

# **Measurement in an Era of Proliferating Virtual and Private Networks**

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# Carnegie Mellon More and more IP Packet Traffic is Not on the Public Internet

CADE.METZ BUSINESS 05.26.16 01:00 PM

## FACEBOOK AND MICROSOFT ARE LAYING A GIANT CABLE ACROSS THE ATLANTIC

GOOGLE TECH FACEBOOK

## Google and Facebook building super high-speed cable between LA and Hong Kong

By Jacob Kastrenakes | @jake\_k | Oct 12, 2016, 12:00pm EDT



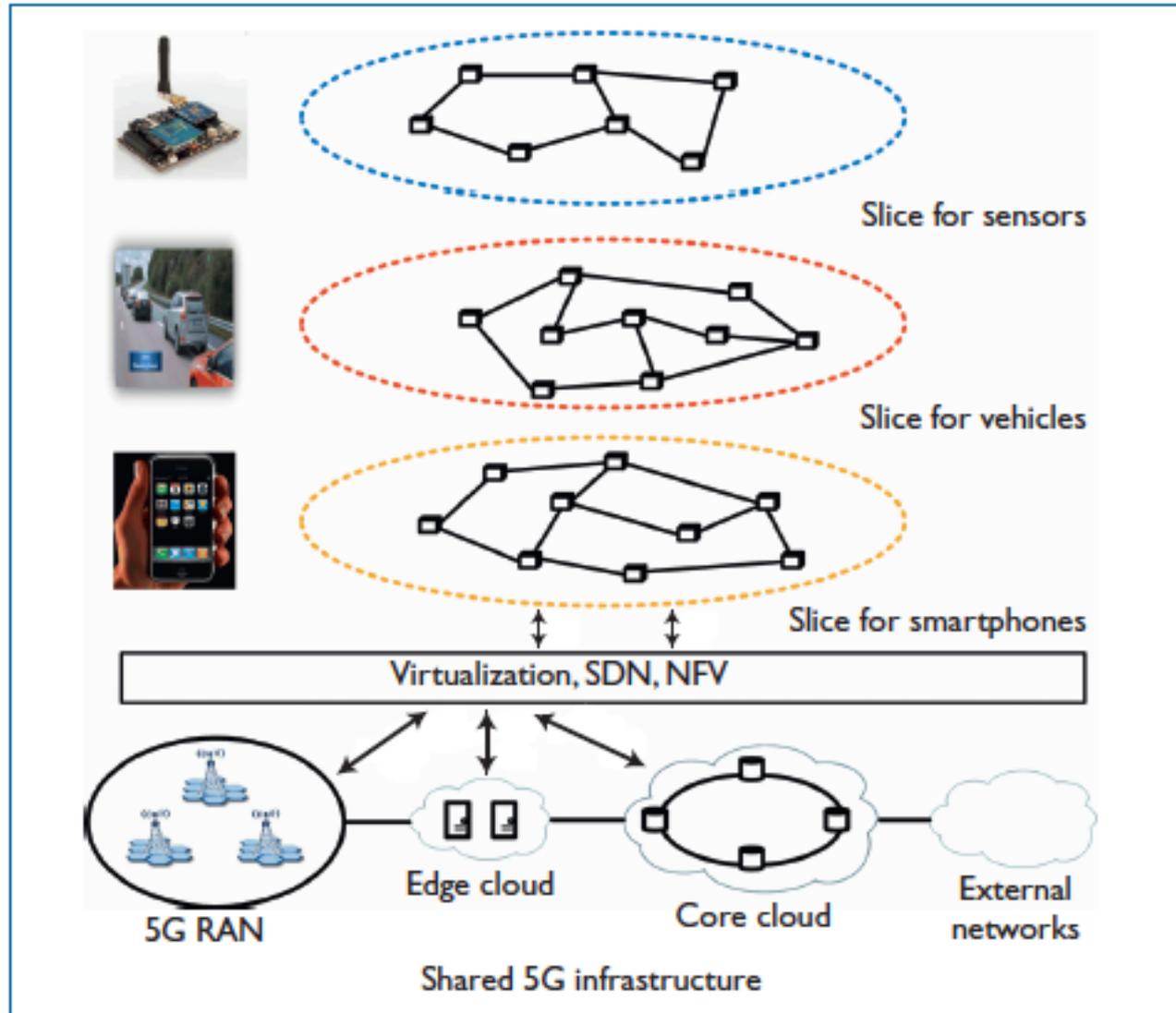
## End-User Traffic Rising, More Traffic Migrating to Private Networks

INTERNET NETWORK

By Anahi Rebatta Aug 24, 2018

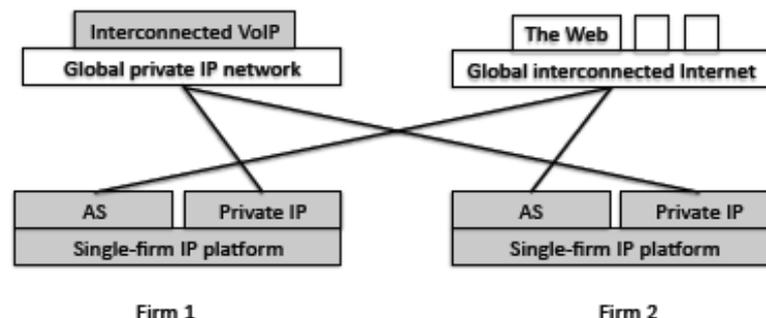
- “...according to telecommunications research firm Telegeography, more than two thirds of the digital data moving across the Atlantic is traveling on private networks...” –May, 2016

# Network Slicing is a Central Feature of Emerging 5G Standards



# What Do These Observations Mean for "Measuring the Internet"

- **FCC defines the Internet as**
- **"...a mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints..."\***
- **Private networks, and slices that cover only some endpoints are excluded from this definition**
- **Scope of non-Internet IP networks is growing\*\***



\* FCC, *In the Matter of Restoring Internet Freedom*, at 21"

\*\*claffy and Clark, 2014

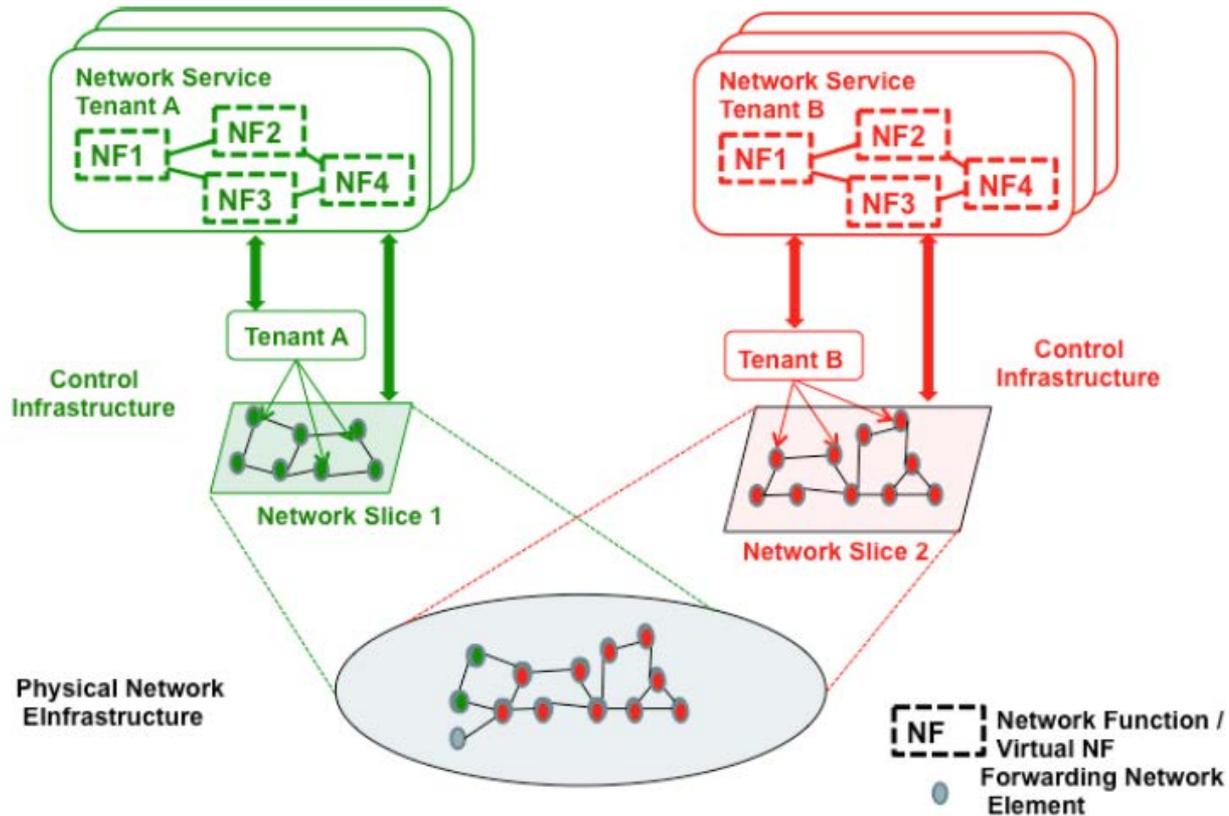
# Why Should we Measure the non-Internet?

- **Volume of traffic on non-Internet IP platforms means these platforms are driving innovation**
  - Innovations in router hardware
  - Problems of scale will appear on private platforms first
  - Understanding market size important to vendors
- **QoS-enabled networks are found here**
  - Understanding issues with delivering QoS
  - NN rules pushing QoS off public Internet

# Measurement Challenges

- **These Networks Cannot Be Measured From Public Internet Endpoints**
  - *E.g.* Ping tests
- **Internet Route servers won't necessarily show slice routes**
- **Potential for double counting**
  - Underlying network and the slices running on top
  - Enron was once a large ISP that deployed no fiber
    - Relied on IRU's from other companies
    - → Double counting of fiber route miles, underestimating national network resiliency
- **Inter-domain slices are a long way off**
  - → Won't see slices at Internet Exchange Points

# Carnegie Mellon Network Slicing is a Central Feature of Emerging 5G Standards



Source: 5G PPP Architecture Working Group - White Paper, Dec, 2017

# Possible Solutions???

- **Virtual networks**
  - Regulators require platform providers to provide some basic information about extent of slice use
    - Slices can be pro- or anti-competitive, therefore of interest to regulators
- **Private networks**
  - ?????