



federated
wireless™

An AMFI company

Shared Spectrum Challenges and Opportunities for US EU Partnerships

DR. JOSEPH MITOLA III, CHIEF SCIENTIST

IYAD TARAZI, CEO

Federated Wireless Overview

- Federated Wireless was founded in August 2012 based on unique cognitive radio technology developed at Virginia Tech
- Federated Wireless is an industry thought leader within software defined networking & cognitive radio with 17 patent filings
- Series A funding by Allied Minds raised \$5m in June 2014 for technical and business development

Federated Wireless Team



Iyad Tarazi
Chief Executive
Officer
Extensive carrier R&D
experience



Dr. Charles Clancy
Director of Strategy
Expert in spectrum sharing
security and incumbent signals



Dr. Joe Mitola III
Chief Scientist
Invented software radio
Invented cognitive radio

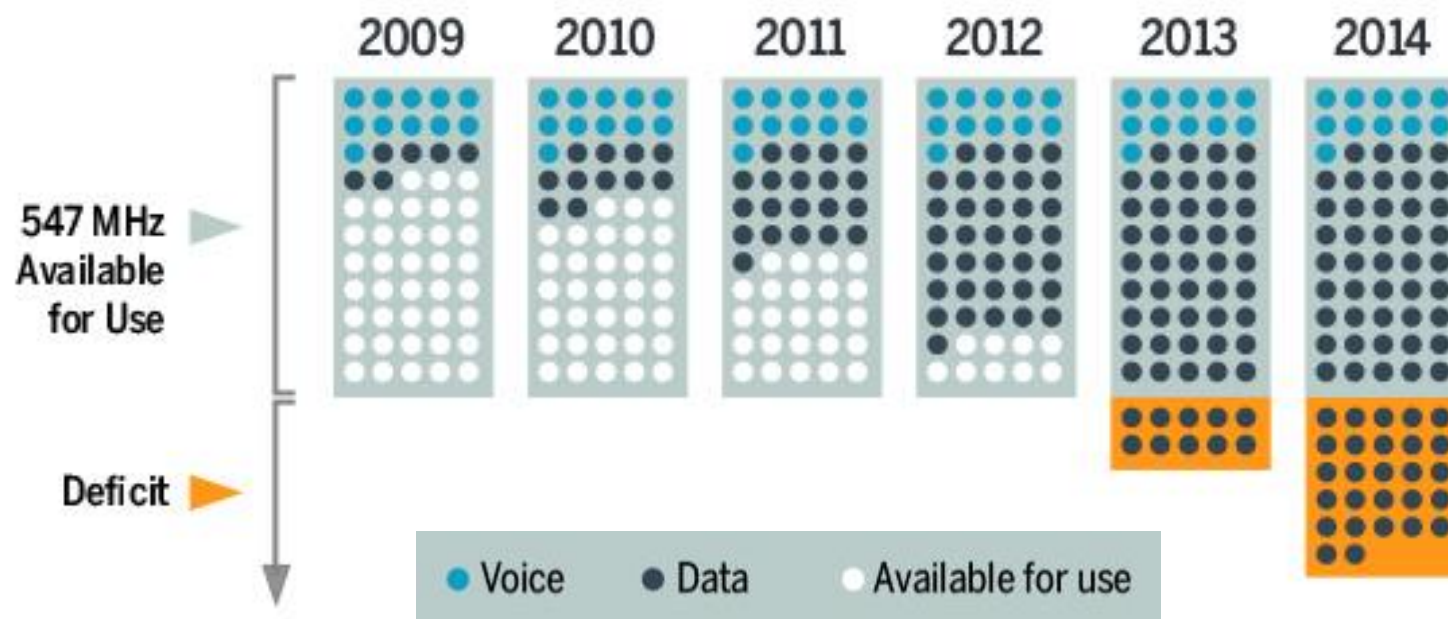


Dr. Jeff Reed
Advisory Board Chair
Member, PCAST Spectrum Committee
“wrote the book” on software radio



Dr. Bob McGwier
Technical Director
Expert in LTE, wireless communications,
and optimization theory

Spectrum Crunch: Spectrum Sharing Needed For Growth



Spectral efficiency is approaching Shannon limits (10-15 b/s/Hz)
Additional density and spectrum sharing are necessary for growth

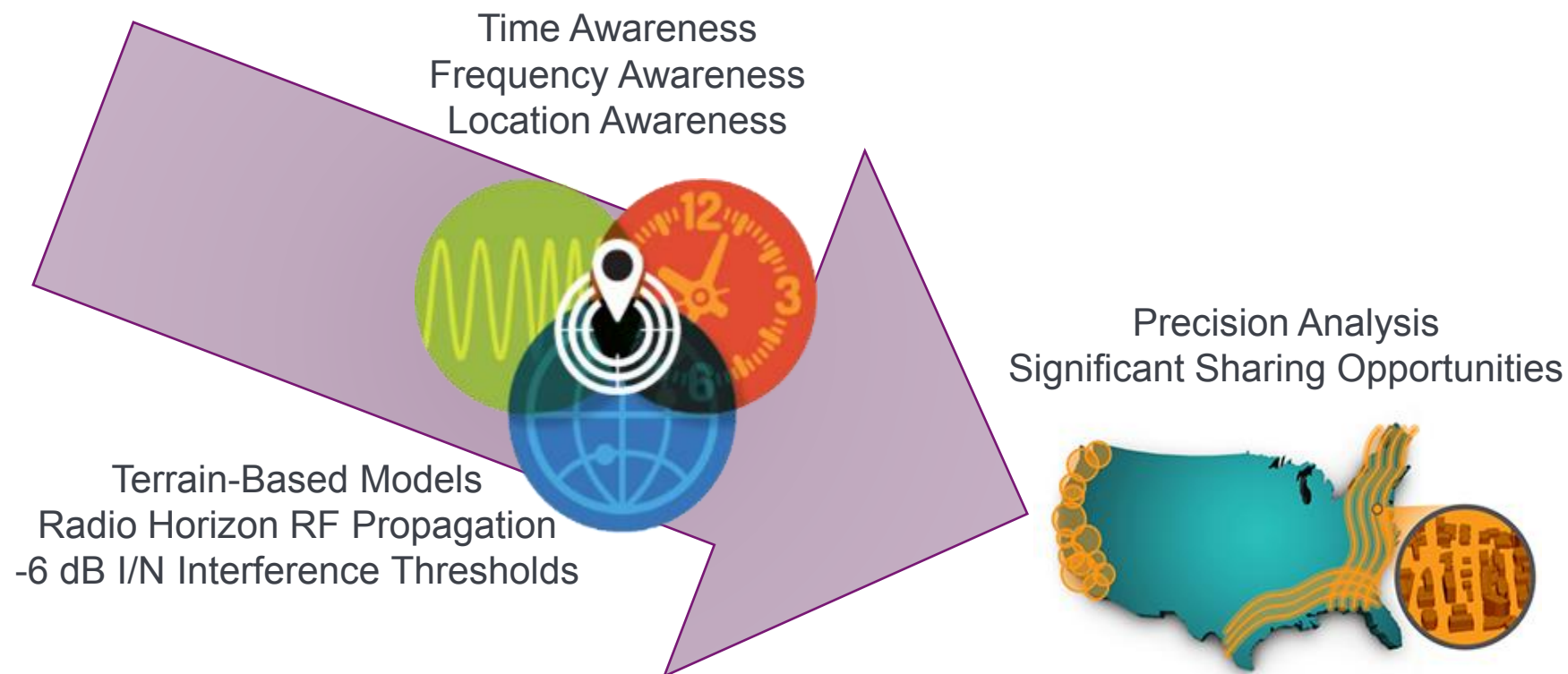
What is Spectrum Sharing

- ***Spectrum Sharing*** encompasses policies and technology innovations that allow multiple users (federal and carriers) to dynamically share a given spectrum resource and greatly improve utilization.
- Existing approaches to spectrum sharing include coordination in time, limiting transmission geographically, protocols that require devices to vacate a band when detecting an incumbent, and database management- **all of which have weaknesses.**

Federated Wireless: Significantly Improved Spectrum Sharing

- ***US FCC proposed*** spectrum sharing will certify Spectrum Access Systems (SAS) which manage interference, spectrum resources, and security to offer the **highest possible Spectrum Utilization Factor with innovative licensing arrangements.**
- Federated Wireless is developing a proprietary SAS, named ***Spectrum Director***, to enable carriers to cost efficiently & securely unlock government incumbent spectrum resources.

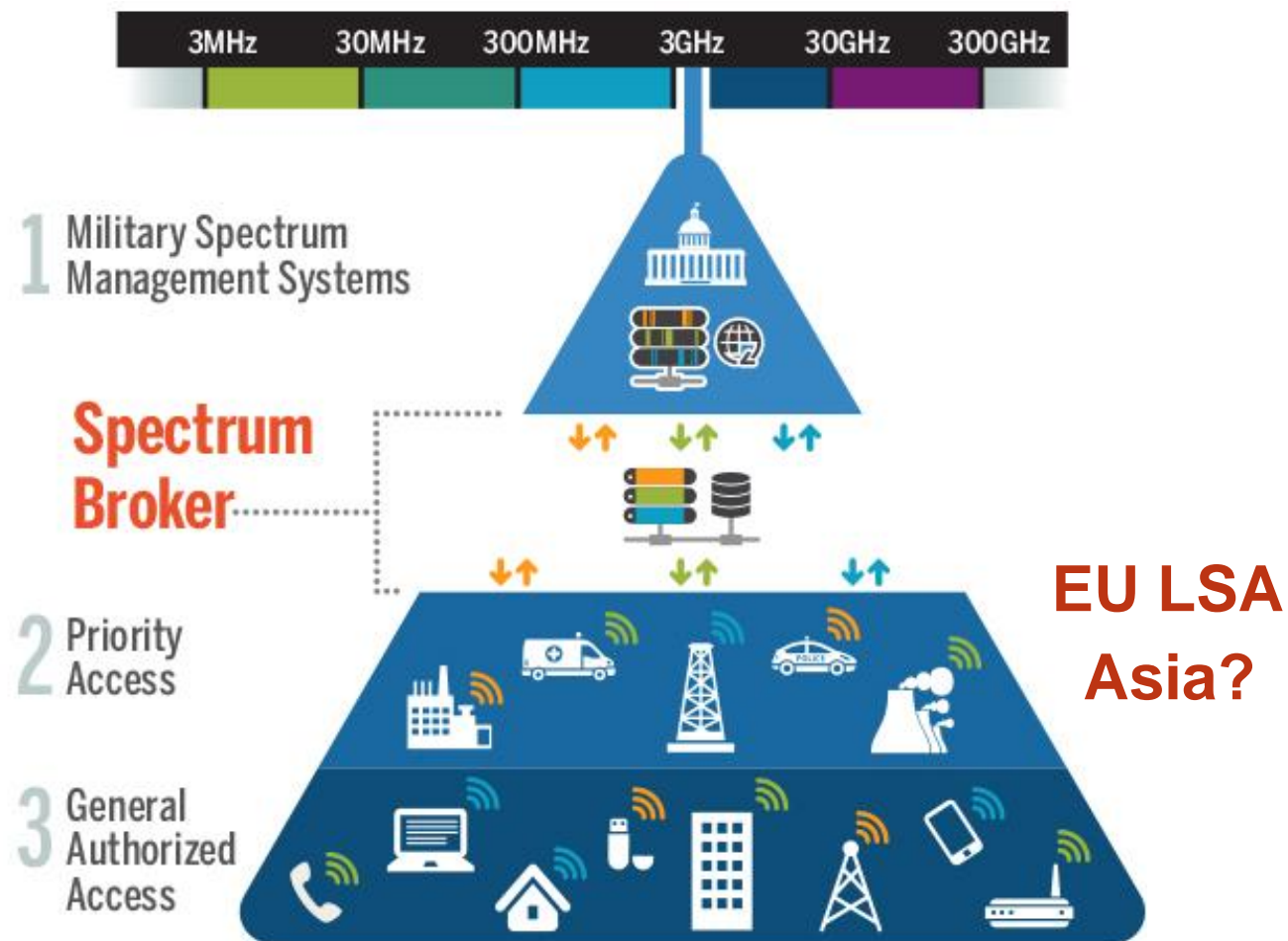
Spectrum Director: Enabling Improved Spectral Efficiency



Spectrum Brokers

NTIA Bands

1755-1780 MHz
1780-1850 MHz
3550-3700 MHz



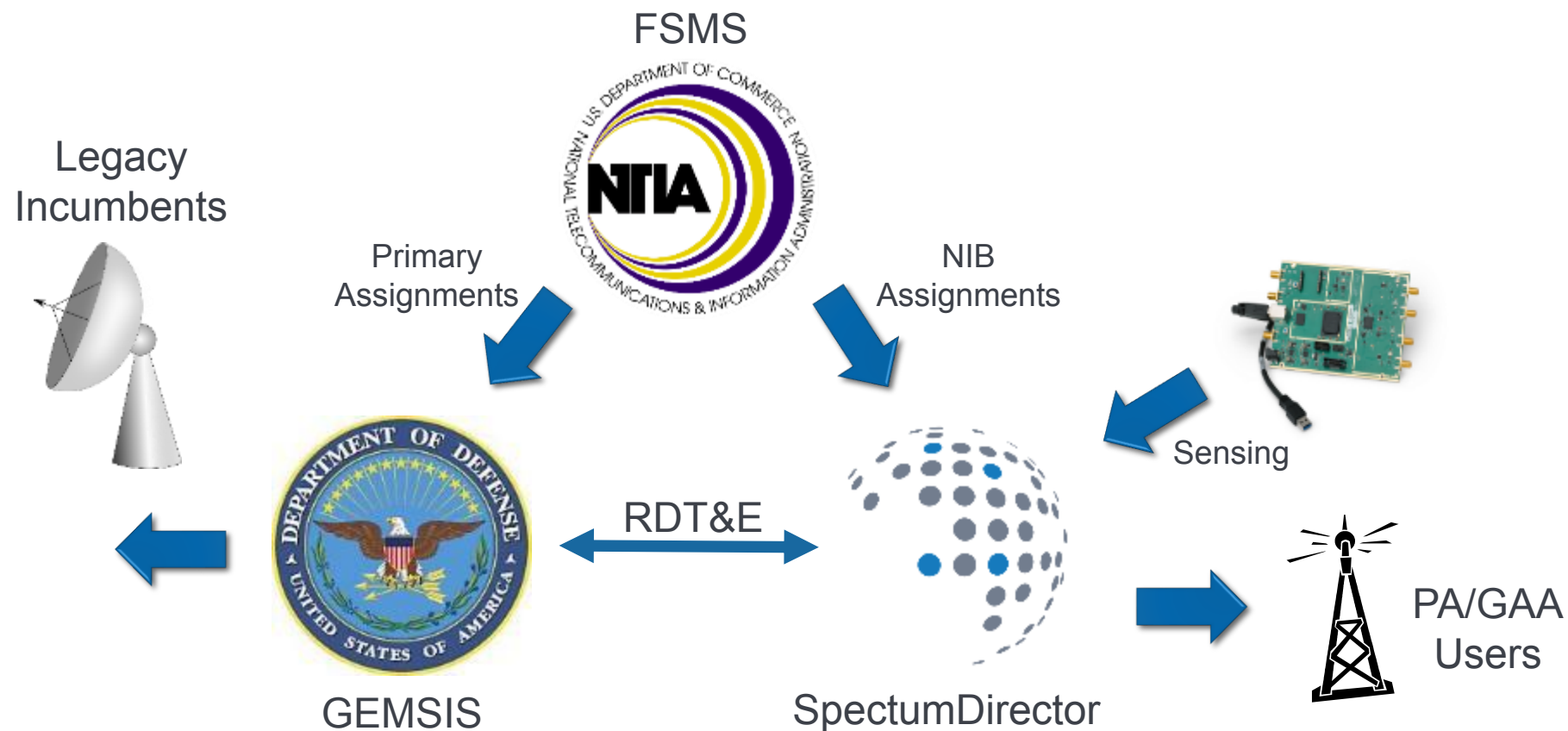
Products and Services: Under Development

- **Private Cloud Spectrum Director:** Carrier specific implementation to manage spectrum allocation & manage interference
- **Public Cloud Spectrum Director:** SaaS architecture with simple APIs to support general access to shared spectrum
- **Spectrum Director Protector:** Incumbent government users implementation focused on protection and operational security

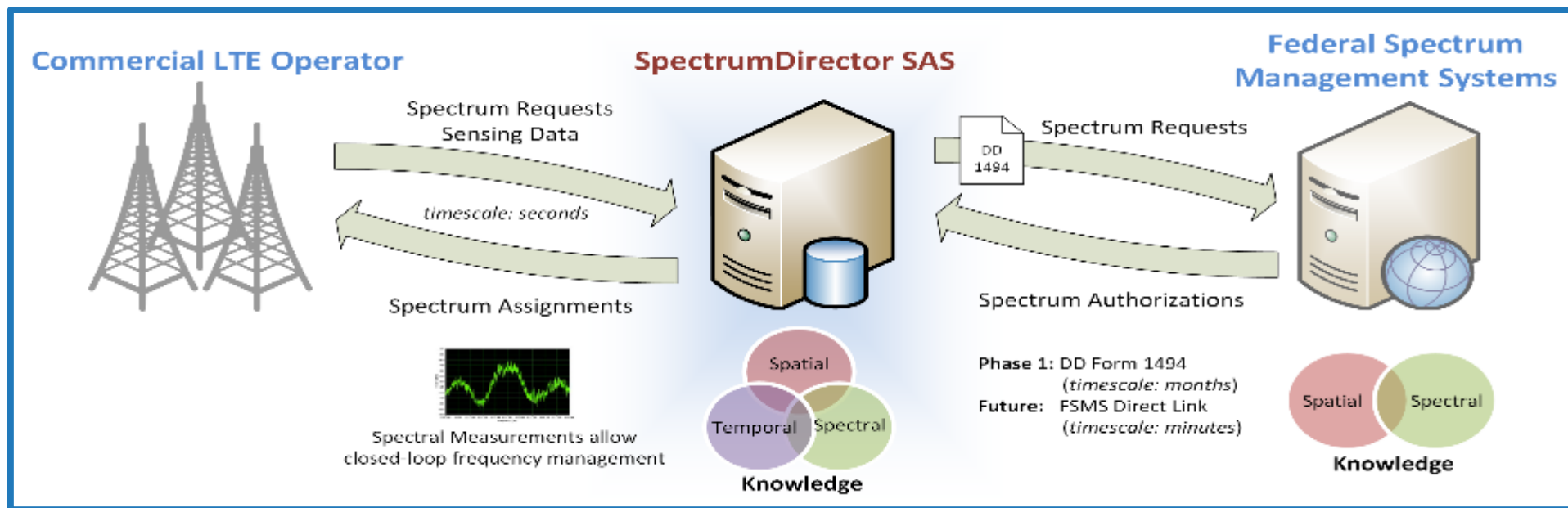
Federated Wireless: Spectrum Director

- Support multiple tiers of users operating at different timescales
- Time and geography-bound leases to maximize reuse
- Request and response architecture enabling governance and obfuscation
- Aggregation of sensing data from dedicated sensors, carrier base stations and end users

Simplified US Spectrum Management Topology



Federated Wireless Spectrum Director SAS Technology Overview



Challenges and Opportunities

- Service Provider Opportunities
 - Expand spectrum holdings
 - Enable new smart phone revenue streams
- Service Provider Challenges
 - Uncertainty of Shared Spectrum Availability
 - Complexity of Integrating Shared Spectrum RANs
- EU-US-Asia Opportunities
 - Research collaborations (U. Roma, OneFIT, NICT ...)
 - SAS-LSA Business Opportunities?

Thank you

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