The 5G Journey… and the 6G Destination

Harnessing the Power of 5G and 6G: Transforming Military Operations

7th November 2024

Introduction

TRANSNATIONAL CRIMES

PANDEMIA

MIGRATION CRISES

ENVIRONMENTAL ISSUES

TERRORISM

PRESSION FOR NATURAL RESOURCES

INTERNATIONAL TRAFFIC

INFORMATION WARFARE

PIRACY

ETNIC-RELIGIOUS CONFLICTS

CYBER WARFARE

History

- The OODA Loop

MIG-15

X

F-86

Weight: 11.023 lb
Thrust: 6.000 lbf
Thrust/Weight Ratio: **0.54**

Weight: 13.791 lbs.
Thrust: 5,200 lbs.
Thrust/Weight Ratio: **0.38**

By the end of the Korean War, 792 Mig-15s had been shot down at a cost of 76 F-86s. An approximate average of **10 Mig-15s shot down for each F-86**.

- ## The OODA Loop
  - John Boyd, an American fighter pilot, noticed two major and crucial advantages of the F-86: better visibility and greater turning speed (140 deg/s versus 120 deg/s).
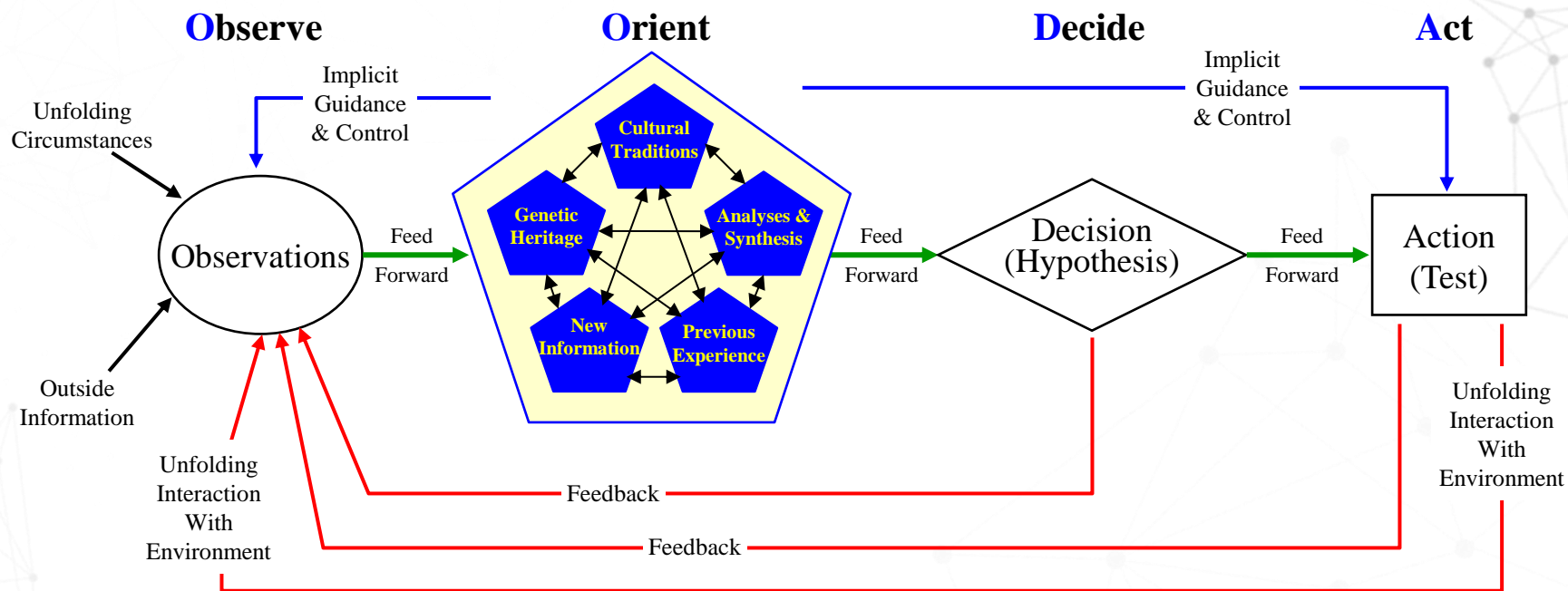
Information with Opportunity

http://worldofwarplanes.com/warplanes/compare/

History

- ## The OODA Loop

Observe **Orient** **Decide** **Act**

Unfolding Circumstances

Implicit Guidance & Control

Implicit Guidance & Control

Observations

Cultural Traditions

Genetic Heritage

Analyses & Synthesis

New Information

Previous Experience

Feed Forward

Feed Forward

Decision (Hypothesis)

Feed Forward

Action (Test)

Outside Information

Unfolding Interaction With Environment

Feedback

Feedback

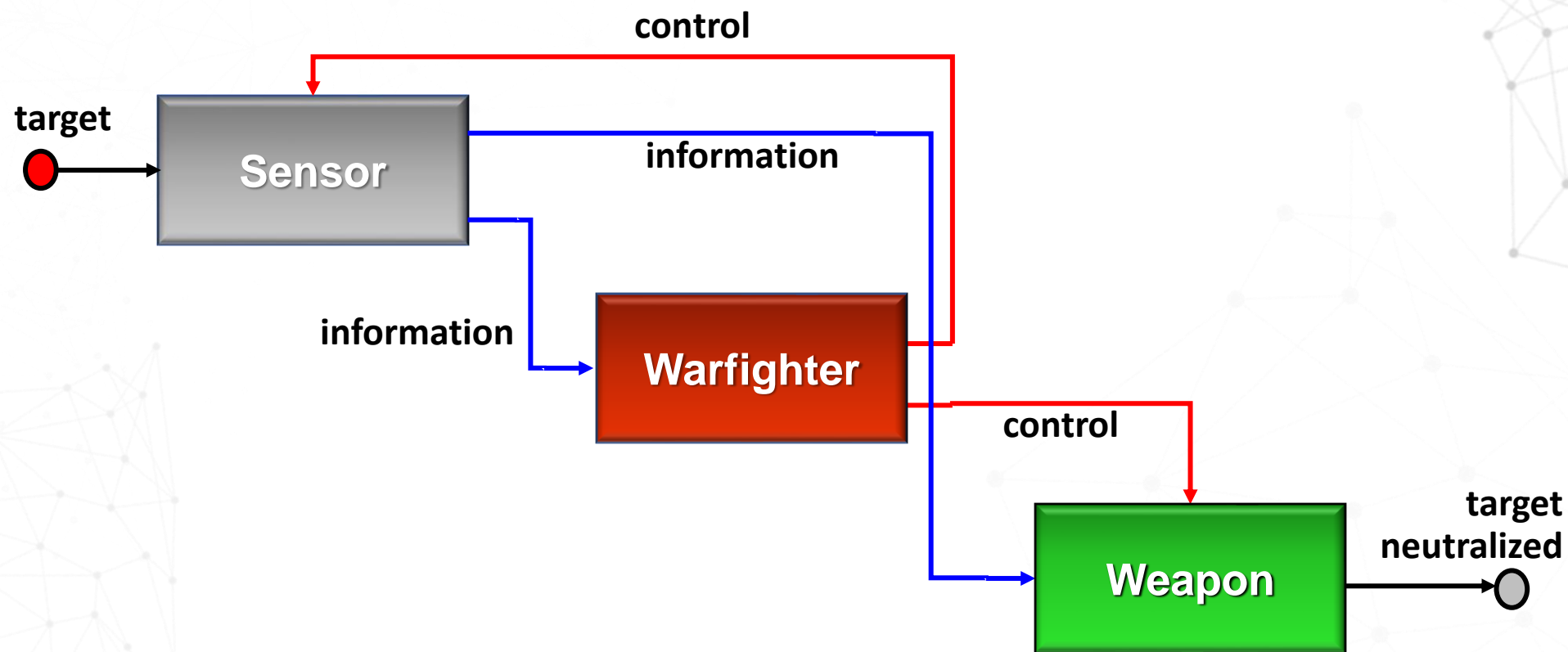Unfolding Interaction With Environment

Note how orientation shapes observation, shapes decision, shapes action, and in turn is shaped by the feedback and other phenomena coming into our sensing or observing window.

Also note how the entire "loop" (not just orientation) is an ongoing many-sided implicit cross-referencing process of projection, empathy, correlation, and rejection.

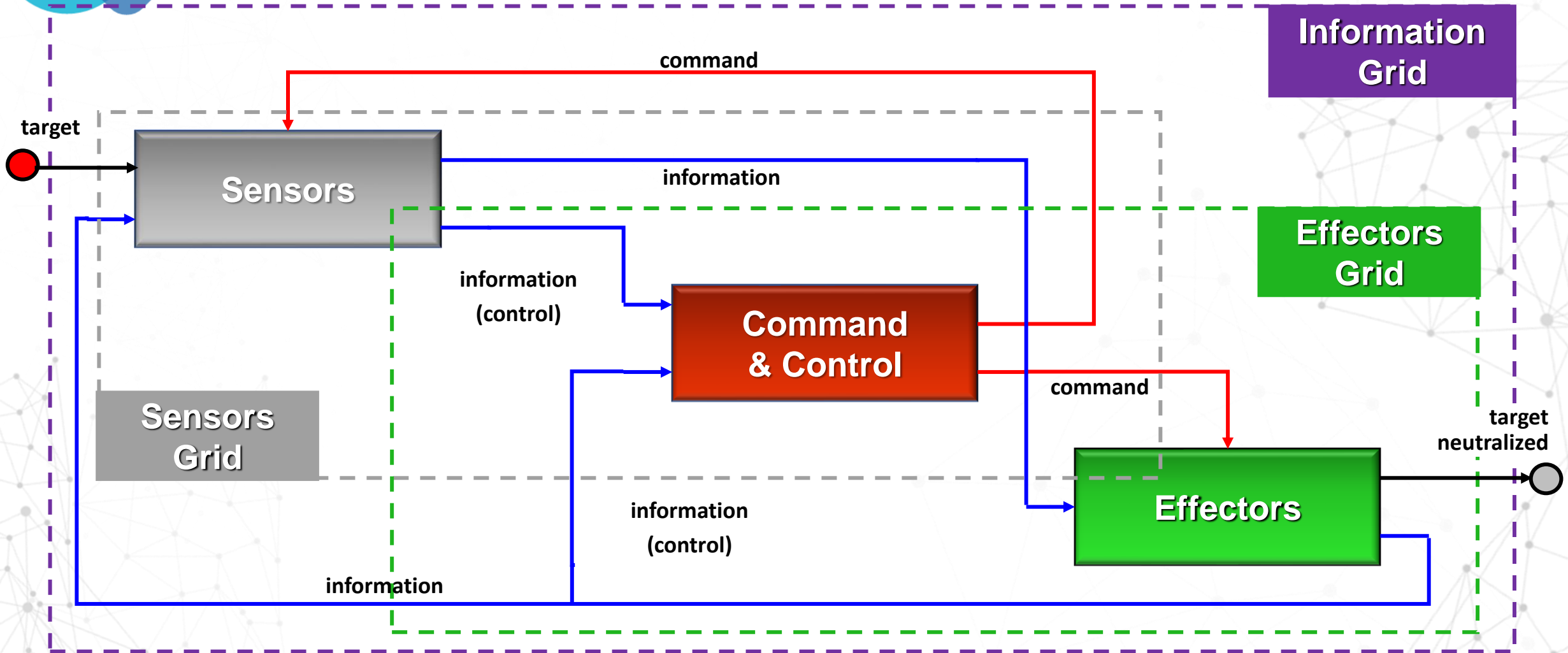From "The Essence of Winning and Losing," John R. Boyd, January 1996.
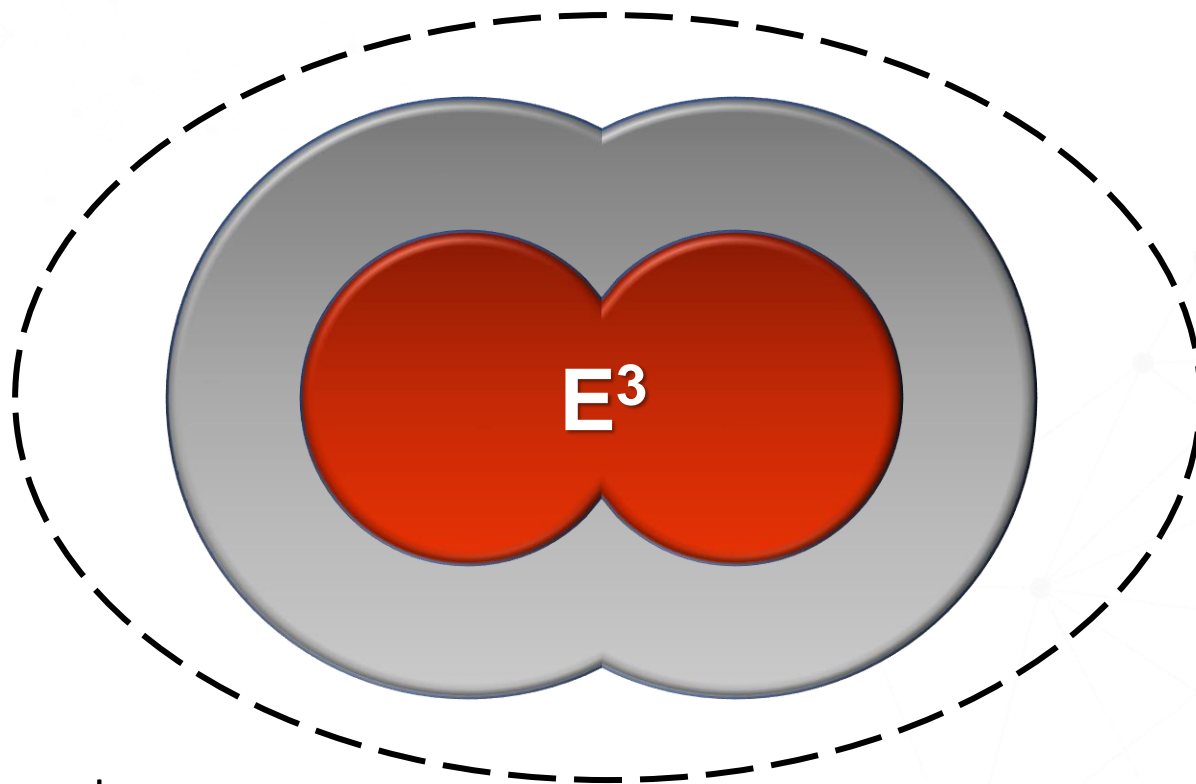
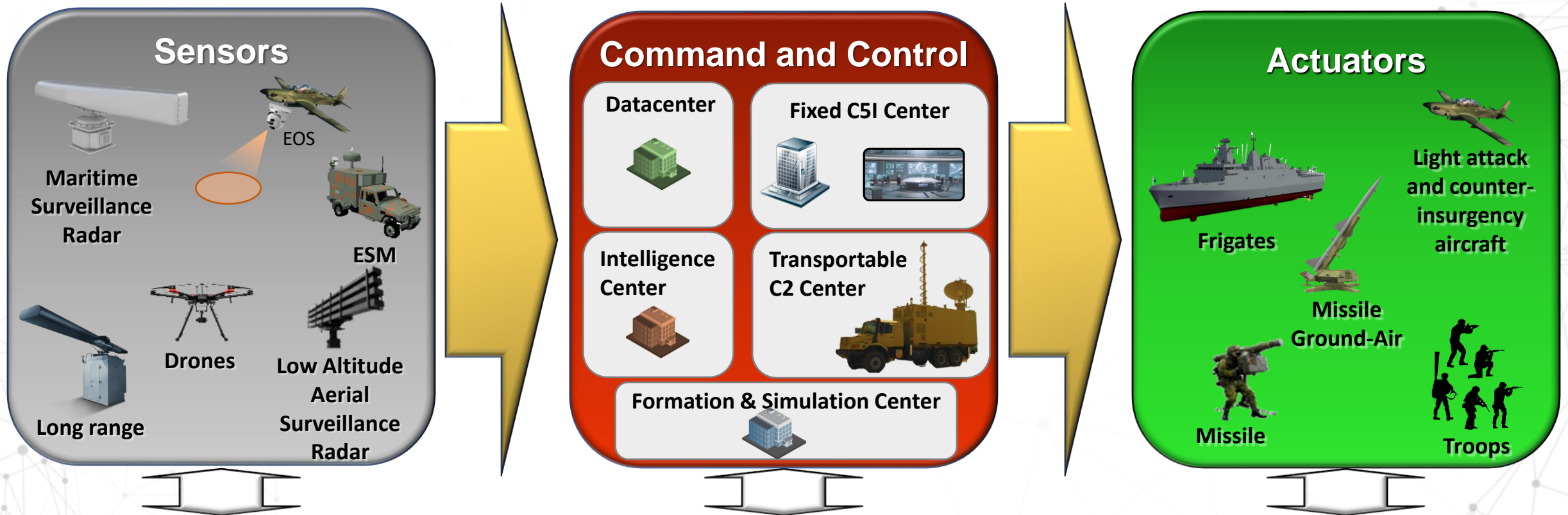# Platform Centric Warfare

Platform Centric Warfare

Sensor range

Identification range

Weapon range

E³

E³: effective engagement envelope
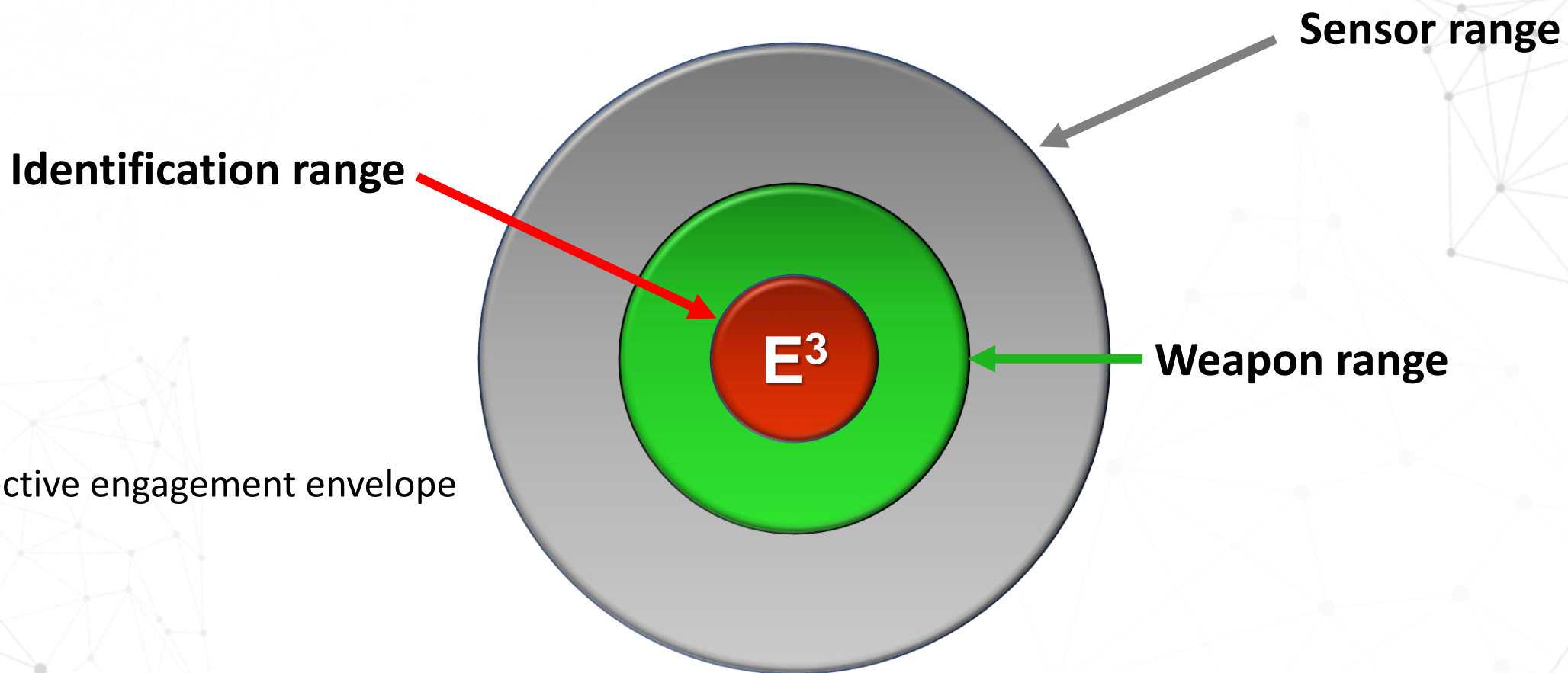
Network Centric Warfare

Network Centric Warfare

E^3

E³: effective engagement envelope

5G

atech
EMBRAER GROUP

- ## Applications

eMBB
- Extreme data rates
- Large data volumes
- Low latency (best effort)

- **Broadcasting**
- **Media delivery**
- **Online gaming**

- Actuators
- Sensors
- Trackers
- Wearables

- Augmented reality
- Virtual Reality
- Mobile robots
- Motion control
- Remote control

mMTC
- Long device battery life
- Low cost devices
- Extreme coverage

URLLC
- High reliability
- Ultra-low latency
- High availability

ITU-R M.2083-0

Military Use of 5G

- **Enhanced Mobile Broadband (eMBB):**
  - **High-speed data transfer:** Enables rapid transmission of large amounts of data, such as high-resolution imagery and video, for real-time intelligence and surveillance.
  - **Low latency:** Reduces delays in communication, critical for applications like remote control of drones and robotic systems.

- **Ultra-Reliable Low-Latency Communications (URLLC):**
  - **Ultra-low latency:** Ensures near-instantaneous communication, essential for time-sensitive applications like autonomous vehicle control, and missile guidance.

- **Massive Machine-Type Communications (mMTC):**
  - **Massive connectivity:** Supports a large number of devices, enabling the deployment of vast sensor networks for environmental monitoring, surveillance, and logistics.

Military Use of 5G

- **Additional Capabilities:**
  - **Network slicing:** Allows for the creation of multiple virtual networks with tailored QoS parameters to meet the specific needs of different military applications.
  - **Security:** Provides robust security measures to protect sensitive military information and infrastructure from cyberattacks.
  - **Beamforming:** Tracking people to improve conectivity

5G Military Solutions Providers

- Telecommunications Giants
  - Nokia: Multi-Domain operations, Multi-cloud integration and impact over interoperability, mobility and resilience enhancement.
  - Ericsson: Network slicing, edge computing, and security.

- Defense Contractors
  - Thales: Network slicing, edge computing, and AI to enhance military operations.
  - Raytheon: Drone swarms, autonomous vehicles, and real-time intelligence.

- Specialized 5G Providers
  - Rakuten Mobile: Open and cloud-native network architectures to enable rapid deployment and customization.
  - Vodafone: use of 5G for secure and reliable communication, as well as for advanced IoT applications
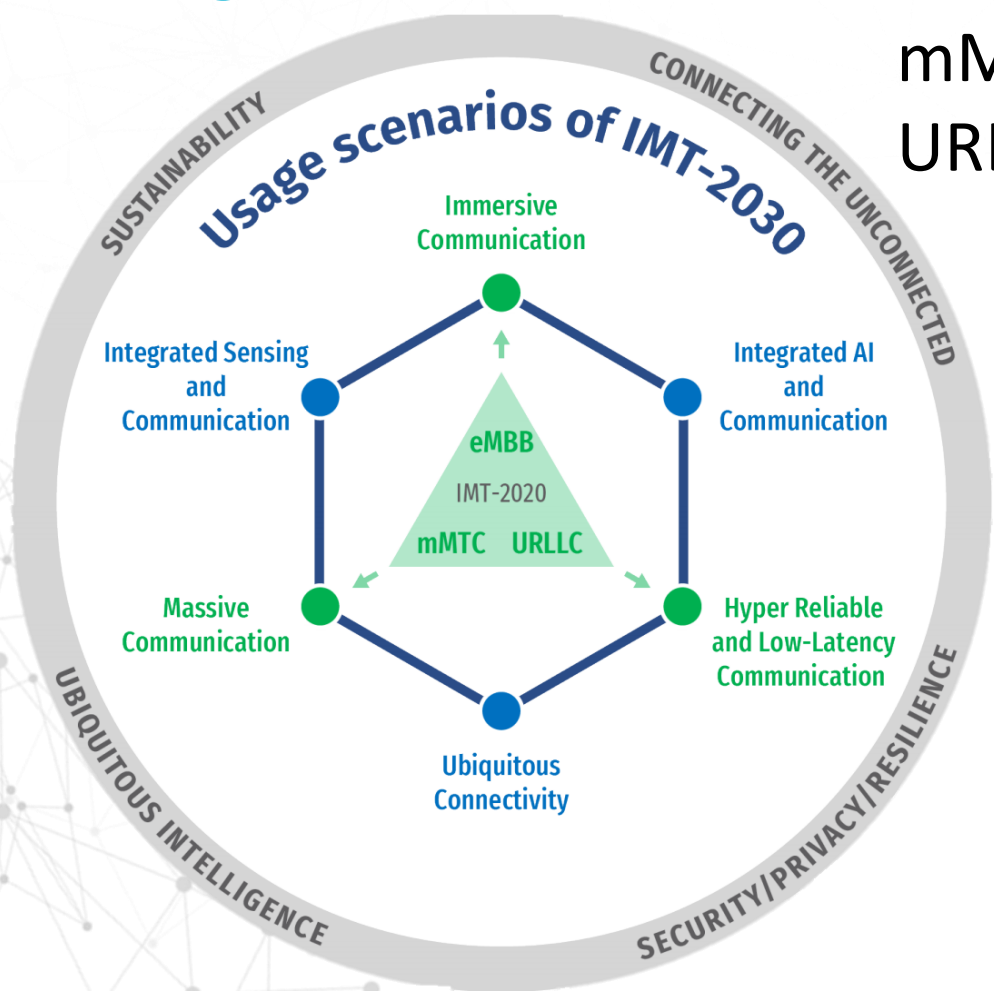
6G

Usage Scenarios

Extension from IMT-2020 (5G)

eMBB ➲ Immersive Communication

mMTC ➲ Massive Communication

URLLC ➲ HRLLC (Hyper Reliable & Low-Latency Communication)
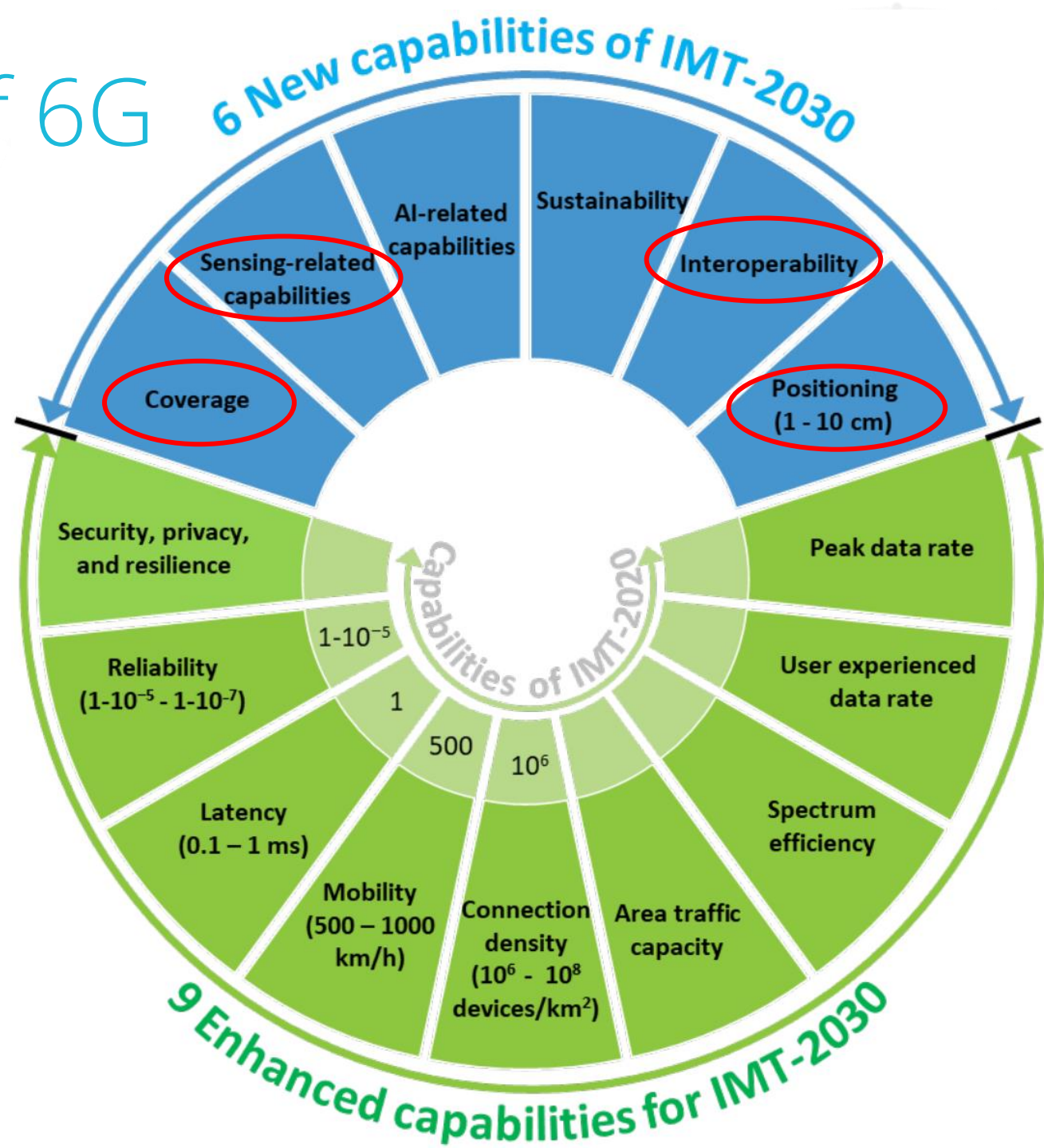
New

Ubiquitous Connectivity

Integrated AI and Communication

Integrated Sensing and Communication

Military Use of 6G

- Usage Scenarios

Military Use of 6G

- Coverage
  - **Enhanced Coverage in Remote and Challenging Environments**: 6G's advanced propagation techniques and higher frequency bands can provide reliable coverage in remote and challenging terrain, such as mountainous regions, forests, and urban canyons. This is crucial for maintaining communication links between troops, vehicles, and drones in these areas.
  - **Seamless Handoffs:** 6G can enable seamless handoffs between different network cells, ensuring uninterrupted communication for troops on the move. This is particularly important for fast-moving units, like those in airborne or naval operations.

Military Use of 6G

- Sensing-related Capabilities
  - **Advanced Radar Systems:** 6G's high-frequency bands and precise timing capabilities can be leveraged to develop advanced radar systems with improved detection and tracking capabilities. This can enhance situational awareness and early warning systems.
  - **Remote Sensing and Environmental Monitoring:** 6G can enable high-resolution remote sensing and environmental monitoring, allowing military forces to gather critical intelligence on enemy activities, weather conditions, and terrain features.

Military Use of 6G

- Interoperability and Positioning:
  - **Interoperability Between Diverse Systems:** 6G can facilitate seamless interoperability between different military systems, such as drones, tanks, and communication networks. This will enable coordinated operations and efficient information sharing.
  - **Precise Positioning and Navigation:** 6G's advanced positioning technologies can provide highly accurate location information, even in GPS-denied environments. This is essential for navigation, target acquisition, and mission planning.

Military Use of 6G

- Drawbacks to overcome
  - **Power consumption**: Smaller components can lead to increased power density, which can be a challenge for thermal management.
  - **Manufacturing complexity**: Producing extremely small components requires advanced manufacturing techniques and precise control.
  - **Signal propagation**: At higher frequencies, signals can be more susceptible to attenuation and interference, necessitating careful design and deployment.

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