Harnessing Communication Technology for Public Protection (Safety) & Disaster Relief

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Public Safety Challenges - Terror Attacks, LWE, Unrest

Public Safety Challenges – Disasters

# Public Safety Challenges – Public Events, Gatherings

Can Technology help?

- Usage of Technology Improves
  - Intelligence Gathering
  - Crime Detection
  - Law Enforcement
- Technology for Homeland Security
  - An upcoming focus research area
- Some Research Centres/Conferences on Homeland Security Technology
  - IEEE International Symposium on Technologies for Homeland security
  - Department of Homeland Security, Govt. of USA
    - Centers of Excellence
  - Public Safety Communications Research Division, National Institute of Standards & Technology, USA
  - National Center of Excellence in Technology for Internal Security, IIT Bombay

Public Protection and Disaster Relief (PPDR) Communication
or
Public Safety Communication

What is Public Safety Communication?

- Communication used by
  - Law enforcement agencies, Fire, Medical Emergency teams etc
- Emergency Warning or Public Warning Systems
- Public Safety and Disaster Recovery
- Critical Communication
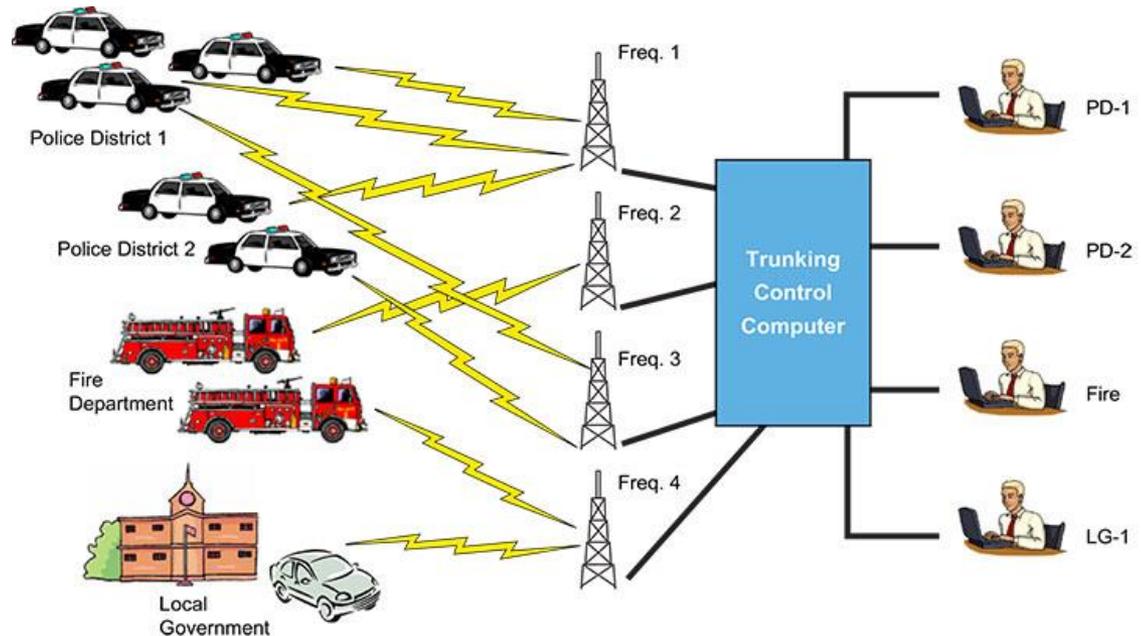
Public Safety Communication - Uniqueness

- Mission Critical
  - Reliable, resilient and secure
- Challenging Working environment
  - Robustness
- Immediate connectivity
  - No congestion/blocking
- Group Communication
- Push-to-talk
- Direct mode - peer to peer - communications
- Situational Awareness
  - Positioning, Maps & Location
- Security

Currently used PPDR Communication Systems

- Technologies in use today in India
  - Analog Radios
  - Digital Radios
    - TETRA
    - APCO
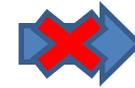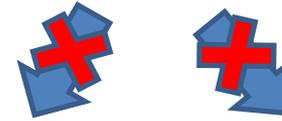
- **Limitations**
  - Narrowband Operation – Cannot transmit Video/Files
  - Spectrally Inefficient – Lower bps/Hz
  - Legacy Technology – Vendor lock-in
  - Not Interoperable – No inter-agency communication

Stuck with expensive equipment, which is unable to provide enough Situational Awareness

Requirements of PPDR Communication

- BB-PPDR : Broadband Communication System for Public Safety
  - Multiple traffic flows at mission critical performance
- Enhanced Situational Awareness
  - Voice + Data + Video
  - If Real-time video surveillance was available during 26/11!
- Interoperability across solution from different vendors
- Compatibility with Civilian Communication Networks
  - Harnessing commercial networks during disasters
- Rapidly Deployable System for targeted operations
- Device to Device/Peer to Peer Communication
- IoT Wearables

Commercial LTE – Is it good enough for BB-PPDR?

- Advantages
  - Evolving Broadband Technology – Voice, Video, Data
  - Spectrally more efficient
  - Based on international Standards
  - More secure
 - Most commonly used Mobile Broadband Technology worldwide
- Limitations
  - Powerful – But Not PSDR grade rugged
  - Audio Communication – But No Push-to-talk
  - Video Communication – But through Base Station ONLY
  - Infrastructure Mode Only – No Ad Hoc mode operation
- Good but not Good enough, how do we resolve this?

PS-LTE – LTE for Public Safety Communication

LTE capability, reach and costs attractive to Public Safety users
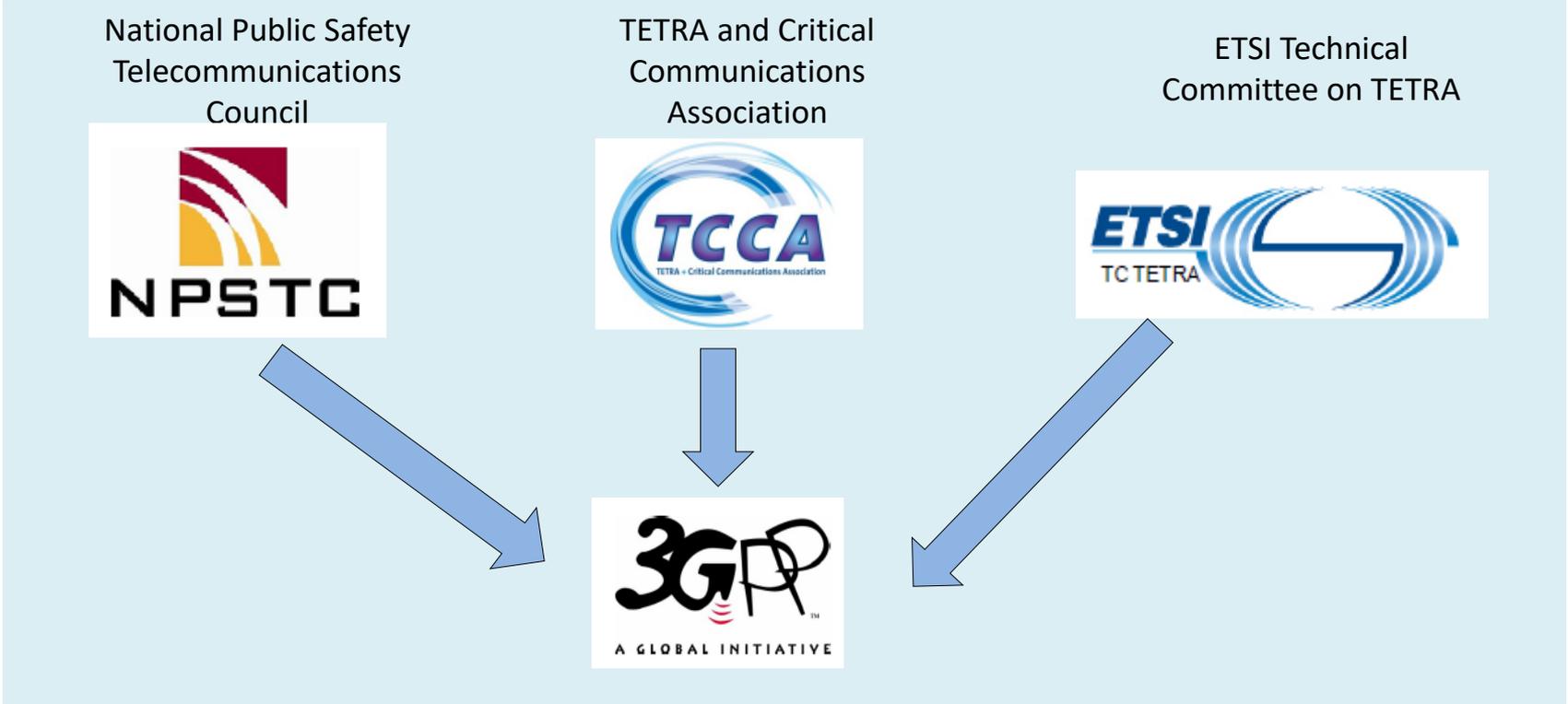
Maximize commonality between commercial and public safety aspects

Enhancements in LTE Specs for Public Safety

- Release 12 (2013-15):
  - Proximity services (ProSe) and Device-2-Device (Direct Mode)
  - Group Communication System enablers
  - Baked in to LTE or Application servers based
  - QoS for Mission Critical Services

- Release 13 (2014-17):
  - Proximity Services - Direct Discovery, UE Relay
  - Mission Critical Push To Talk (MCPTT)

- Release 14 (2016-):
  - Mission Critical Video & Mission Critical Data Application

Mission Critical Push-to-Talk over PS-LTE

*Courtesy: GSC-19_101 by Erik Guttman*
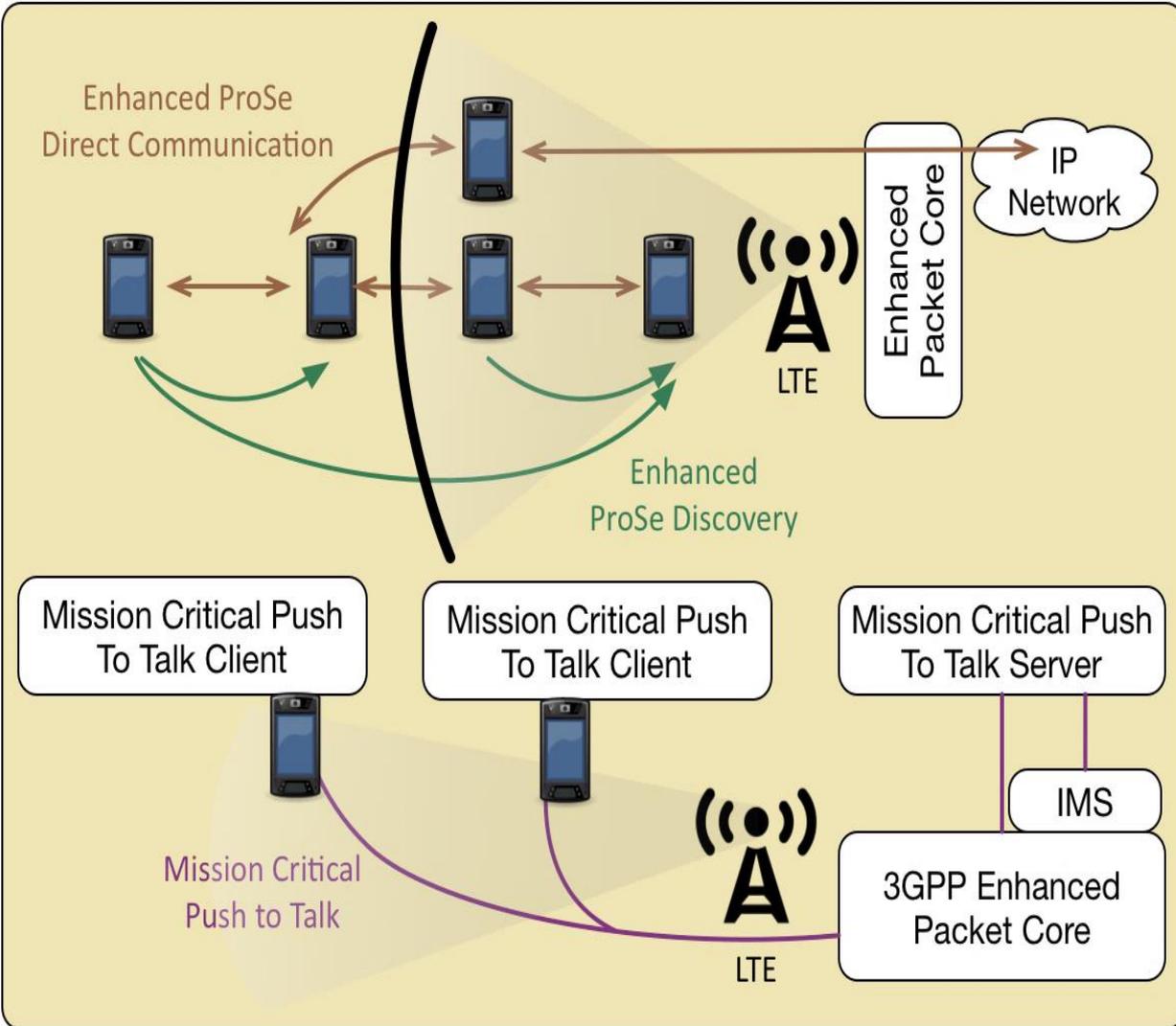
PS-LTE - Summary

- Additions to 3GPP 4G/LTE Standard to make it PS grade
  - Ad-hoc mode of operation
  - Mission Critical Push-to-talk
  - Mission Critical Video
  - Mission Critical Data
  - Prioritized data transfer, QoS guarantee
  - Sophisticated Group Communication
    - Floor Control
  - Higher level of security than LTE
  - Compatible with Commercial LTE Network

PS-LTE based Rapidly Deployable BB-PPDR System
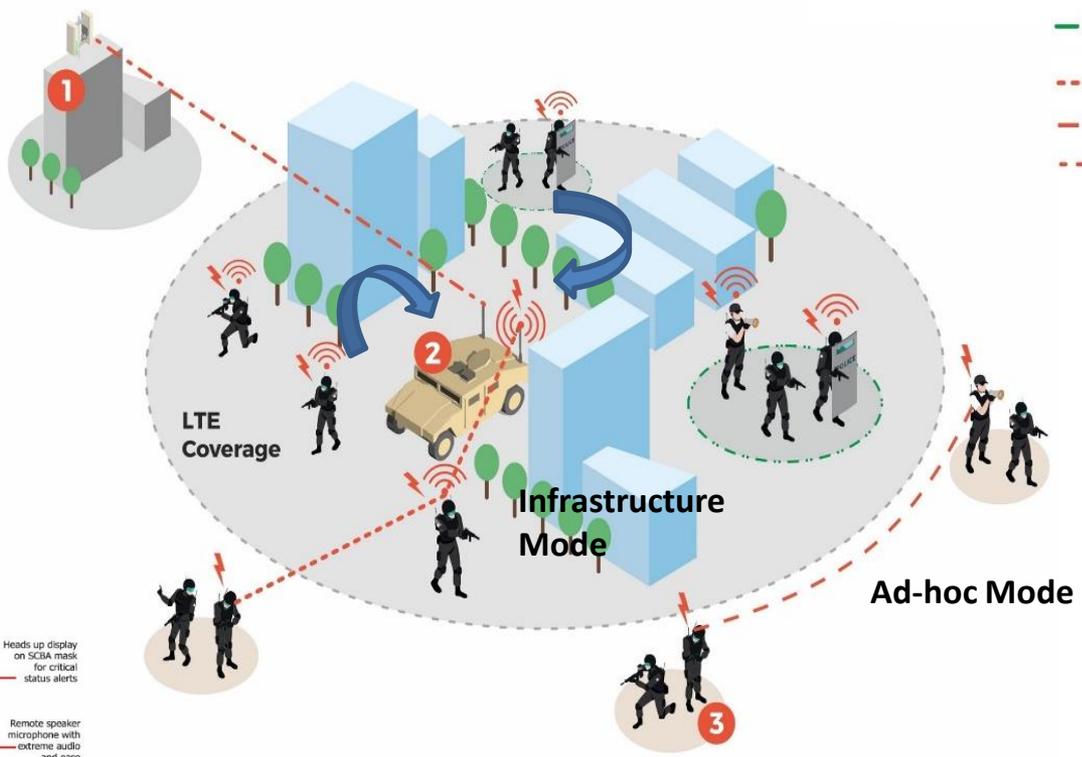
Spectrum for BB-PPDR in India - NFAP 2018

- PPDR Frequency Ranges as proposed by NFAP 2018
  - 380-387.5 MHz & 390-397.5 MHz
  - 410-417.5 MHz & 420-427.5 MHz
  - Part of 440-470 MHz
  - 806-811 MHz & 851-856 MHz
  - 4940-4990 MHz
- Broadband PPDR especially encouraged in 410-430 MHz
- Use channel arrangements to promote harmonization
- ITU Resolution 646 for Region 3
  - Frequency ranges 406.1-430 MHz, 440-470 MHz, and 4940-4990 MHz harmonized for PPDR applications

TRAI Recommendations for BB-PPDR

- Pan-India BB-PPDR Communication Network
  - Based on 3GPP PS-LTE technology
- Hybrid model
  - Dedicated network in certain areas
    - Metros, Border areas, Disaster prone areas
  - Existing commercial network to be leveraged in other regions
- Dedicated spectrum for BB-PPDR Network
- Special Purpose Vehicle under MHA
  - To Plan, Coordinate and Steer the National BB-PPDR Network
- Phase out existing Analog Networks in PPDR

TSDSI Report - BB-PPDR Systems in India

- One size doesn't fit all
  - Different PPDR agencies may have different procedures, solutions

- Diversity of Deployment
  - Agencies to leverage an appropriate technology

- Connectivity to Existing in-use Technologies
  - e.g., Gateway to TETRA

- Device Ecosystem
  - Device ecosystem unavailable for TRAI recommended Band 26
  - Provision PPDR services across the country
    - Over existing commercial mobile networks
    - on commercial spectrum in SubGHz

Broadband-PPDR@IIT Bombay

BB-PPDR - Project Scope

- To design and develop a high-speed broadband wireless system in sub-GHz (400 MHz) spectrum with public safety and emergency features
  - User terminals capable of conventional (via Network) as well as direct mode communication (Infrastructure-less mode)
  - Support for Real-time voice as well as Real-time data transfer including video
  - Support for Mission-Critical Applications, e.g., Group Call (Push-to-Talk)
  - Support for Isolated Operation
  - Readily deployable system
- Investigate protocols & algorithms for group communication (e.g., Mission Critical Push-to-Talk, Mission Critical Video Service) and Proximity Service (direct-mode communication)

# BB-PPDR - Rapidly Deployable System - Architecture
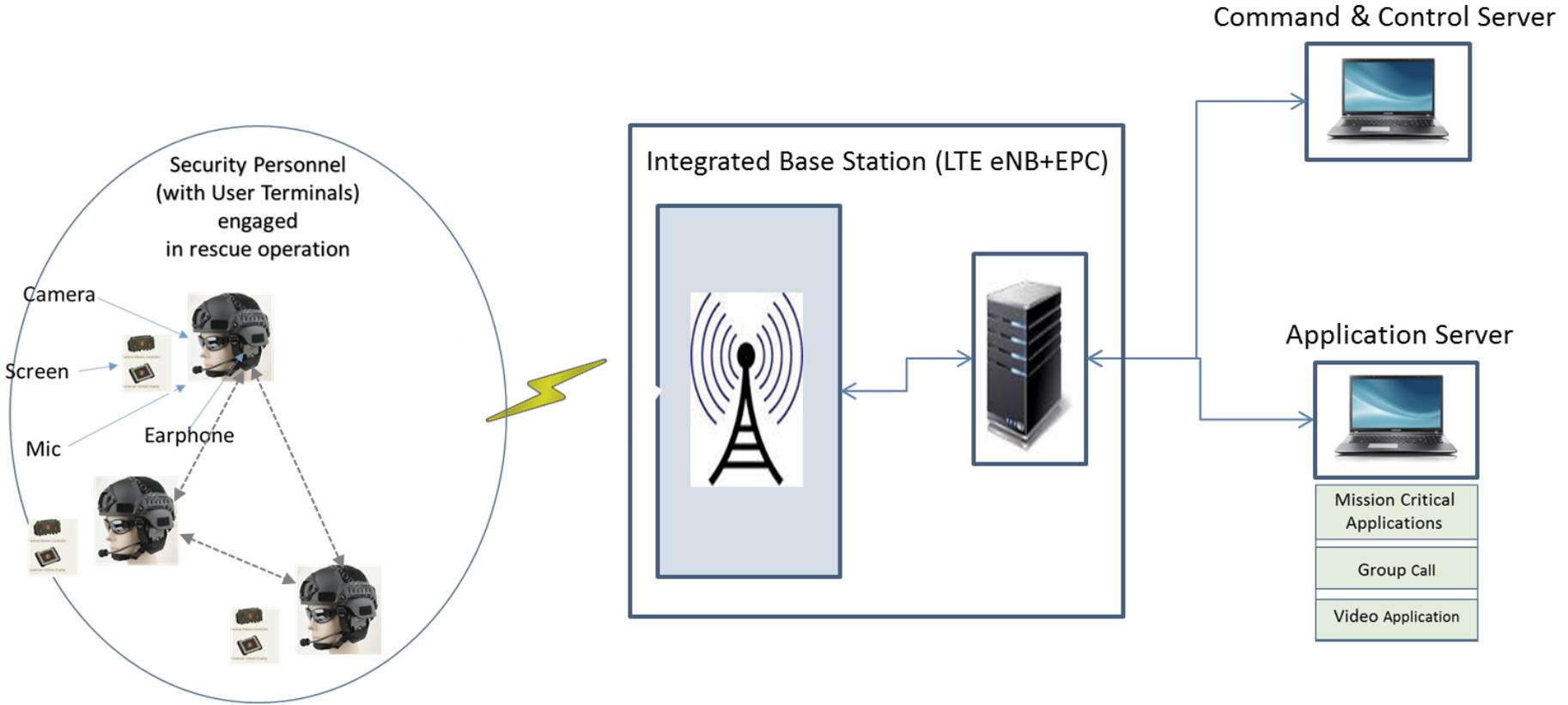
BB-PPDR@IIT Bombay – Achievements (1/2)

- Indigenously built PS-LTE system

- Portable and Rapidly Deployable System

- Design & development of Mission Critical Communication Components

- Multiple Patents filed and granted by USPTO

- Contribution to 3GPP International Standards on "Push-To-Talk" Service

- Educate and inform PPDR agencies

BB-PPDR@IIT Bombay – Achievements (2/2)

- Successful Participation in ETSI's "Plugtest" Event
  - Global Interoperability Testing Event
  - Validation of Mission Critical Push-To-Talk Service
  - IITB Team participated in Year 2018 & 2019
    - Face-to-Face Participation in Finland in 2019
  - Push-to-Talk Server developed by IITB successfully verified against PS-LTE devices from multiple global vendors

- Incubation of a start-up
  - Startup won the "Innovations For Defence Excellence (iDEX)" Challenge instituted by the Defence Ministry, GoI

National Center of Excellence in Technology for Internal Security – IIT Bombay

MANUFACTURING INDUSTRY

R&D LABS

STATE POLICE FORCES
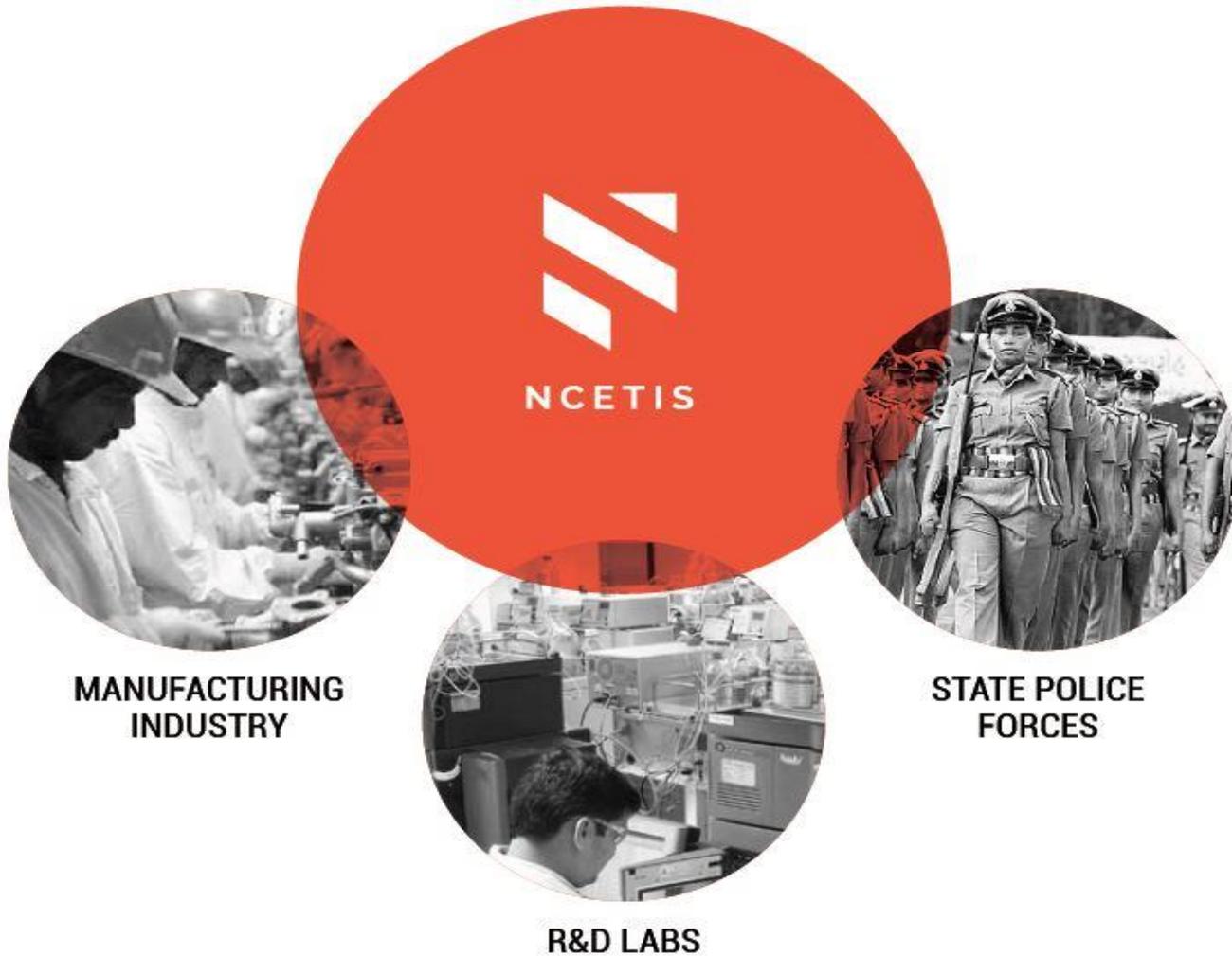
Scope of the Center

- National Center focusing on the needs of internal security

- Coordinate with other institutes and labs in the country

- Engagement with industry

- Target towards self sufficiency in the area of ESDM for strategic sector

Focus Areas of the Center

- Wireless Communications System
- Social Networking and Internet
- Video Surveillance and Analysis
- Ground Penetrative Radar (GPR) for Landmine Detection
- Unmanned Vehicles
- Cyber and Data Security
- Biometric Applications
- Sensors and Detectors for Explosives, Landmines, Chemical and Biological Warfare
- Thermal Imaging
- Product Design, Product Interaction Design and Prototyping
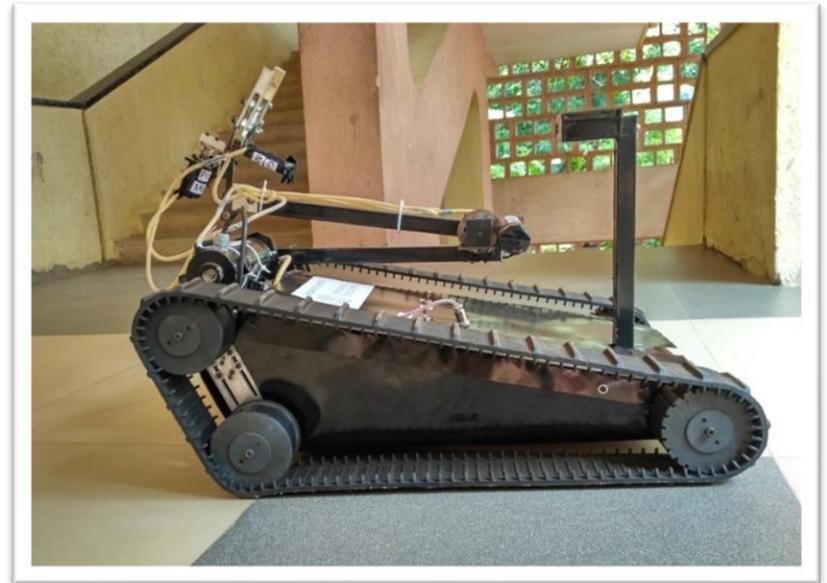
Remotely Operated Vehicle

Design Specification for Medium Duty Rover: 140 kg

- Workspace : 1000 x 500 mm
- Object Handling:
  10 kg : 300 x 300 x 300 mm
- 500 m Live video feedback
- 3 hour battery operation
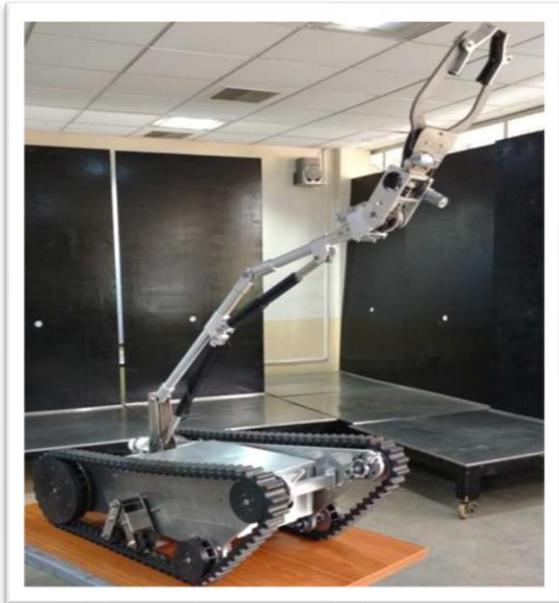
Design Specifications for Light Duty Backback Rover: 70 kg

- Workspace : 1000 x 400 mm
- Object handling :
  3 kg - 200 x 200 x 200 mm
- 500 m Live video feedback
- 3 hour battery operation

Video Analytics for Internal Security

Real-time Alerts
Email / Mobile /
Audio / Visual

"Alert me when a human enters a
restricted area"

Smart Search
for Entities / Color /
Gender

"Show me all people wearing yellow shirt"

Summarization
Watch hours in
minutes!

"Show me a digest of whatever happened
today"

Analytics
Count of entities /
Motion Analysis

"Show me the period of maximum
motion"

First-Aid Redefined

Thank you