RYSAVY RESEARCH

Wireless Technology
and Network Neutrality

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http://www.rysavy.com

February 2015

Recent Papers

- *LTE Congestion Management – Enabling Innovation and Improving the Consumer Experience*
  - January 15, 2015
  - Published by Mobile Future
  - http://www.rysavy.com/Articles/2015-01-Rysavy-LTE-Congestion-Management.pdf

- *How Wireless is Different - Considerations for the Open Internet Rulemaking*
  - September 4, 2014
  - Published by Mobile Future
  - http://www.rysavy.com/Articles/2014-09-Wireless-Open-Internet.pdf

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“Mobile Broadband Networks Can Manage Congestion While Abiding By Open Internet Principles”

- New America Foundation’s Open Technology Institute

- “In this neutral framework, an unaffiliated application can be provided QoS; ‘like’ applications are treated in a ‘like’ fashion; and the LTE network provides QoS to latency-sensitive and/or high-bandwidth applications that benefit from it or require it to run consistently and effectively in congested environments.”

- “Industry standards bodies or another industrywide process approved by the FCC create generic QoS profiles related to latency sensitivity or other attributes that need similar QoS treatment, and make them open to all like applications, such as toll-quality voice and video communications.”

- “There will be challenges in transparency. There will be many policy rules, and they may be complex, making it more likely that automated tools maybe necessary to read and analyze the rules. The verifiers must be trusted to be neutral and thorough, as well as protective of proprietary information.”

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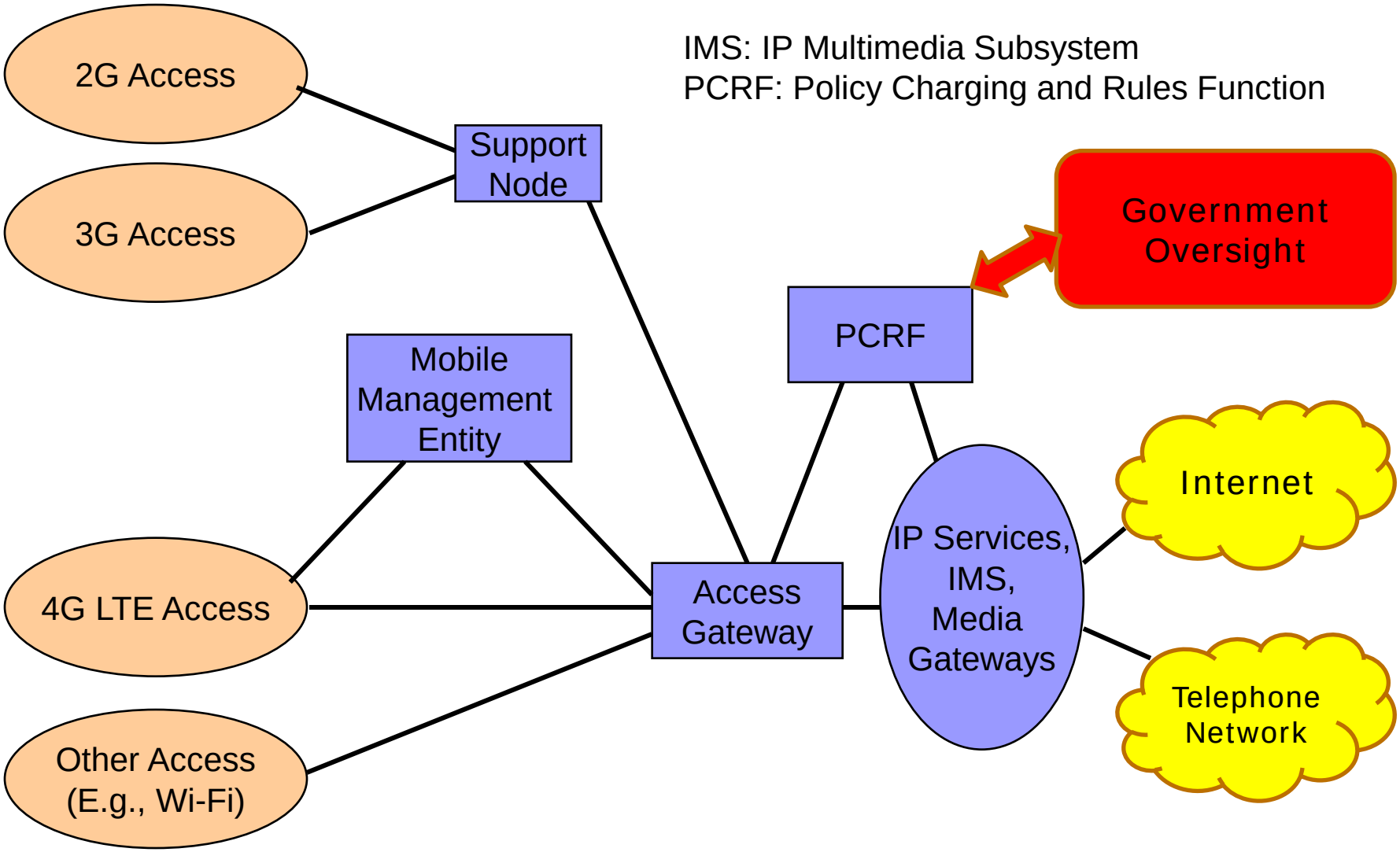
Government inside Mobile Operator Business



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Thorny Questions

- What is the definition of congestion?
- What are “like” applications?
- Who defines the categories?
- What about hybrid applications (e.g., different QoS treatment for voice and video)?
- How will operator-deployed specialized services that need QoS be handed?
- How will QoS for purposes other than congestion management be discerned from QoS for congestion management?



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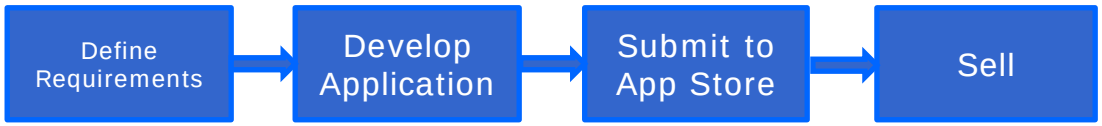
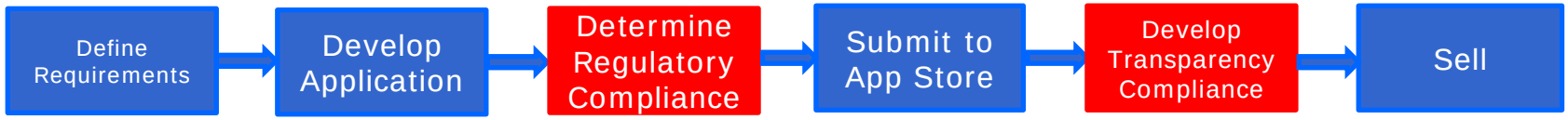
Mobile Application Deployment with and without QoS Regulatory Regime

Mobile Application – Deployment Today



Mobile Application with QoS – Deployment Under New Regulatory Regime



Time



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Wireless is Different from Wireline

- User broadband experience feels similar . . . *BUT*

- Resources differ vastly
- Wireless capacity is far lower
- Radio connections are dynamic
- Traffic management is essential for mobile quality-of-service
- Treating all packets the same undermines consumer interest
- Mobile technology and entire mobile ecosystem are evolving quickly

➢ **Growth and investment should not be constrained**

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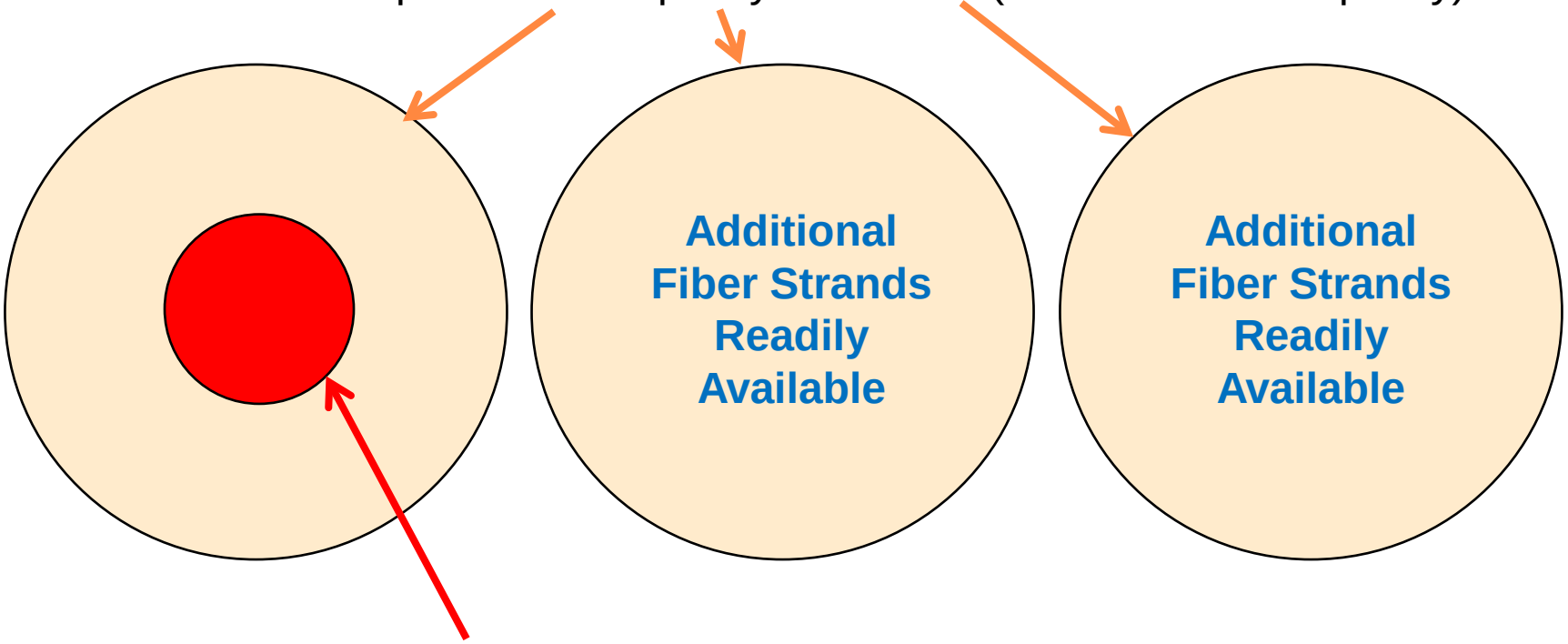
RF Capacity Versus Fiber-Optic Cable Capacity

Achievable Fiber-Optic Cable Capacity Per Cable (Area Denotes Capacity)



Achievable capacity across entire RF spectrum to 100 GHz is 10% of one fiber strand. Mobile broadband only has 500 MHz of that spectrum.

So, one fiber strand has *2000 times* more capacity than all mobile broadband spectrum.

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LTE Configurations and Users Supported

	Bandwidth (Mbps)	LTE in 5 MHz + 5 MHz	LTE in 10 MHz + 10 MHz	LTE in 30 MHz + 30 MHz
Downlink Sector Capacity (Mbps)		8.5	17	51
YouTube at 480p resolution	1			
Number of simultaneous users		9	17	51
Percentage of subscribers		2%	5%	15%
Netflix at 720p resolution	3			
Number of simultaneous users		3	6	17
Percentage of subscribers		1%	2%	5%
Netflix at 1040p resolution	5			
Number of simultaneous users		2	3	10
Percentage of subscribers		0%	1%	3%
Netflix at 4K resolution	15			
Number of simultaneous users		1	1	3
Percentage of subscribers		0%	0%	1%

Assumes LTE efficiency of 1.7 bps/Hz, nationwide average of 350 subscribers per cell sector.

Tiny percentage of users can consume all capacity.

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Despite good intentions, additional wireless regulations will likely have adverse, unintended consequences

- for consumers
- for the efficiency of networks
- and for the ability of network engineers to manage them effectively

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