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**How network measurement can  
inform telecommunications  
public policy**

# Fixed Broadband Service: availability

- Where do service providers offer service?
  - Which service tiers do they offer at each location?
  - Granularity: zip code, census block, ...

# Fixed Broadband Service: performance metrics

- Throughput:
  - Variation in throughput experienced by different subscribers, for a given service tier?
  - How do I tell when these variations are due to
    - location within an access network?
    - technology?
    - network management?
  - Throughput vs. time window over which it is measured?
- Delay:
  - Where does queuing delay occur?
- Packet loss:
  - Where does packet loss occur?

# Fixed Broadband Service: variation

- Probability distribution for a single customer
  - Throughput
  - Delay
  - Packet loss
- Burstiness, duration of variations?
  - Auto-correlation functions?
- Metrics to capture variation
  - 80 percent of customers, 80% of the time ??
  - % uptime?
- Peak usage period
  - How to determine?

# Mobile Broadband Service

- Same questions as fixed
- Additional focus on variability
  - Probability distribution:
    - Throughput: mode of download speed lower than median?, long upper tail?
    - Latency: long upper tail?
  - Cause?
    - signal strength?
    - layer 1/2 protocol?
    - congestion?

# Usage and QoE

- Broadband customer usage:
  - mix of class-of-applications?
    - time?
    - volume?
- QoE:
  - for each class-of-application, what is the ratio of peak required speed to average throughput?
- Subscription:
  - Which service tier should I subscribe to?
    - Given probability distribution, what is the right multiplier of my needs to median download speed?
  - For whom is mobile broadband service a substitute for fixed broadband service?

# Usage

- Data caps
  - What is the relationship between heavy monthly users and heavy instantaneous users?
  - How do data caps impact user demand?
- Demand
  - What is the real mobile broadband demand
    - Given that TCP and achieved performance regulate user behavior?

# Network Management

- Mobile:
  - Throttling of video, music, gaming, tethering, ...
  - Transcoding
  - Caching
- Cable:
  - Prioritization of certain VoIP streams?
  - Separate capacity for certain video streams?