SKYLINE ORBIT SEMICONDUCTOR

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Your trusted Global Partner in Proven Semiconductor Solutions

Silicon Shield: Role of Semiconductors in Modern Warfare

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Introduction

Orbit & Skyline

About Our Customers

Agenda

Overview of Webinar Structure

01 Warfare Evolution from conventional to strategic combat

02 Role of Chips cross modern military domains

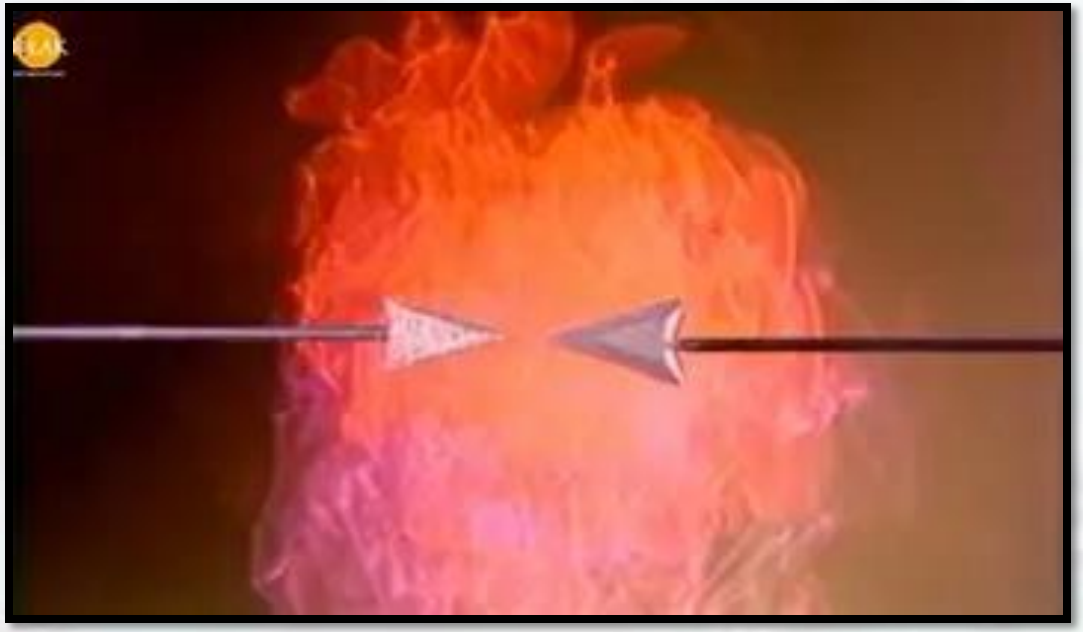
03 Semiconductor Applications in EW, navigation, targeting, surveillance

04 Classification of Semiconductors

05 Defence-Centric Semiconductor Requirements

06 Case for Semiconductor Indigenization

From Myth to Modern Warfare: Arrows to Missiles



- *Many of us remember watching 'Ramayan' TV series in 1980s, where arrows lit up the sky during epic battles*
- *Today, similar scenes play out in real life; but with missiles intercepted mid-air by systems like Israel's 'Iron Dome', broadcasted live on our screens*

What once seemed mythical is now real—technology turns imagination into reality

Warfare Without Electronics: A Glimpse into the Past

Dresden before bombing

Dresden after bombing

- **In 1945, Allied forces bombed Dresden in Germany to cut supply lines but lacked precision**
- **The attack caused a firestorm destroying ~1600 acres area and killing ~25,000 civilians**

Deadly impact of imprecise warfare on human life and property

Vietnam War: Bridge that survived Non-Precision Bombs

Dragon's Jaw Bridge connecting North and South Vietnam

- **Thanh Hoa (Dragon's Jaw) Bridge was key railway and road bridge over Ma River, crucial for North Vietnam's supply lines**
- **From 1965, US bombing raids failed to destroy the bridge due to strong air defences, and lack of precision bombs**

Took US forces 7 years and use of laser-guided bombs to finally destroy this resilient bridge in 1972

Kargil War: The Need for Precision Coordinates

Drass town and Tiger Hill

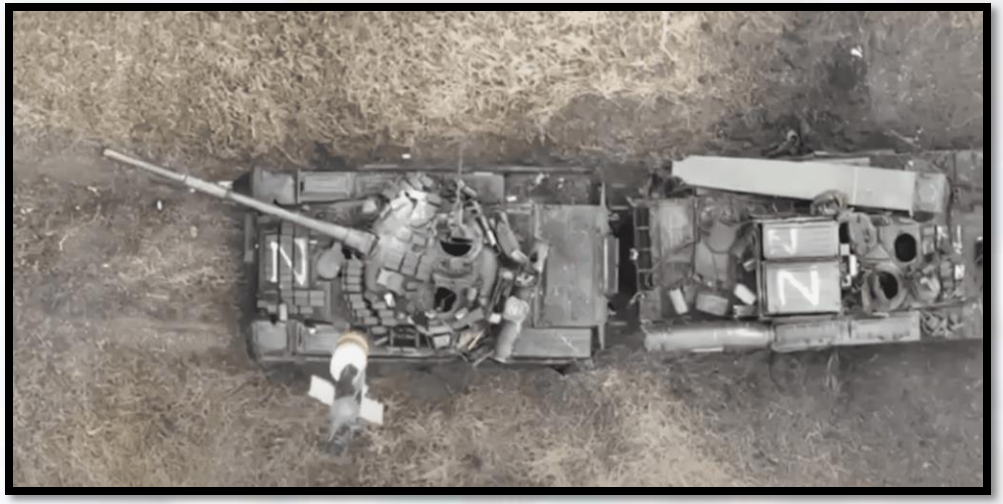
Bofors Gun striking Kargil Hills

- **During 1999 Kargil War, Pakistani intruders occupied key hilltops along LoC (Line of Control)**
- **India required accurate GPS coordinates to effectively target enemy positions at these high altitudes (~17,000 feet)**
- **US denied access to precise GPS coordinates, limiting strike precision and prolonging the war**

Prompted India to develop its own navigation system, NaVIC, for strategic autonomy

Modern Warfare Empowered by Electronics

FPV (First-Person View) Kamikaze Drones



FPV drone dropping ammunition on T-72 tank

- **A $500 FPV drones can destroy $3M tanks, shifting battlefield economics**

- **Drones can travel hundreds of kilometers, survey targets and strike**
  - ✓ **Advanced navigation:** GPS, gyroscopes, and live video ensure accurate kamikaze attacks
  - ✓ **Electronic warfare resilience:** Enhanced anti-jamming and secure communication
  - ✓ **AI-powered precision:** Semiconductor-based AI enables real-time target tracking and autonomous strikes
  - ✓ **Scalability & swarm tactics:** Mass-produced drones can overwhelm traditional defences
  - ✓ **Adaptability:** Commercial drones with semiconductor tech are easily weaponized

Modern electronics ingenuity has revolutionized warfare with low-cost, high-impact systems

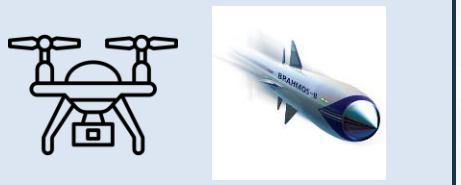
‘Chips’ Behind Modern Weapon Accuracy

MEMS Gyroscope

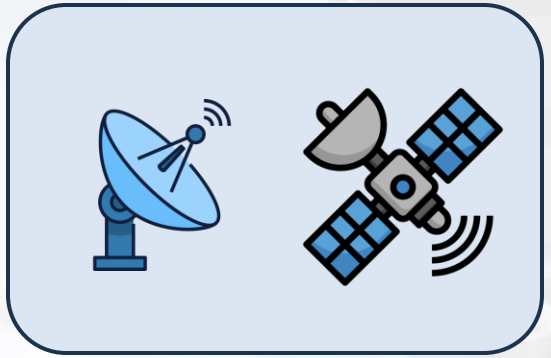
Accelerometer

Inertial Measurement Unit (IMU)

GNSS Receiver IC



Navigation & Guidance



Target Tracking

Radar Processing IC

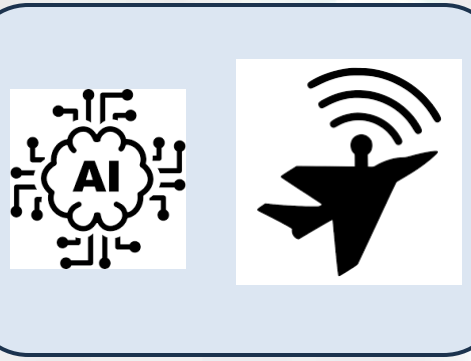
Image Processing IC

Digital Signal Processing IC

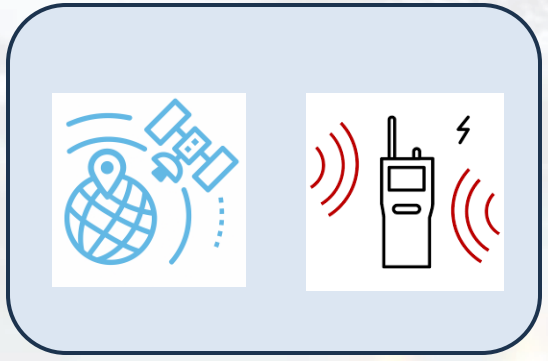
Microcontroller

Microprocessor

FPGA



Smart Decision Making



Secure Communication

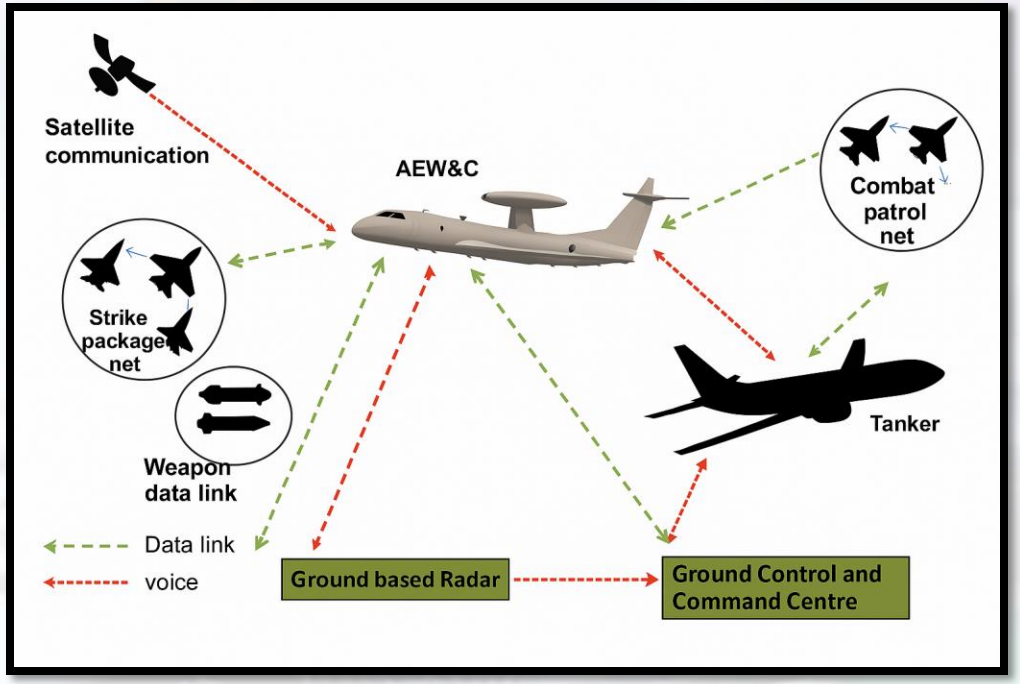
RF Transceiver

Encryption

Communication

Semiconductors Powering Electronic Warfare & Radar Systems

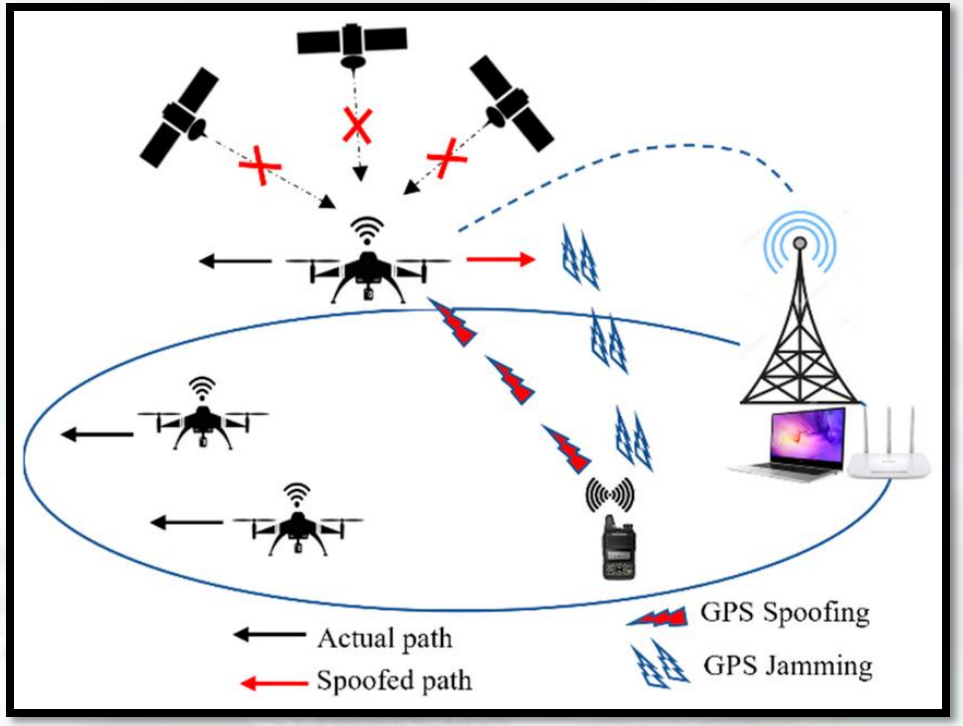
- **Electronic warfare and radar use semiconductors to dominate battlefields by jamming signals and controlling radio waves**



- **Key IC Components & their Roles:**
  - **GaN HEMTs (MMICs):** High-power RF amplification for long-range radar and jamming
  - **SiGe BiCMOS LNAs**: High sensitivity and signal integrity for clear detection
  - **RF Switches & Phase Shifters** (SOI, RF MEMS): Dynamic beam steering in AESA radars
  - **High-speed ADCs/DACs (CMOS/Bipolar**): Digitize wideband signals for processing
  - **Frequency Synthesizers & VCOs (SiGe/CMOS**): Low-jitter, frequency-agile clocking for detection and deception

Semiconductors in Guidance and Navigation Systems

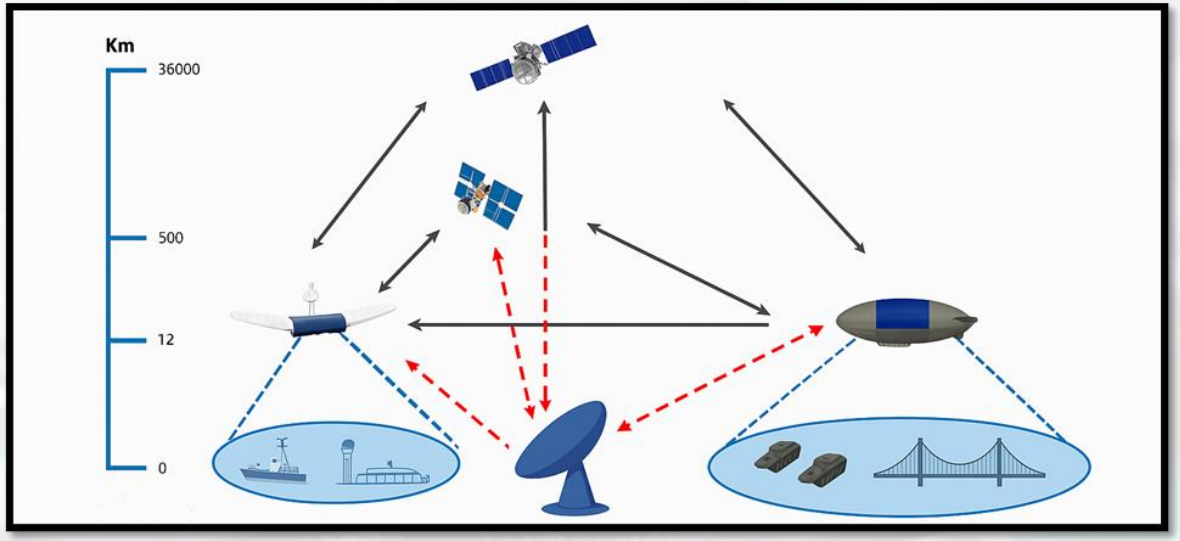
- **Guidance and Navigation enable precision targeting and autonomous operation in missiles and drones**



- **Key IC Components & their Roles:**
  - **MEMS Accelerometers & Gyroscopes:** Measure motion and orientation in inertial navigation systems (INS)
  - **GNSS Receiver Chips (CMOS):** Provide absolute satellite-based positioning with anti-jamming and anti-spoofing
  - **IMUs (Inertial Measurement Units):** Integrate sensors for real-time calculation of position and velocity
  - **Digital Signal Processors (DSPs):** Process sensor data, run flight control algorithms, enable adaptive navigation
  - **Microcontrollers (MCUs):** Manage real-time decision-making and control tasks for guidance systems

Semiconductors in Surveillance and Reconnaissance Systems

- **Surveillance and Reconnaissance systems deliver real-time battlefield intelligence through advanced sensing and processing**



- **Key IC Components & their Roles:**
  - **CMOS & CCD Image Sensors:** Electro-optical and night vision imaging
  - **Infrared Detectors with ROICs (InGaAs, HgCdTe)**: Thermal and FLIR imaging capabilities
  - **SiGe, GaN HEMTs:** Enable high-power RF transmission and high-sensitivity signal reception in radar systems
  - **High-speed ADCs/DACs (CMOS/BiCMOS):** Digitise radar signals, including SAR data for analysis
  - **FPGAs, SoCs, AI Edge Chips (FinFET):** Rapid sensor data processing and on-board decision-making
  - **DRAM & SRAM:** Store real-time sensor and image data

Semiconductor Classification: Materials, Applications, and Technology Nodes

By Material	**Elemental**	Silicon (Si) , Germanium (Ge)
	III-V	Gallium Arsenide (GaAs), Indium Phosphide (InP), Gallium Nitride (GaN)
	II-VI	Cadmium Telluride (CdTe), Zinc Selenide (ZnSe)
By Application	**Analog**	Amplifier, Voltage Reference, Analog Front-End
	Digital	Logic ICs (CMOS), Memory, Microprocessor, FPGA
	RF/Microwave	PLLs, SERDES, RF Transceivers
	Power Electronics	Power MOSFETs (Si, SiC), IGBTs, GaN HEMTs
By Technology Node	**Legacy Nodes**	≥130nm (180nm, 250nm, 350nm)
	Mature Nodes	90nm, 65nm, 45nm, 28nm
	Advanced Nodes	22nm (FD-SOI), 14/16nm (FinFET), 10nm, 7nm, 5nm, 3nm & below

Rugged, Secure, Trusted: ICs for Defence Applications

Temperature Range: Military spec: -55°C to +125°C or wider for extreme conditions

Key MIL Standards:

- MIL-STD-883: Microelectronic test methods
- MIL-PRF-38535: IC performance and reliability
- MIL-STD-202: Environmental testing for electronic components

Trusted Foundry: Fabrication must be done at DoD Trusted Foundries for security, authenticity, and IP protection

Radiation Hardening: ICs need rad-hard or rad-tolerant designs to withstand space and nuclear radiation

Export Restrictions: Military ICs must comply with ITAR/EAR rules regulating their export and defence use

Military ICs must endure harsh conditions, meet strict standards and preferably build in trusted secure fabs

How Semiconductor ICs Can Be Compromised

Hardware Trojans: Hidden circuits added during design or fabrication that can leak data or disrupt systems when triggered

Counterfeit Components: Fake or inferior chips can cause system malfunctions or degrade mission performance

Firmware Vulnerabilities: Embedded malicious code can jeopardize system security and functionality

Supply Chain Tampering: Chips modified in transit or assembly may be rigged for surveillance or sabotage

Mask Tampering: Mask sabotage can insert hidden threats into all chips undetected

Vulnerable chips can enable sabotage, espionage or system failure in defence operations

Why Indigenous Semiconductor Capability Matters

Strategic Independence: Reduces dependence on foreign sources for vital defence and communication tech

National Security: Modern security systems safeguarding against internal and external threats rely heavily on chips

Economic Strength: Drives high-value employment, propels advanced manufacturing, and fortifies tech ecosystem

Rapid Innovation: Enables fast development of custom chips for emerging needs in defence, AI and communication

Semiconductors ensure secure systems, strategic autonomy, economic strength, and innovation

Concluding Lesson from Ramayan: Strategic Precision for Victory

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🎯 **Highlight:** Vibhishan revealed a secret to lord Ram about nectar in Ravan's **navel**, making him invincible

⚔️ **Strategic Action:** Lord Ram aimed his arrow to destroy nectar in Ravana's navel, leading to his demise and ending the battle

🔑 **Modern Warfare Lesson:** Weapon system powered by Semiconductors enable surveillance, intelligence and precision strikes for national victories

End-to-end semiconductor capability acts as a 'Silicon Shield' for strategic and economic security of nations

Q&A

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