Internet Architecture Innovation: 2020 and 2030

kc, caida/uc san diego
17 oct 2014

Internet Regulation in 2020
(Duke Law Center for Innovation Policy conference @ NAS)

UC San Diego

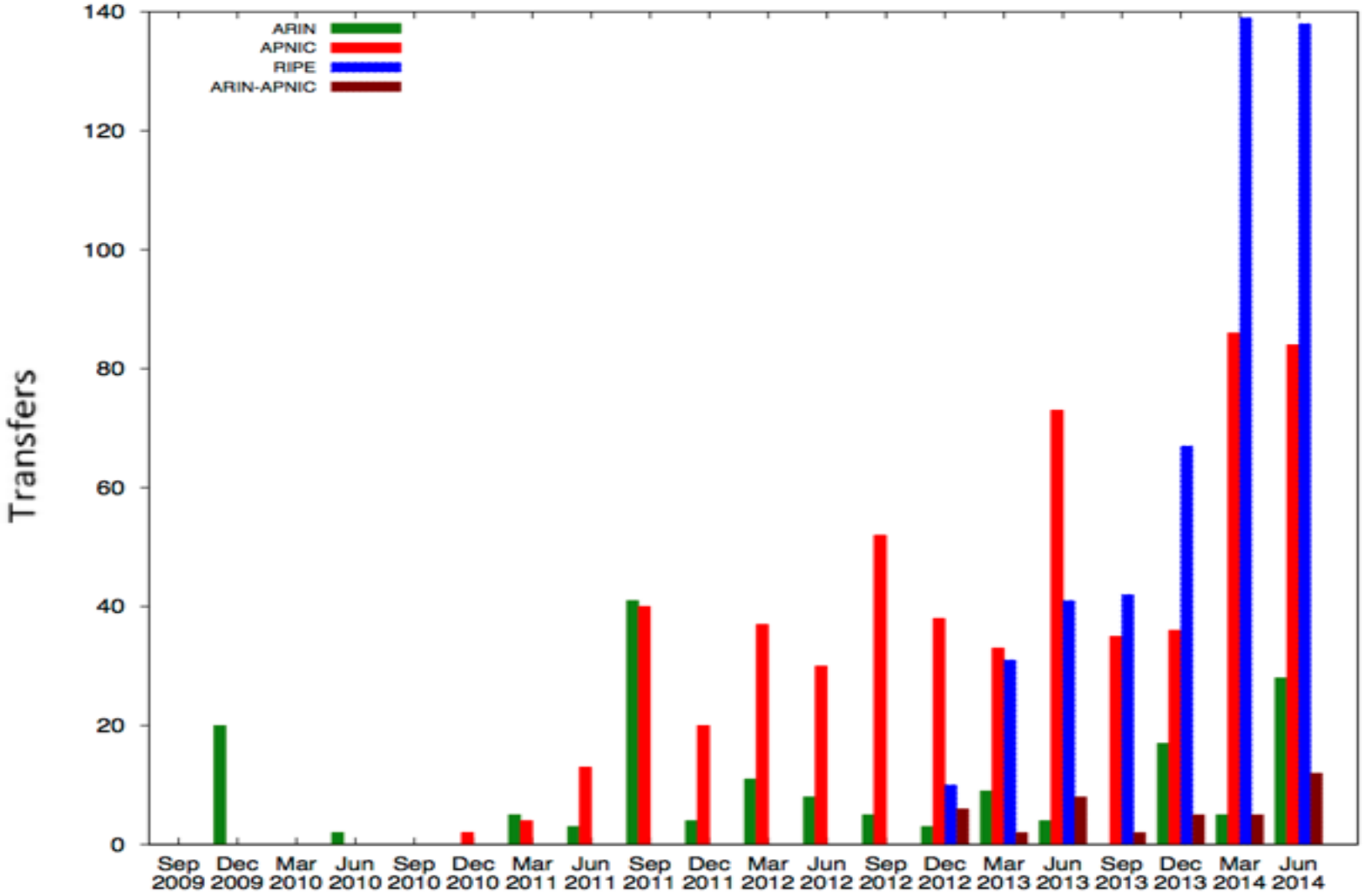
Network architecture innovations by 2020 (5-6 years)

1. IP address architecture: some IPv6 growth; even more CGN
   - more security and stability problems despite available architectural innovations to prevent (& more measurement)
2. naming architecture (DNS): expansion of TLDs;
   - more security and stability problems despite available architectural innovations to prevent (some DNSSEC growth)
3. routing architecture (BGP): ___
   - more security and stability problems despite available architectural innovations to prevent
4. transport architecture:
   - more encryption and performance capabilities

effecting architectural innovation is complex and hard

(data informing CGN vs IPv6 prediction)

Increasing Number of Published IPv4 Transfers

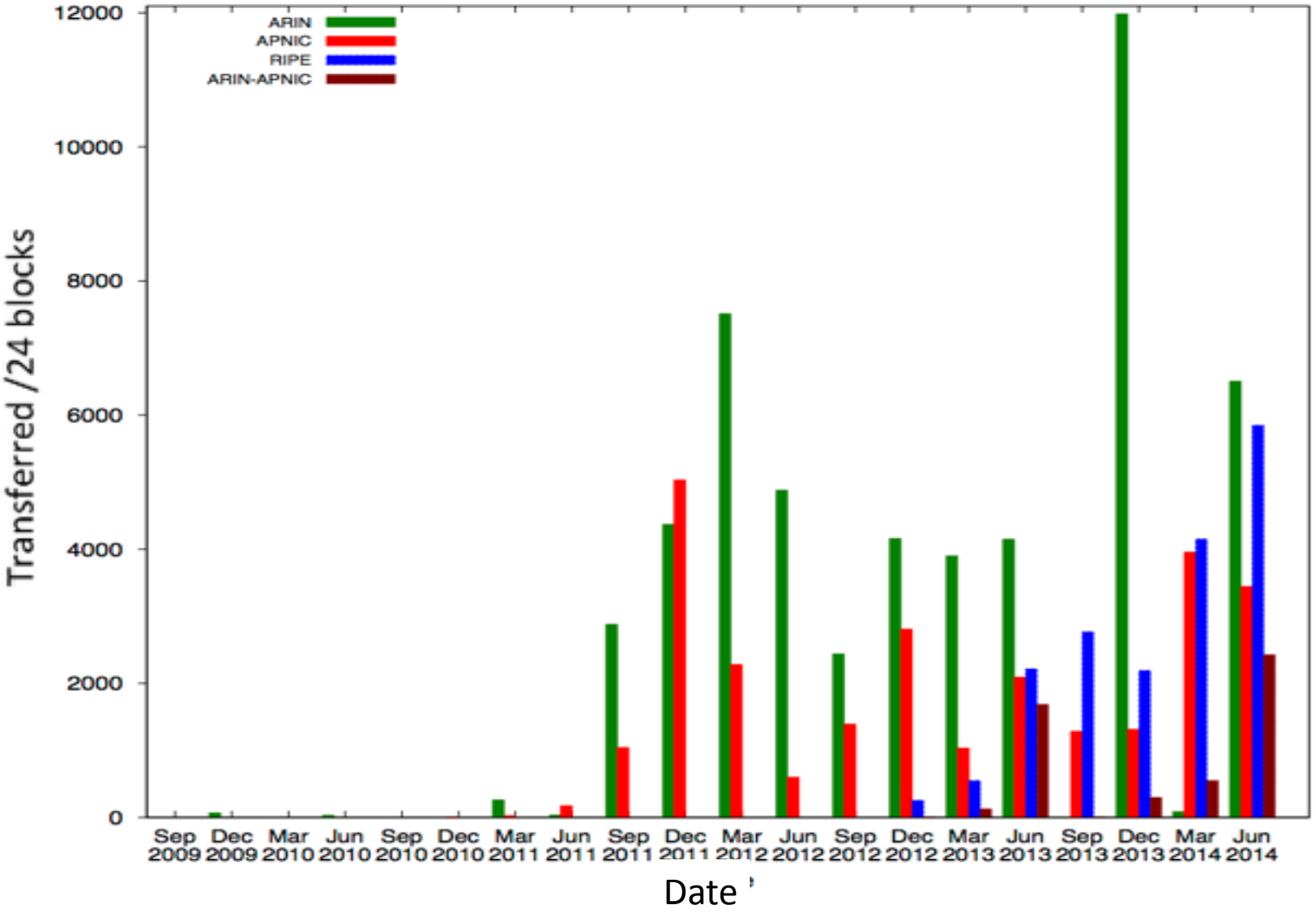


* APNIC data includes non-market transfers (e.g. due to mergers & acquisitions)

Source: “A First Look at IPv4 Transfer Markets”, CoNEXT2013 (updated)

(data informing CGN vs IPv6 prediction)

Increasing Number of Published IPv4 Transfers



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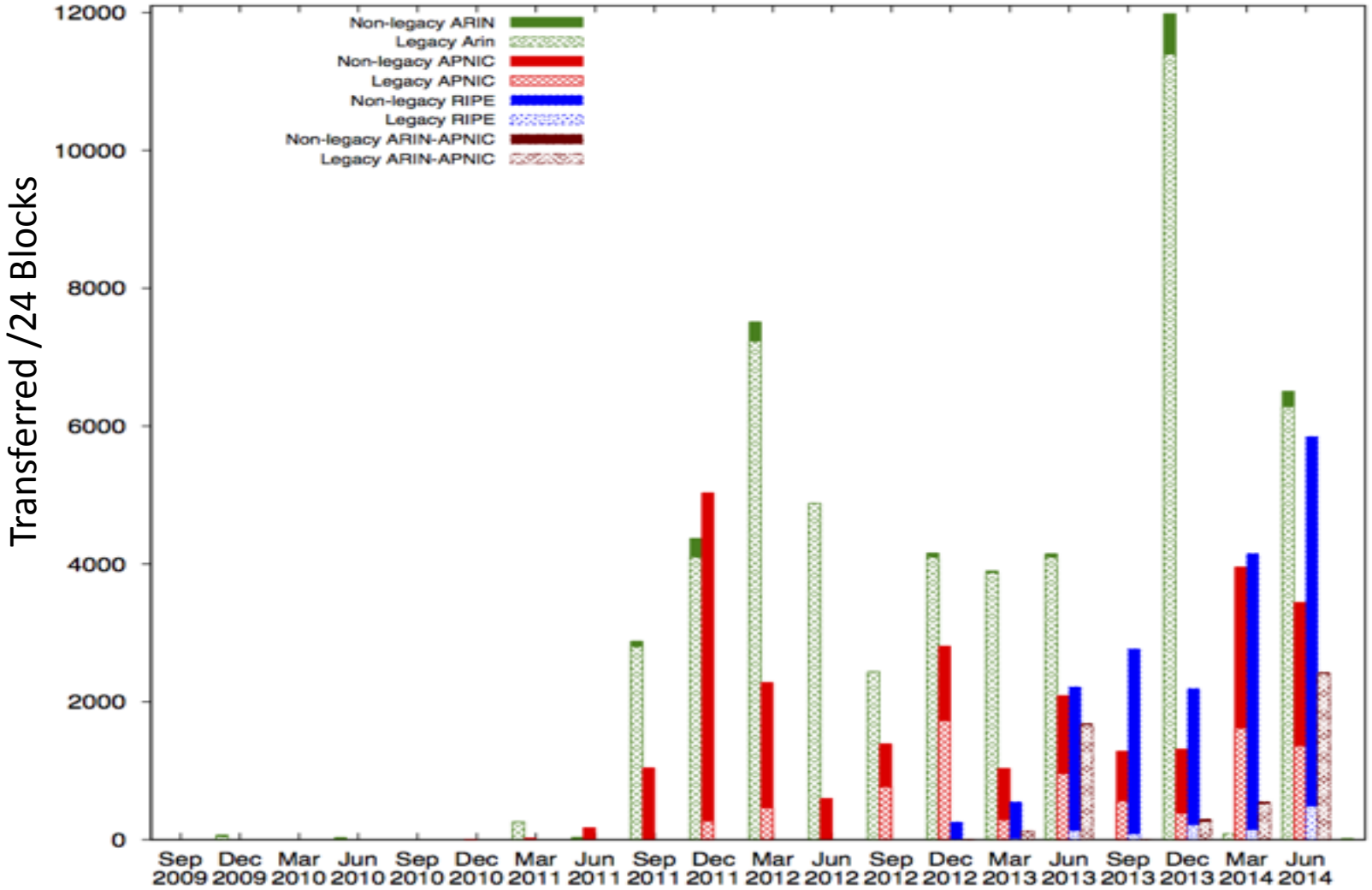
(data informing CGN vs IPv6 prediction)

Which IPv4 addresses are transferred?



Most transferred space in ARIN (96.67%) and between ARIN and APNIC (97.23%) represents legacy allocation.

Business architecture innovations by 2020 (5-6 years)

1. IP addressing: growth in IP address market activity
   - speculative and real (operationally motivated) transactions
   - CGN-based businesses
2. naming (DNS): growth in defense, speculative, and fraudulent registration
   1. and business models to handle (e.g., domain reputation)
3. routing (BGP): SDX experimentation?
4. transport: private IP-based interconnected network platforms
   - in parallel with public Internet, but not the same
   - multi-sided platforms will support range of complementers, "specialized services", and pricing models
   - largely unregulated "shadow industry" (financial sector term)
   - will yield higher returns on capital investment..
   - leaving public Internet in questionable position ("dirt road")
5. also: municipal networking will make a comeback

Network architecture innovations by 2030 (15 years)

1. Information-Centric Networking
   - dominant communication paradigm now
   - especially with mobile
   - IP architecture does not support secure communication or data distribution well (especially with mobile..)
   - Increasing incongruity between architecture and its use motivating attempts to have architecture catch up to use
   - one option: Named Data Networking (named-data.net)
     - proposed new "narrow waist"

Today's Internet will become an overlay on a more general architecture, as telephony has become an overlay on today's Internet.

Interaction between policy and innovation (5 years)

1. Regulatory policy will not change much
   - much gnashing of teeth over 706 vs TitleII
   - symptom of underlying incongruity between political economy and network architecture
   - i.e., IP transport is not a profitable competitive utility
   - transparency requirements will increase. slightly.
2. Academics will start to tune in
   - legal as well as technical
   - research funding will increase. slightly.
3. Discussion of new regulatory title (for Internet) will thrive
4. Municipal networking will be legal again
   - but not consistently successful

Interaction between policy and innovation (15 years)

1. New regulatory title to cover Internet ("Title 7"?)
2. Perhaps new protocol architecture by that time
3. If so, imagined policy-relevant implications include
   - increased consumer choice (broadcast across media)
   - more free and anonymous communication (no IP addresses)
   - security architectures will need policy support (key mgt)
   - privacy, data deletion, copyright will require reconceptualization (caching inherent to ICN)
   - content control/traffic discrimination (sorry)

Most problematic interaction is the patent system, since core architectural ideas will be patented by players seeking to monetize them

Costs and benefits of innovations and policies (2020)

1. Little focus on harms vs benefits of proposed innovations to network or policy architectures; little data to inform analyses
2. Example: banning Internet traffic discrimination
   - harm: proliferation of private interconnected IP networks
   - harm: prevents beneficial traffic discrimination
   - benefit: some level of consumer protection
3. Example: proliferation of private interconnected IP networks
   - harm: rich users migrate away from Internet ("dirt road")
   - harm: inconsistent access to users,
   - harm: constant concerns about discriminatory treatment
   - benefit: increased capabilities, capital for investment (?)
4. Example: usage based pricing and monthly caps
   - harm: create culture of scarcity rather than abundance
   - benefit: traffic engineering, capital for investment

Costs and benefits of innovations and policies (2030)

1. If new ICN architecture by that time, benefits include
   - increased consumer choice (multi-path friendly)
   - more free and anonymous communication
   - improved security of communications and data distribution
   - easier to write secure applications (app semantics in names)
   - improved resilience to device config changes
   - disruption tolerant
   - cleaned up privacy and copyright regulatory frameworks
   - improved patent system (by definition)

Related reading

http://www.caida.org/publications/papers/2014/

1. Platform Models for Sustainable Internet Regulation (JIP14)
2. Anchoring policy development around stable points: an approach to regulating the co-evolving ICT ecosystem
3. Approaches to transparency aimed at minimizing harm and maximizing investment (FCC NPRM comment)
4. Measurement and Analysis of Internet Interconnection and Congestion (TPRC14)
5. Named Data Networking: An Introduction (CCR)
6. A World on NDN: Affordances & Implications of the Named Data Networking Future Internet Architecture (TR)