5G Wireless Security

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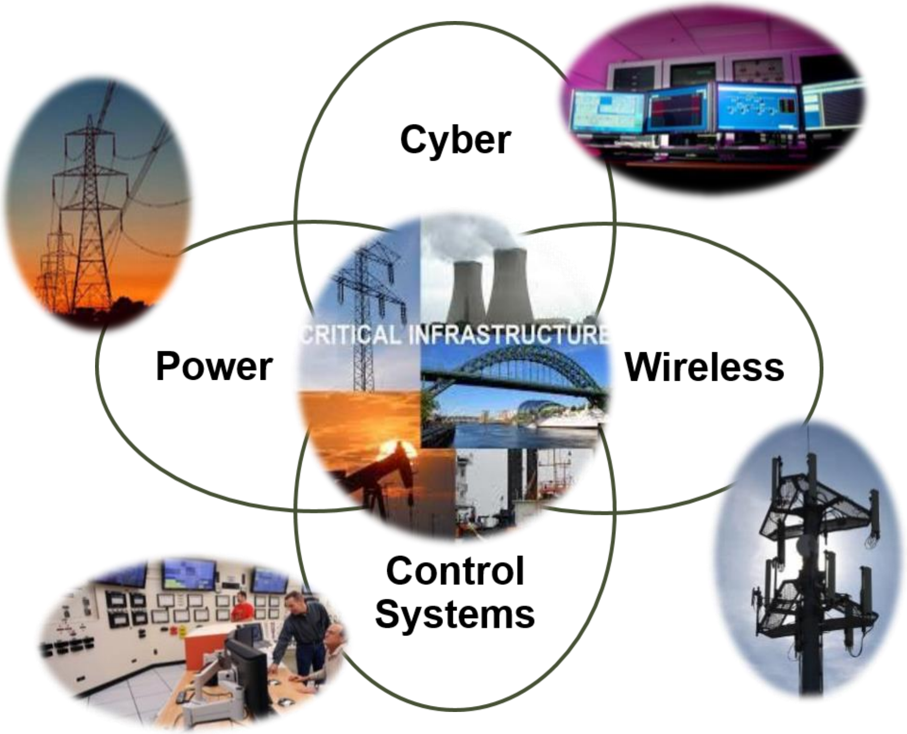
Wireless security is essential to protecting the nation’s critical infrastructure



INL Capabilities Secure Wireless Solutions from Concept through Validation and Deployment

Wireless Research: **Develop solutions to national spectrum and wireless communications security challenges** ***(WSComm[1], WiFIRE[2], mmWave physical layer security, 5G Cellular UAS[3])***

Wireless Modeling & Simulation: **Advanced software engineering, validation and testing of wireless security solution technology design (*IMOM[4]*)**

Wireless Test Bed: **Test and validate full-scale deployment of wireless communications security technology solutions (*JamX 17[5]*)**

[1] Wireless Spectrum Communications, [2] Wireless RF signal Identification and protocol Reverse Engineering, [3] Unmanned Aircraft System, [4] Improved Many on Many, [5] 2017 First Responder Jamming Exercise

Securing Wireless Communications Spectrum

Current challenges:

- Communication disruption from both unintended and deliberate interference.
- Violation of spectrum sharing rules.
- Use of vulnerabilities in wireless spectrum protocols (LTE/WiFi, etc.) to disrupt or degrade services.
- Illegal access of subscriber information for spectrum use, user traffic, and protected spectrum databases.
- Attack on critical information such as location in a sensor network.
- Use of cellular connected UAS/drone to attack critical infrastructure.

Current approaches for mitigation:

- Detection and localization of interference source.
- Transmission of content over a large band with very low power levels comparable to noise.
- Signaling data link with higher reliability.
- Real time spectrum monitoring and RF classification with machine learning.
- Cryptographic methods such as authentication and encryption.
- Security at the lower/physical layer exploiting uniqueness of wireless transmission.
- Detection of unauthorized UAS in sensitive areas.

How will 5G Impact the Spectrum Security Issue

New spectrum capabilities with 5G:

- Additional spectrum with and without spectrum sharing in sub 6 GHz and mmWave bands.
- Use of unlicensed and shared spectrum with 5G NR (New Radio).
- Beam based instead of sector based air interface.
- 5G enabled IoT[1], connected health, vehicles, UAS etc.
- Edge computing with SDN[2] and NFV[3] for applications including industrial IoT, augmented reality (AR), connected health, and connected vehicles (V2X).

Additional challenges:

- Increase in illegal and disruptive use of spectrum sharing.
- Adapting wireless security to beam based directional transmission.
- Secure operation of increasing number of connected UAS and vehicles.
- Secure use of edge connectivity to enable 5G applications.
- Decrease in the size of an antenna array needed to localize RF sources in the GHz bands for malicious purpose.

[1] Internet of Things, [2] Software Defined Networking, [3] Network Function Virtualization

Wireless Research Opportunities

5G Wireless Security Research Areas:

- Security and resiliency improvement using unique physical layer characteristics in the mmWave bands (e.g., device forensics and RF biometrics).
- Attack identification and threat mitigation for the radio frames and channels in NR.
- Secure spectrum sharing with improved and faster detection, localization, and response to spectrum abuse.
- Secure cellular UAS/drone control and communication system, including authentication system for detecting and localizing illegal users.
- Beam propagation and RF coverage models in the air for secure and reliable cellular UAS/drone operation.
- Secure and reliable use of spectrum for V2X wireless communications.

Additional Recommendations:

- Increase nationwide focus on wireless security and resiliency research efforts.
- Advocate “Cyber Informed Engineering” for spectrum control and operations.
- Support Intrusive test set and procedures to certify equipment for secure use of spectrum (e.g., adversarial model based automated test generation).

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