when content carriage disputes lead to congestion, dropped packets and reduced QOS.

Growing Dominance of Internet Platform Intermediaries

ISPs operate as intermediaries in a double-sided market with retail, broadband subscribers downstream and other ISPs, content distributors and content creators upstream.

The Internet ecosystem supports powerful platform operators who can capture large market share by exploiting scale economies, network externalities and high switching costs/barriers to market entry.



Source: George Ou, Digital Society, http://www.digitalsociety.org/2010/12/division-of-labor-between-broadband-and-cdn/

Proliferation of Interconnection Models

- ISPs consider price and QOS discrimination essential for generating new profit centers; “better than best efforts” offered in lieu of a single “best efforts” model.
- New alternatives to the peering/transiting dichotomy: use of Internet Exchange Points; paid peering (Comcast-Netflix); CDN surcharges (Level 3-Comcast), equipment co-location, e.g., Netflix Open Connect Network; “specialized networks” and Intranets; Multiprotocol Label Switching and non-carriers like Google securing Autonomous System identifiers.
- Retail ISPs providing last km service test pricing limits by tiering and raising end user monthly subscriptions at the same time as they impose surcharges on upstream ISPs, and offer paid peering options to highest volume content providers, e.g., Netflix. This has resulted in several high visibility conflicts.
- Retail subscribers quickly become agitated when QOS suffers and have no patience with ISP compensation disputes, much like cable television subscribers denied access to particular networks during a retransmission dispute.

Legacy and New Interconnection Models

Peering/Barter—zero cost interconnection based on near parity in traffic volume, or reliance on external subsidy	**Paid Peering**—traffic volumes not in parity, e.g., CDNs; content source secures higher QOS with closer and earlier interconnection
Transit—volume-based interconnection for pay	Unchanged, but smaller ISPs agree to peer, or meet at Internet Exchange Points
Unwelcomed Hot Potato Routing—"premature" traffic hand-offs; considered abuse of privilege	**Welcomed Hot Potato Routing**—offered for additional compensation
Primary Reliance on Receiver Pays—end user broadband subscriptions cover cost of service	**Receiver + Sender Pays**--Last km. ISP seeks to operate in a 2x-sided market combining sender and receiver payments; strategic balancing of financial burdens, including "sponsored data/zero rating"

New Incentives Risk More Frequent Interconnection and Compensation Disputes

Level 3-Comcast

In late 2010, Comcast imposed a traffic delivery surcharge when Level 3 became a major CDN for Netflix in the U.S.

Level 3 characterized the surcharge as a discriminatory toll while Comcast framed the matter as a commercial peering dispute.

Comcast is correct if one narrowly focuses on downstream traffic termination.

But more broadly, the dispute raises questions about the scope of duties Comcast owes its broadband subscribers and whether Level 3 is entitled to a good faith effort by Comcast to abate the traffic imbalances with upstream traffic.

It also raises questions about the flow of compensation due participating carriers downstream from sources with which retail ISPs do not directly interconnect.

Misconceptions (or Misrepresentations) in the Level 3-Comcast Dispute

Retail ISPs providing the last km delivery of traffic customarily do not directly receive compensation from upstream sources of content such as Google, Netflix, YouTube and Hulu.

The peering process traditionally involves directly interconnecting carriers. This means (absent paid peering) Netflix has the responsibility of securing the services of a CDN, such as Level 3, but Level 3 bears the direct interconnection and compensation burden with retail ISPs such as Comcast.

It is untrue to assert that hyper giant sources of traffic do not pay for delivery of their content.

Note that Comcast successfully imposed a surcharge on its peering partner Level-3 when Netflix traffic upset the balance of traffic flows.

Netflix-Comcast

Once an advocate for network neutrality, Netflix has opted for higher QOS through a paid peering arrangement with Comcast. Netflix now directly interconnects with Comcast at many locations thereby reducing latency and the number of networks and routers typically used. Virtually overnight Netflix traffic congestion problems evaporated.

Paid peering, providing "Most Favored Nation" treatment of specific traffic streams, has triggered a vigorous debate over what constitutes reasonable price and QOS discrimination.

Netflix's payments to Comcast are offset in part by reduced or eliminated payments to CDNs, but the accrual of more revenues for retail ISPs raises concerns about increasing bottleneck/terminating monopoly control.

Will surcharge demands and better than best efforts become the new normal even for venture with modest traffic volumes previously accommodated by the standard best efforts model?

Preliminary Conclusions

As broadband markets mature, services proliferate even as many consider everyone entitled to a low cost, universally available baseline.

NRAs will continue to struggle to find lawful ways to satisfy consumers' expectations for security, data protection, network openness, ubiquity, affordability, interoperability and reliability without harming operators' incentives to invest in plant, innovate and develop new services.

If consumers lack trust in innovations, they won't use them.

In most countries ISPs do not have to be treated as public utilities for the NRA to impose good faith, transparency, truth in billing and reporting requirements, but consumers may not support a cyber-libertarian environment that permits confusion, disruption and invasion of privacy.

ISPs appear to have solidified their control over the Internet ecosystem, despite the conventional wisdom that "content rules." Last km ISPs can demand compensation from both downstream broadband subscribers and upstream carriers and content providers.