SMART NETWORKS

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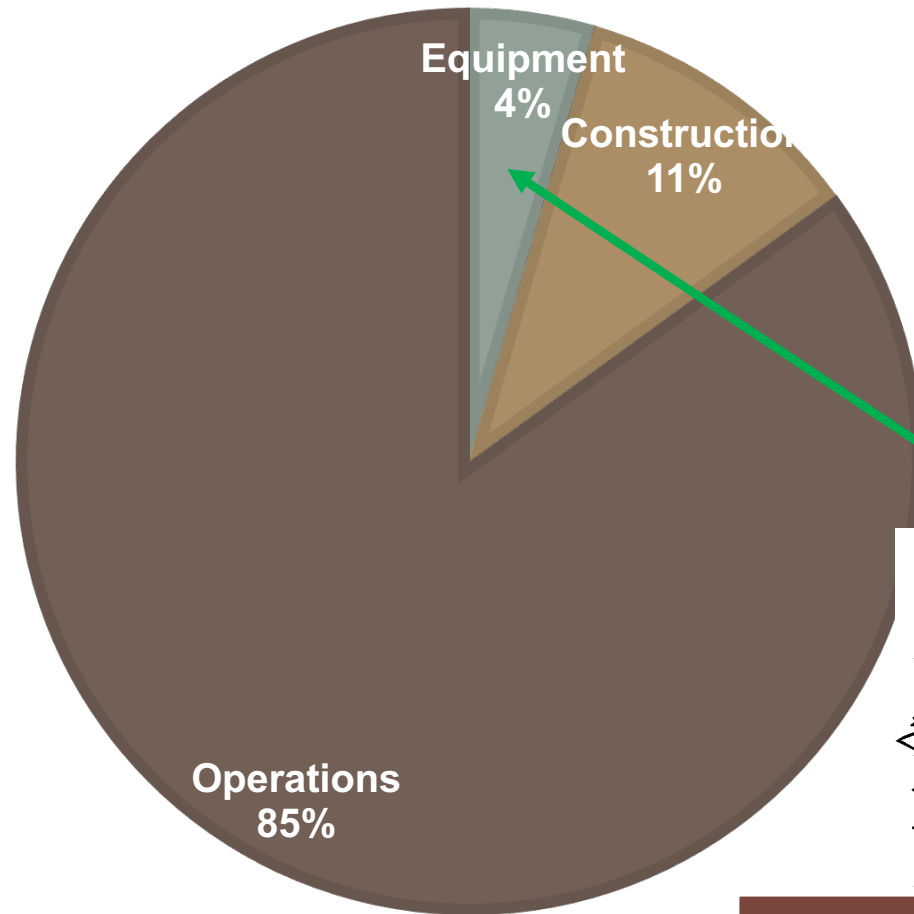
(NSF workshop, Atlanta, GA – May 2017)

Secure
(self) Managed
Adaptive
Resilient
Transparent

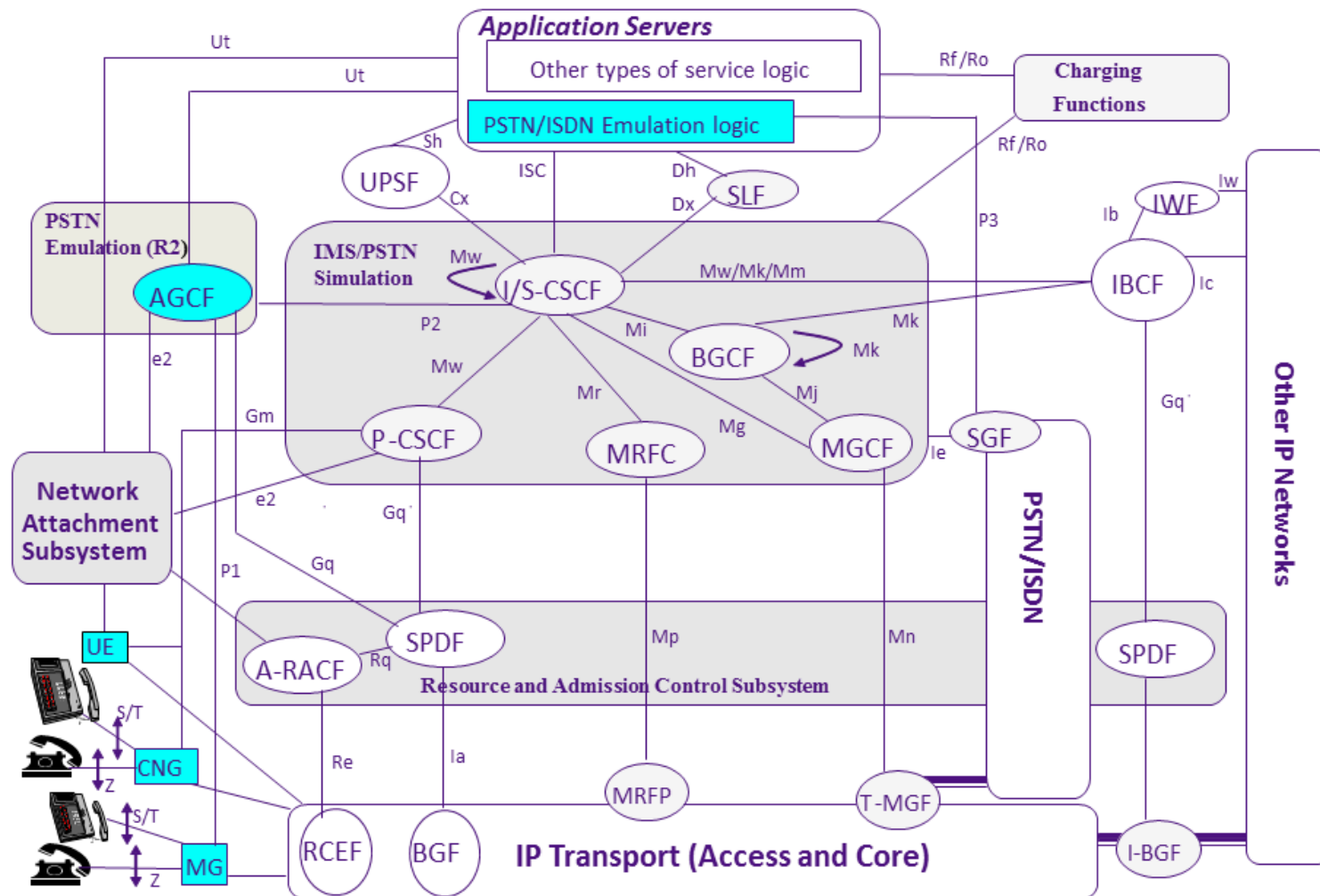# Network economics, (over)simplified

% OF REVENUE

■ Equipment ■ Construction ■ Operations ■

70%

30%

Equipment
4%

Construction
11%

Operations
85%

90% of papers.

Complexity kills

IMS

General observations

- Economics, not capabilities
  - nobody was asking for IPv6 until addresses ran out
  - not clear anybody is asking for ICN, either
- Real-world challenges:
  - Can you build affordable networks to rural areas (other than satellite)?
  - Can you operate networks with no PhDs around?
  - Can you operate networks constantly under attack?
- Research is good at layering on complexity, not good at 99/5 solutions
  - still into saving bandwidth or hardware, not operations
  - how to quantify the trade-off?
  - examples: IP multicast, IP mobility

My guide posts

- Networking is a mature field – with enough money, can get any bandwidth anywhere at any time
- Networking is an infrastructure engineering discipline
- Where are there 10x *economic* opportunities?
- What is not working for users today?
- What are societal needs that are not being met?
- What has a chance to get beyond a conference paper?
- Can we formulate before-after scenarios?
  - "Today, we cannot do X. After we do research, X is available to users."
  - "Today, we do not understand Y. After research, we do."

Challenge 1: Lights-out network

- Home & small business networks largely self-managing
- Enterprise and carrier networks – not so much
- Configuration, fault diagnosis, performance management
- Architecture: where should complexity and generality reside?
  - e.g., should object storage and point-to-multipoint be network functions or application-layer functions?
- Goal: no more phone tech support
- Goal: if physical problem, fixed before user notices

Challenge 2: Self-secure networks

- Much larger diversity of software
  - not just 3-4 PC operating systems
  - hundreds of different IoT devices, printers, …
- Not all Internet actors are trustworthy
  - see BGP routing
- Can we protect stupid (not just dumb…) devices?
- Can we protect the network and the user
  - DDOS and privacy violations?

Challenge 3: Spectrum-agile networks

- Essentially all spectrum below 6 GHz is in use
  - and much of the spectrum below 90 GHz (satellite, mainly)
- Unlicensed + licensed, but also unplanned + planned
- From 150,000 cell towers → 100 million mmWave radios
- Single frequency devices → O(10) bands from 450 MHz to 38 GHz
- Many bands unlicensed → much better power control & frequency coordination
  - sliced & shared infrastructure
- How to detect sources of interference?