#### IETF 116 dinrg

30 March 2023 A Taxonomy of Internet Consolidation draft-mcfadden-consolidation-taxonomy-01

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#### Motivation

- Lots of discussion in a variety of forums about Internet consolidation
- Observation
  - Not everyone is talking about the same thing
  - Important to ensure that the discussion is focused on the same causes and effects

#### Revision to Previous Draft

- This draft is a revision of one presented in London at IETF 115
  - Adds references to other discussions
  - Expands the discussion of economic centralization slightly
  - Distinguishes between economic flow and economic revenue
    - The "path" capital and revenue takes versus the eventual "destination"
  - But, it is hard to miss the fact that this is a topic of significant interest to a broad community not just engineers and operators

#### The Essential Taxonomy

- Divides the topic into four key areas
  - Economic consolidation
  - Traffic and Infrastructure consolidation
  - Architectural consolidation
  - Service and application consolidation

#### **Economic Consolidation**

- Economic consolidation on the Internet refers to the effects of market consolidation on competition and the economic power of a small set of companies that dominate economic activity in the Internet
- There are two aspects to economic consolidation on the Internet:
  - Economic consolidation means that a small number of companies dominate the marketplace and hence, the revenues gathered from the use of the Internet
  - Economic consolidation also means that a small number of companies control the flow of capital among enterprises that provide services on the Internet

## Traffic/Infrastructure Consolidation

- A significant majority of the Internet's traffic is delivered from very large content services
- These companies naturally attempt to provide the best possible service for their customers
- The result is a "flattening" of the Internet's traditional topology
  - In fact, a recent study shows that these large services can reach more than 76% of the Internet without having to traverse traditional Tier 1 and Tier 2 ISPs. over the elements of the infrastructure being used to deliver services.
  - An empirical view of this consolidation in February of 2022 [shows that the number of webpages that are hosted on these networks has increased from 2015 to 2020 at a rate exceeding 80%.

#### Architectural Consolidation

- Two developments have led to architectural consolidation:
  - The emergence of intermediary services
  - The movement of transport related code to the application layer

#### Intermediaries

- Technologies like CDNs are built into the network for the efficient delivery of content and services
- The end-user is largely unaware that the service or application is being hosted by an organization other than they one they think they contacted
- Content delivery is pushed as close to the consumer as possible to ensure that the end-user experience is as optimal as possible
- The result is a series of security, economic and policy concerns associated with the small number of very large providers of these intermediary services

# Applications

- Companies that control the applications attempt to control all aspects of the communication.
- The advantage of this kind of architectural consolidation is that it allows the largest players to introduce technological innovation more quickly than if multiple layers of the stack required innovation in parallel
- With tools like DNS over HTTPS, we see applications taking control of the infrastructure of transport
- Applications essentially provide their own ecosystem (from centralized control of DNS services all the way to the end-user experience)

# Finally

- Taxonomy seems important to guide the discussion
  - Implications for architecture
  - DINRG charter
  - RG adoption?

## Thanks

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