



RUGGED OPTICAL SOLUTIONS

A DIVISION OF MOOG

MOOG

Shaping the way our world moves™

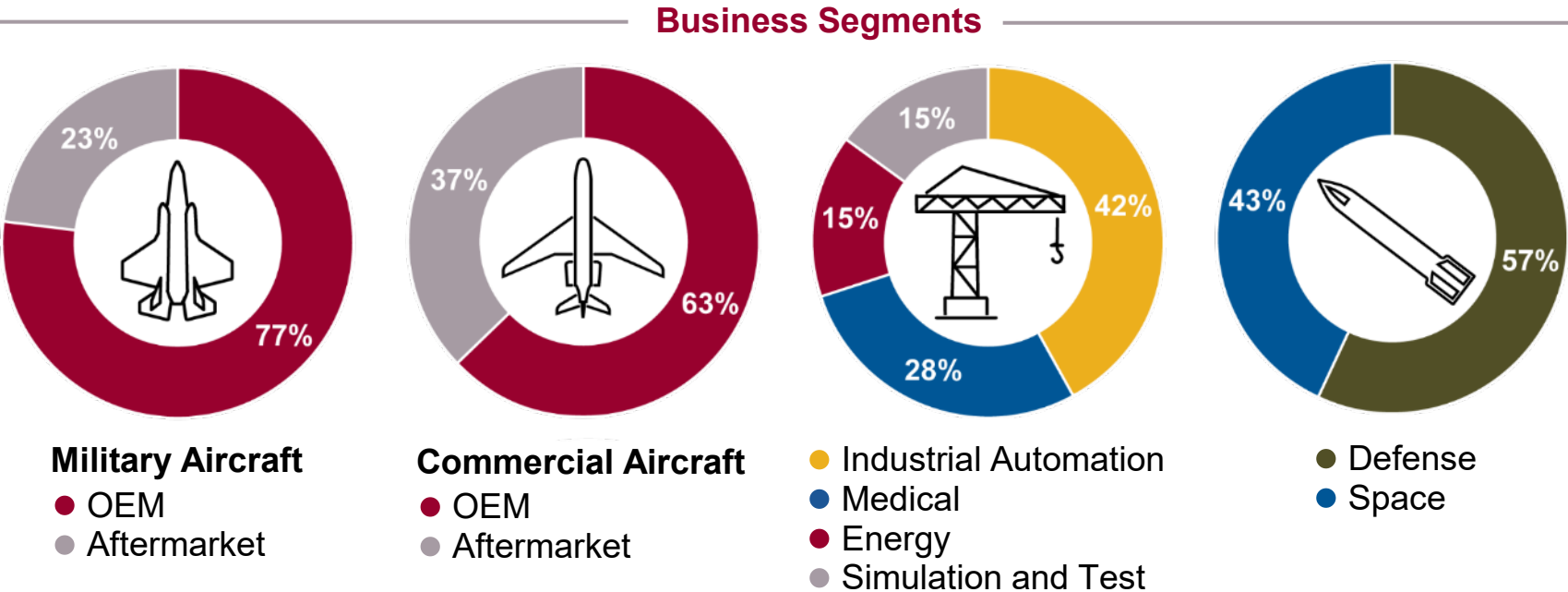
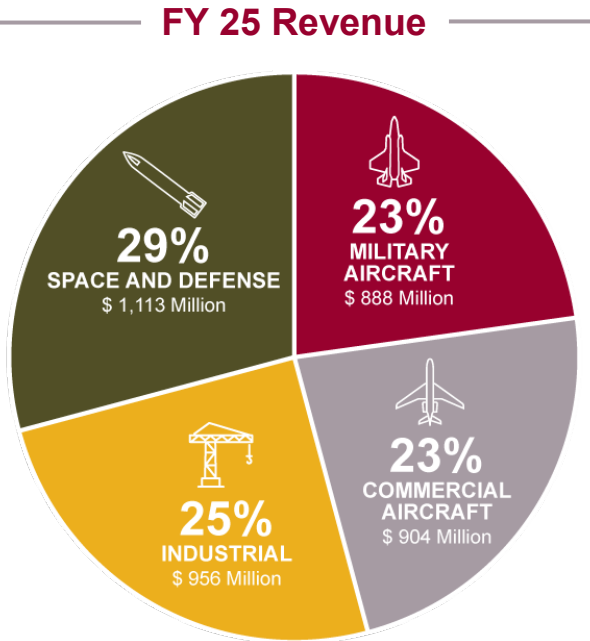
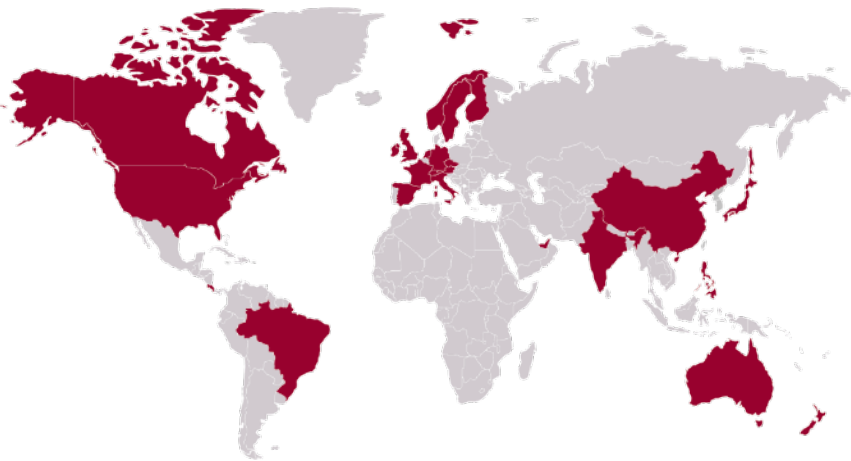
World leader in high-performance motion control solutions for mission-critical applications

1951
Founded by Bill Moog

\$3.9 B
FY 2025 Revenue

75 YEARS
Controls Heritage

20
Countries



Power and Data Division



- Slip rings, motors, resolvers for armored vehicle and remote weapon station turrets, aerospace sensors and weapon systems, solar array drive assemblies
- Multi-component and pedestal solutions for electro-optics/infrared sensors and airborne, naval and ground-based radar systems
- Flight servos and utility actuators for UAVs, aircraft and military systems
- Communication networking ethernet switches, media converters, optical transceivers



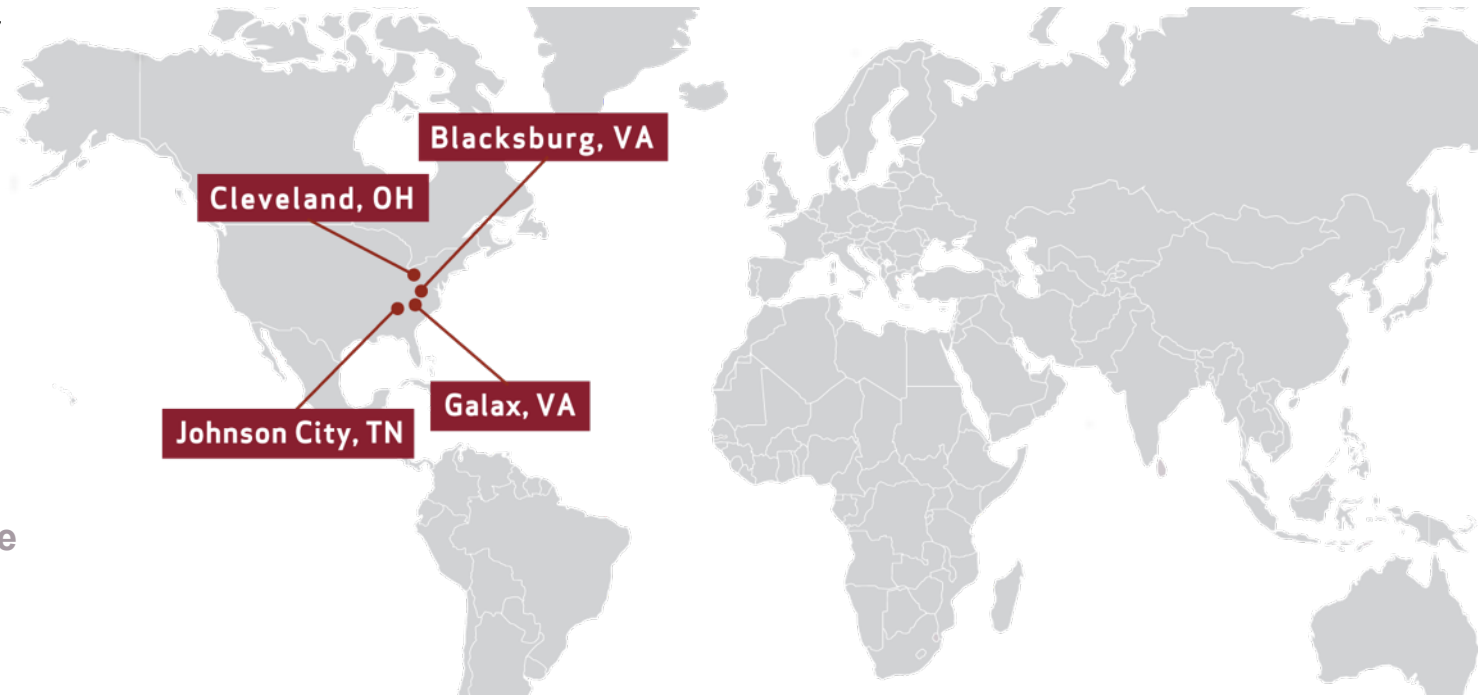
Power & Data Division

Moog is an innovative provider of power and data transfer solutions, motion control, and signal conversion products to the aerospace and defense markets.

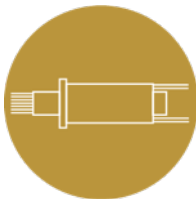
75 YEARS
High Performance
Components

1,200
Power &
Data
Employees

**WORLD
LEADER**
Military/Aerospace
Slip Rings



Business Segments



Slip Rings



Motion Control



Rugged
Optical Solutions

Moog | Rugged Optical Solutions Mission

- Modern vehicles are becoming highly networked platforms, high-definition video, multi-sensor fusion, and semi-autonomous systems all demand an increased bandwidth, with lower latency, and a greater immunity to interference than legacy copper cabling can provide.
- Gone are the days when combat vehicles were solely responsible for transporting personnel or equipment. The role of the combat vehicle has expanded to provide on demand battlefield situational awareness data by including a suite of sensors and communication equipment. As the demand for data on the battlefield increases, the optical network connected to sensor systems must advance to supply the warfighter instantaneous information. Therefore, the equipment needs to seamlessly communicate both to each other and the operators.
- The Moog Rugged Optical Solutions group capitalizes on their experience in defining system architectures and optical networking solutions. By leveraging their expertise, on optical components, media conversion, and network signaling (e.g. Time Sensitive Networks - TSN), Moog Rugged Optical Solutions designs, develops, and supports entire network architectures for existing vehicles and future platforms for use in harsh and unforgiving environments.

About Moog Rugged Optical Solutions

Moog Rugged Optical Solutions provides rugged optical networking solutions for the harsh environments of aerospace and defense applications.

Moog ROS addresses a critical gap in the space and defense sector, where no traditional provider individually designs enough of the network to ensure seamless performance. This business unit brings full ownership of the system, from design to implementation, beyond just component supply.

Rugged Optical Solutions delivers significant advantages, including lower total cost of ownership, lighter system weight, lower power demand, and improved reliability. Components and assemblies are vertically integrated, and U.S. manufactured in an onsite facility.

Johnson City, TN



Power and Data Division
25,000 sq. ft. facility



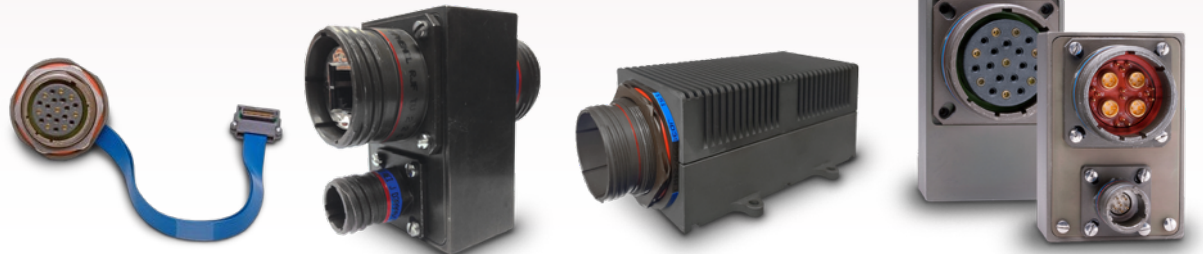
40 Employees

Highlights

- Designs and manufactures high-speed optoelectronic components and communication subsystems for use in harsh environment networking equipment applications
- Leads the industry in developing innovative optoelectronic components and communication subsystems for harsh environments
- Manufactures components and systems qualified on many key military platforms
- Certifications:
 - AS9100D
 - ISO9001:2015



Rugged Products for Harsh Environments



Optical Transceivers

Ethernet Media Converters

Ethernet Switches

Video Media Converters

Cleveland, OH



Power and Data Division
30,000 sq. ft. facility



125 Employees

Highlights

- Rugged optical components for harsh environments
- Commercial or custom-off-the-shelf components
- Industry-leading performance in link budget, RX sensitivity, optical speed and reliability, reduces data wire weight up to 70%, increase network bandwidth and enables multiple protocols on one fiber
- ISO 7, Class 10,000 Cleanroom
- Certifications:
 - AS9100:D
 - ISO9001
 - ATEX



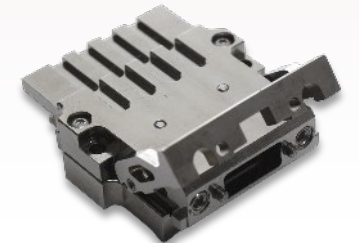
Rugged Products for Harsh Environments



Military Grade Cable Assembly



TOSA



SPOT-MB Transceiver

Rugged Optical Solutions Management Team



Timothy Nevin
General Manager,
Johnson City & Cleveland



Dr. Kevin Lefebvre
Business Unit Product Marketing
Manager



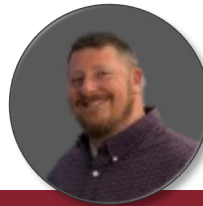
Jeffrey Pawlowski
Business Unit Finance/Controller



Donna Rhodes
Business Unit HR Manager



Christopher Majzun
Cleveland Site Lead Manager



Joseph Breedlove
Business Unit Engineering
Manager



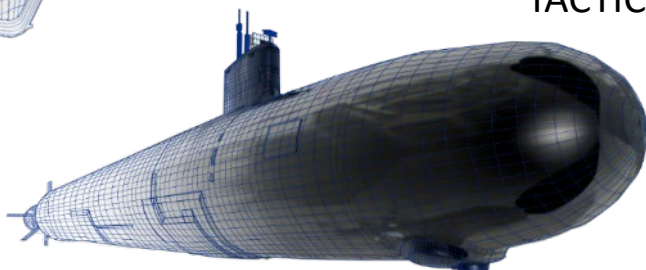
Tramy Simpson
Johnson City Site Manager

Markets and Product Application

MILITARY AEROSPACE



SUB SEA

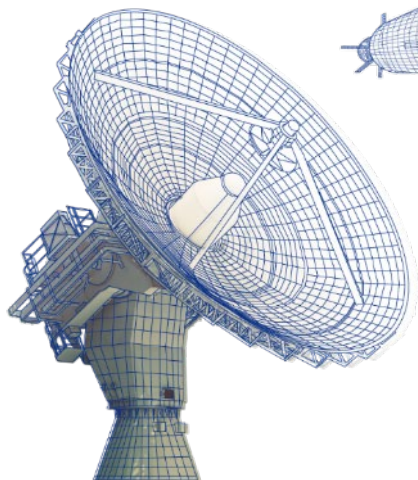


TACTICAL VEHICLES



COMMERCIAL AEROSPACE

RADAR



INDUSTRIAL

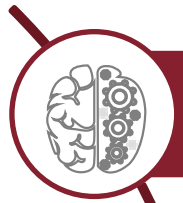
APPLICATIONS

Flight Deck Displays | In-Flight Entertainment and Cabin Crew Interfaces | Electronic Warfare | Radar Systems | Flight Recorders | Heads Up and Down Displays | Storage Devices | Cameras | Towed Array Networking

FIBER NETWORK ADVANTAGES

- Reduces data wire weight by up to 70%
- Increase network bandwidth and enables multiple protocols on one fiber
- Enables powerful edge computing network architectures
- Reduces EMI concerns in composite airframes Vs copper wire

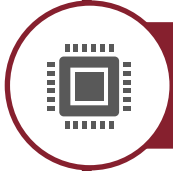
MOOG | Rugged Optical Solutions – The Competitive Advantage



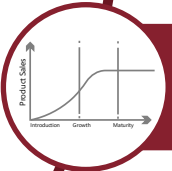
A combined 45 years experience in component & system design



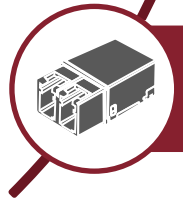
End-to-end system design tailored to specific customer platform requirements



Control down to the device and switch firmware level



Tight electro-optical parameters and tolerances



Transceiver, termini, fiber, connector, switch, optical engine, FORJ

Ethernet Electronics

ETHERNET NETWORK SWITCHES

- Ruggedized L2/L3 Managed switches
- Copper ports: 10/100/1000Base-T
- Optical ports: 100Base-FX, 1000Base-SX, 10GBase-SR
- Customization/Modification available
- All commercial/Non-ITAR
- **IN DEVELOPMENT** – **TSN (Time Sensitive Networking) compliant Ethernet switches**
- **IN DEVELOPMENT** – **10/25GBase-KR/SR multi-port ethernet switches**

ETHERNET MEDIA CONVERTERS

- Compliant with IEEE-802.3:2005
- 100Base-FX, 1000Base-SX, 10GBase-SR
- D38999 Mil-circular interconnect with ruggedized enclosure
- All commercial/non-ITAR
- **IN DEVELOPMENT** – **10/25GBase-KR/SR Ethernet media converters**



Managed L2/L3 Ethernet Switches



Managed Opto-Electronic Ethernet Switches



Fiber Optic Ethernet Media Converters



Active Opto-Electronic Media Converter Cables

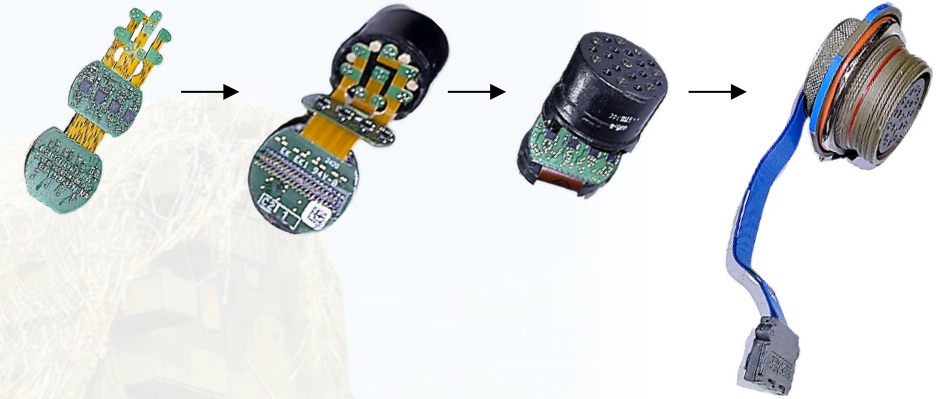
Panel Mount Transceivers

RUGGED TRANSCEIVERS

- Electronics PCB folded inside rear cap of D38999-style connector shell
- Integrated optical components eliminate complex intra-enclosure fiber routing
- TOSA/ROSA components embedded in standard D38999-style insert body
- Industry standard high-speed copper cable assembly for copper signal transmission

ADDITIONAL FEATURES

- D38999, D-Sub, ELIO, ARINC 801, ARINC 600
- Operating temperature range from -40° C to +85° C
- Data rates: 1Mbps – 10 Gbps (25Gbps in development)
- Protocols supported: Ethernet, Fibre Channel, ARINC 664, ARINC 818, sFPDP, sRIO, PCI-e, among others



Dagger



Lightning



Matrix



Sabre 09-01



Sabre 11-02



Cutlass



Magnum



Direct 9

Opto-Electronic Product Platform

RUGGED OPTICAL TRANSCEIVERS

- Rugged networking components designed for the harsh environments of aerospace & defense applications
- Engineered & tested to meet and exceed parameters defined within MIL-STD-883 & MIL-STD-810 i.e. shock, vibration, temperature, mechanical force, and the varied environmental profiles
- Multiple platforms boasting a variety of mounting options, pluggable, surface mount, or thru-hole solder attach, offering solutions to fit any design
- Optical interfaces include Mil-Spec termini and connectors, industry-standard LC connectors, unique highly ruggedized metal LC connector, ARINC 801, MT, unique metal MT-T connector, or pigtailed fiber cable assemblies.

ADDITIONAL FEATURES

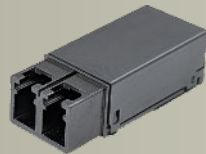
- Duplex, Dual Duplex, Quad Transmitter/Quad Receiver and Bi-Directional configurations options
- 100Mbps – 100 Gbps in singlemode and multimode wavelengths, including Wave Division Multiplexing for high data rates on a single fiber (ideal for Fiber Optic Rotary Joint applications in slip rings)
- Ethernet, Fibre Channel, SDI, HDMI, A818, SFPDP and proprietary protocol support



RJ 1-10G



RJ-28G



RJ-10G-
CWDM/DWDM



RCP 1-10G



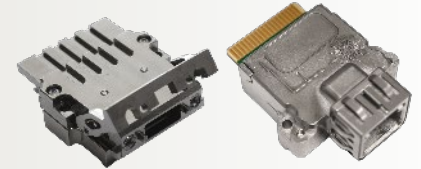
Essential/BiDi
1-28G



QSFP/SFP+
1, 10, 40 or 100G/1-28G



SFF/SFB
100M-4G/1-3G



SPOT-MB/SPOT-CE
1, 10, 40G (100G Coming Soon)

Interconnect Product Platform

RUGGED TERMINI, CONNECTORS & ADAPTERS

- Develop and manufacture rugged optical termini, connectors & adapters for better performance in harsh environment applications above their plastic datacom counterparts
- Robust materials selected at the design phase for their high reliability in rugged mil-aero environment, capable of handling higher shock, vibration, and thermal exposure than commercial equivalents

CUSTOM CABLE ASSEMBLIES

- From jumper cables to entire fiber optic EWIS wire harnesses for aircraft installations
- 100% optical testing performed on all fiber strands including end face inspection and geometry verification; all traceable by serial number or manufacturing lot when processed through our AS9100 certified manufacturing facility for complete traceability
- Robust suite of test equipment ensures reliability and manufacturing cell contributes to the ever-growing product offerings
- MT/High Density offerings continue to expand to meet the increasing bandwidth needs of the industry

OPTICAL ACCESSORIES

- SpliceWORKS: Rugged Mechanical Splice enables field repair for fiber cables in under 30 minutes with low optical loss
- Optomux: Configurable Optical Multiplexers with high isolation, excellent return loss, low insertion loss, high power support



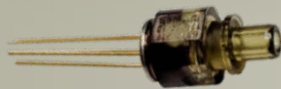
Optical Sub-Assembly (OSA) Product Platform

OSAs: TOSA, ROSA, BOSA

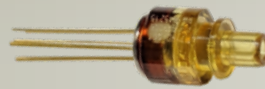
- TOSA: 980nm, SWDM, CWDM4, LR4, CWDM, DWDM
- ROSA: 980nm, SWDM, CWDM4, LR4, CWDM, DWDM
- BOSA: 1310nm/1310nm, 1270nm, 1310nm, 1330nm, 1490nm, 1550nm

DESIGN & MANUFACTURING CAPABILITIES

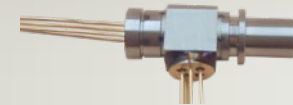
- ISO 7, Class 10,000 Cleanroom houses optical alignment, encapsulation, test equipment capable of producing OSAs operating at 100M to 28Gbps
- Burn-in, active alignment and capping, curing, performance testing, harsh-environment reliability testing, visual and optical inspection
- Die attach, fiber metallization, micro-welding, wire bonding, TO-can welding, mechanical test, and hermeticity test
- Optical paths including lens creation, selection, forming, silicon bench, chip on board taking light from a solid-state semiconductor to precise fiber coupling.



Transmitter Optical Sub-Assembly

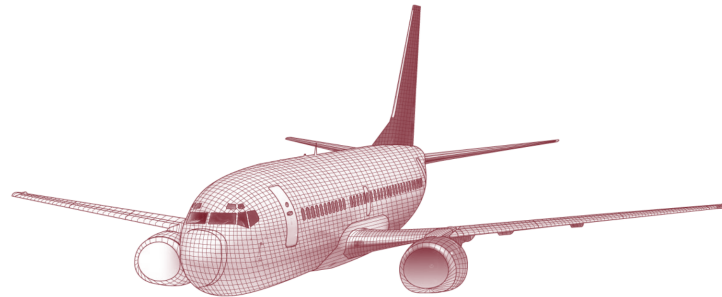
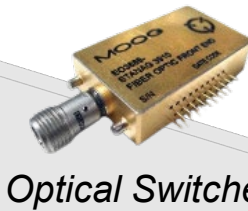
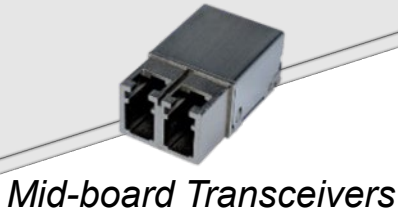
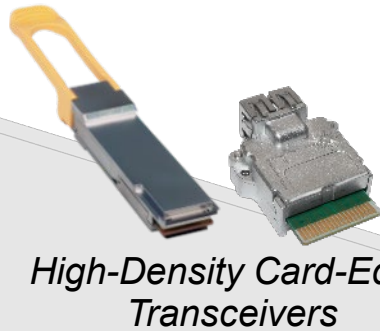
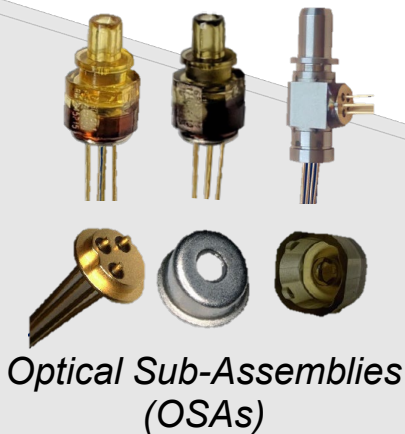


Receiver Optical Sub-Assembly

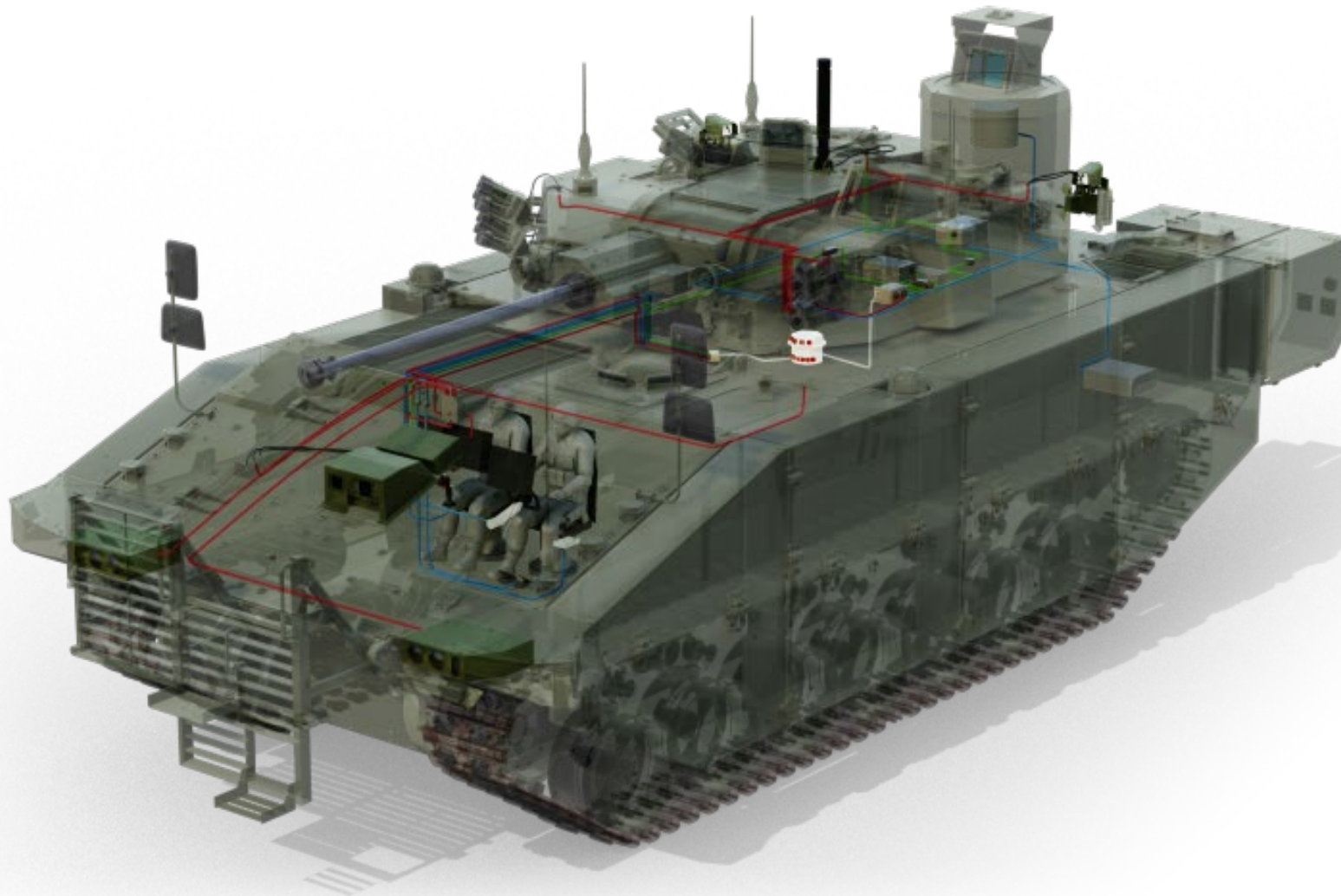


Bi-Directional Optical Sub-Assembly

ROS Product Portfolio



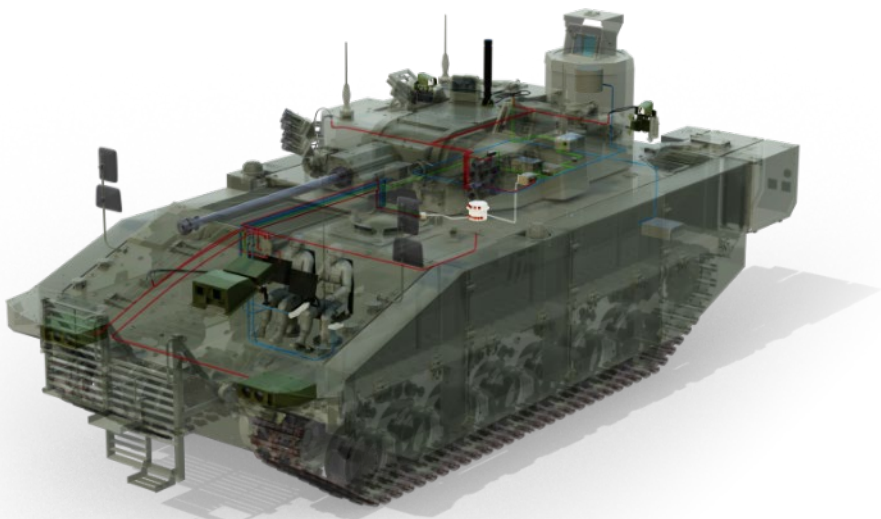
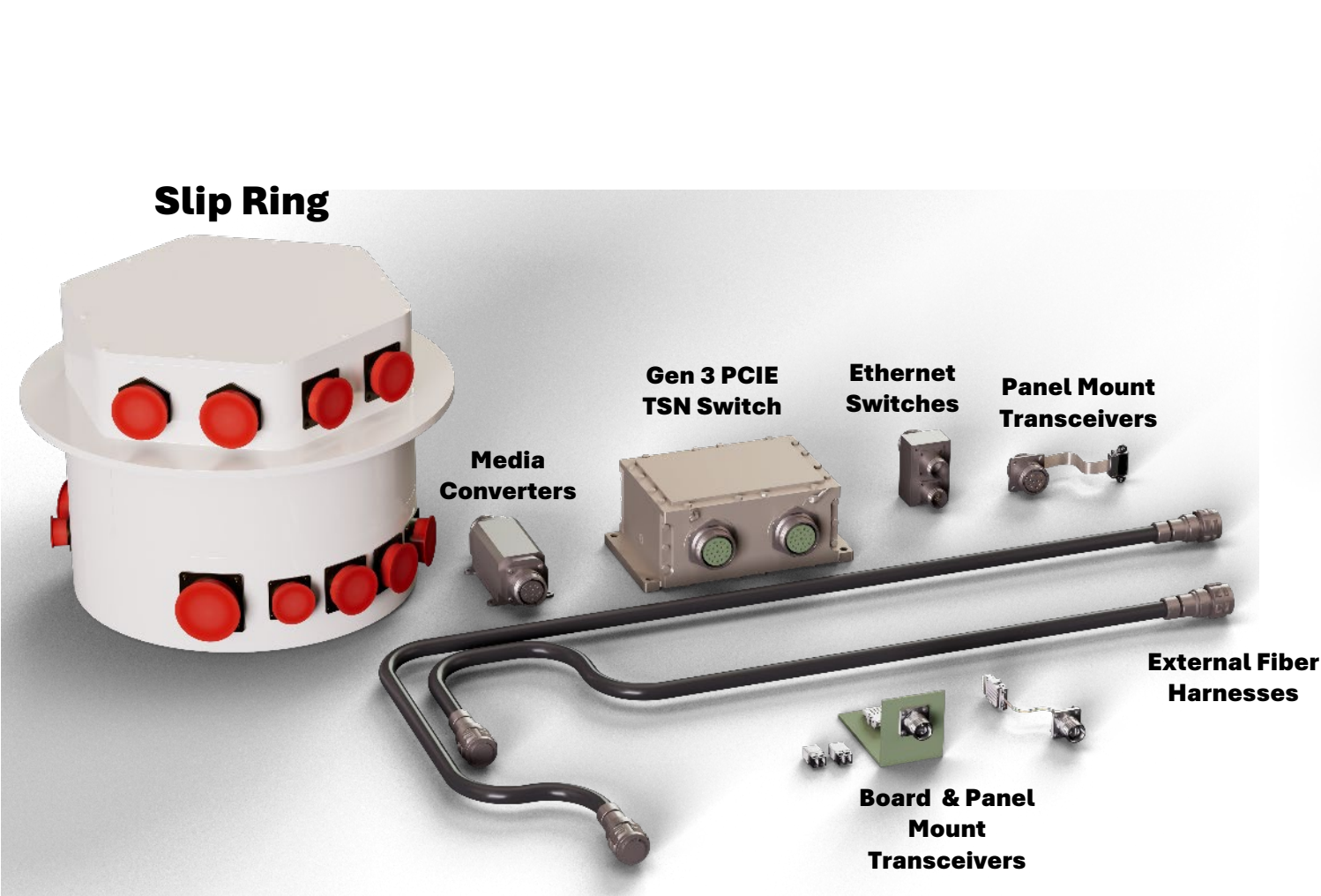
Why Choose Us: Full Network Architecture



Please note – separate data paths travel along the same single fibers. Single fiber can be used to minimize the amount of optical fiber running through the system. This reduces the cost, weight and power demand.

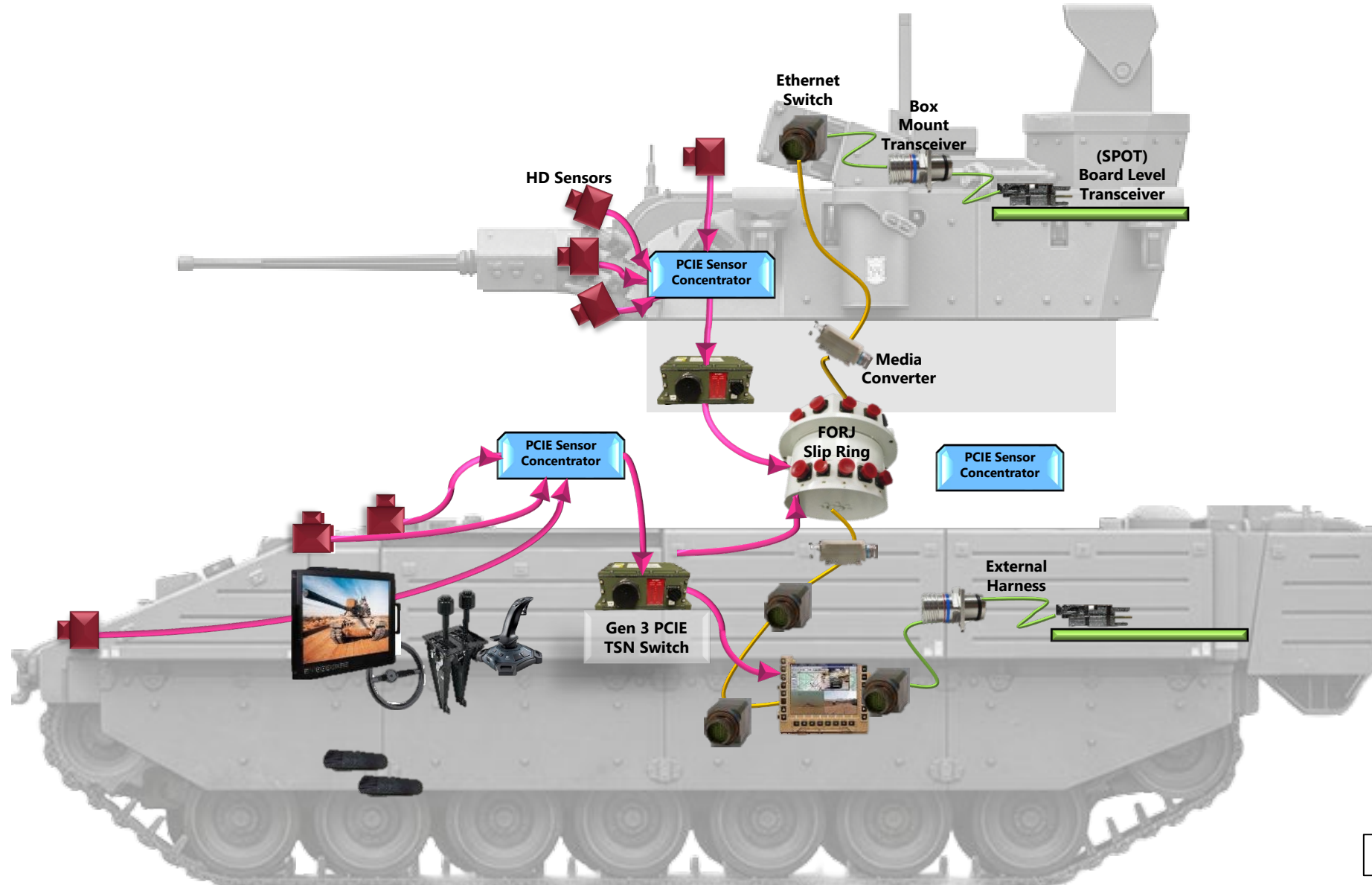
- Video Sensor
- Drive by Wire
- Radar/Radio Receiving

ROS Components for Data Paths



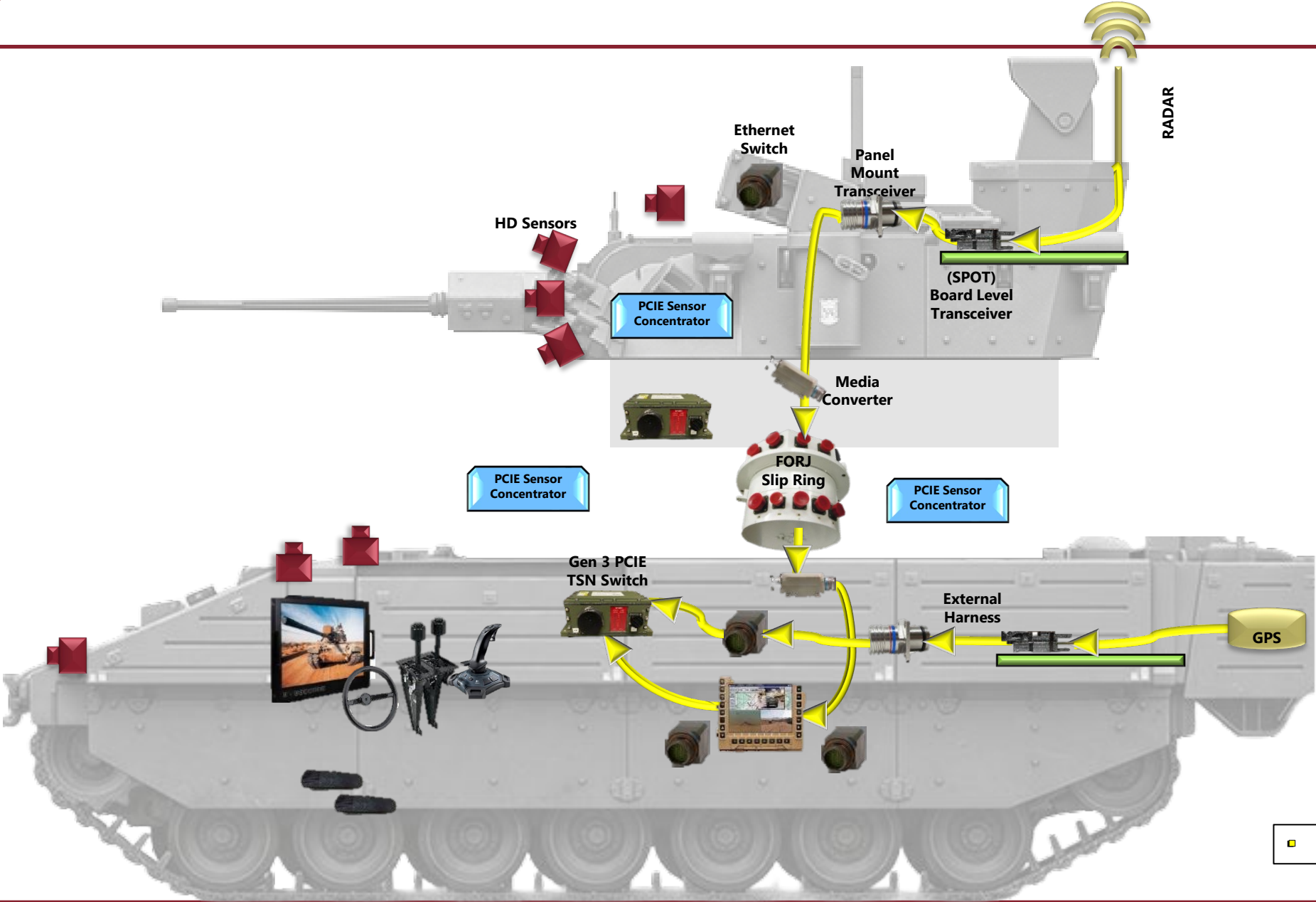
Board & Panel Mount Transceivers

Video Sensor

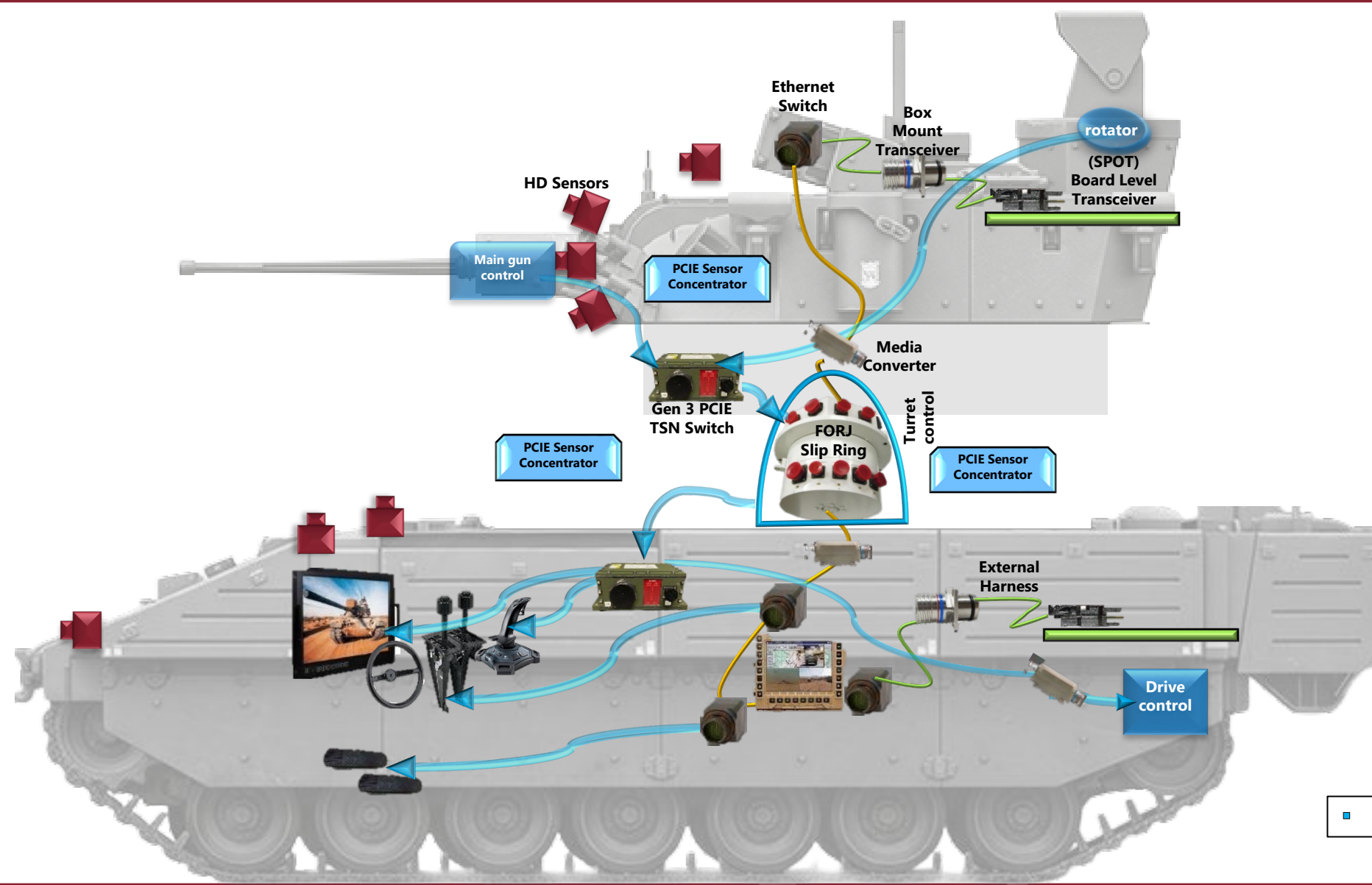


▪ Video Sensor

Radar



Drive By Wire



▪ Drive by Wire

Aerospace Applications

Sensors

- RJs, RCPs, SFFs
- Simplex Fiber Optic Cables
- LC-R termini
- Optical Multiplexers
- Panel Mount Transceivers

Mission Computers

- RJs, SFFs
- LC-Rs, LC-Ts,
- Complex Cable Assemblies
- Ethernet Media Converters
- Panel Mount Transceivers

Large Area Displays

- RJs
- Complex Cable Assemblies
- Panel Mount Transceivers

Warning/Jamming Systems

- RCPs
- C-beams
- Complex Cable Assemblies
- Panel Mount Transceivers

AESA Radars

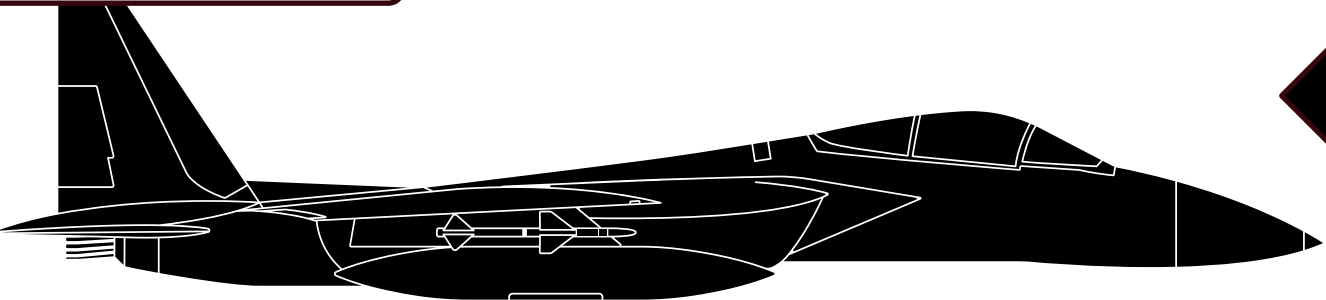
- RJ-5G-SX
- Complex Cable Assemblies
- Panel Mount Transceivers

LRU

- Ethernet Switches

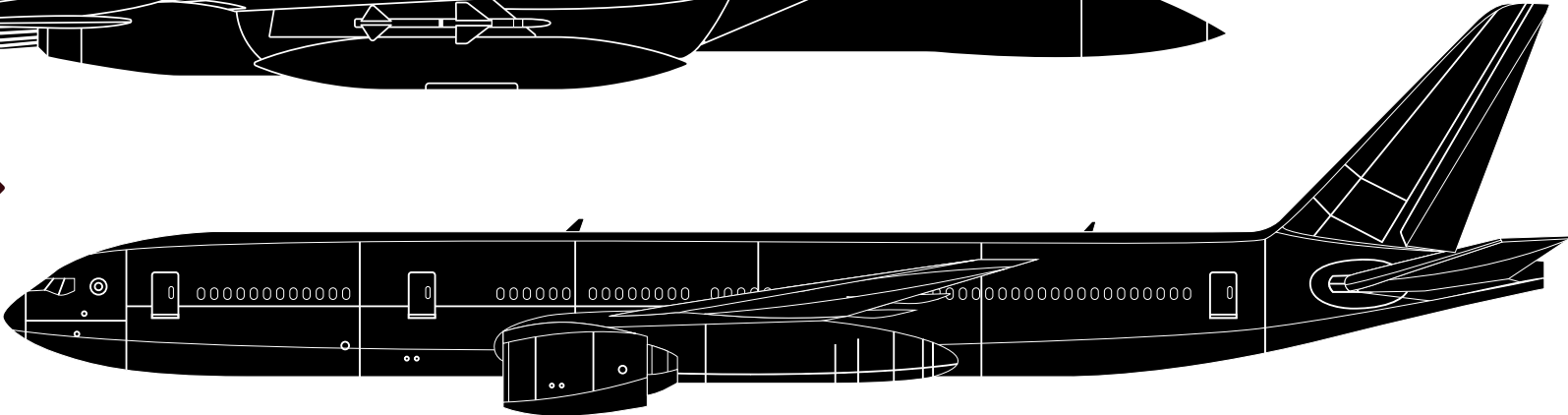
Refueling Camera

- RJs



Military Aircraft

Commercial Aircraft



Flight Deck Displays

- SFFs, SFBs
- Simplex Fiber Optic Jumpers
- LCs to ARINC 801s
- Panel Mount Transceivers

In Flight Entertainment

- SFFs, SFBs
- Simplex Fiber Optic Cables
- Panel Mount Transceivers

Remote Switches & Data Connectors

- RJs, SFFs
- LC-Rs, LC-Ts,
- Complex & Simplex Cable Assemblies

Cameras & Data Recorders

- RJs, RCPs,
- Simplex Jumpers
- Panel Mount Transceivers

Fiber Optic Backbones

- SFFs, RJs, SPOT
- HD Cable Assemblies

Military Tactical Applications

Mission Computers

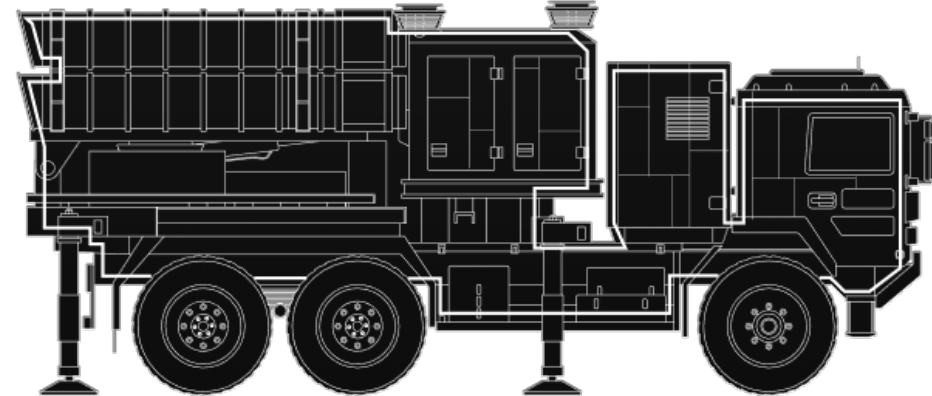
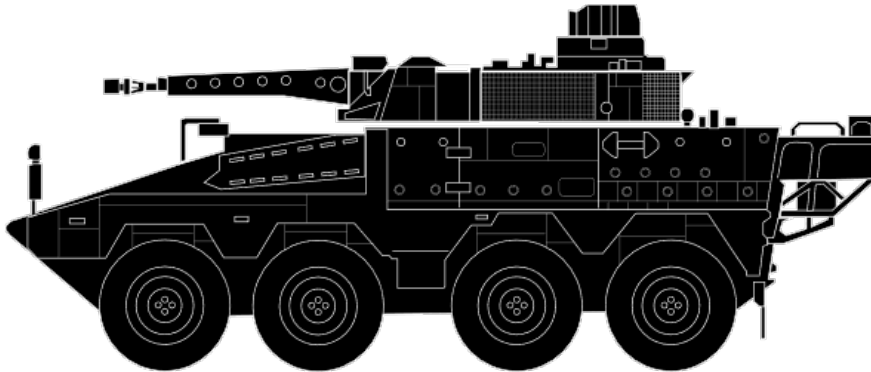
- RCPs, RJs, SFFs
- LC-Rs, LC-Ts,
- Complex Cable Assemblies
- Panel Mount Transceivers

Sensors

- RJs, RCPs, SFFs
- Simplex Cable Assemblies
- LC-R termini
- Optical Multiplexers
- Panel Mount Transceivers

Displays

- RCPs, RJs
- Complex Cable Assemblies
- Panel Mount Transceivers



Command & Control

- Complex Cable Assemblies
- All Transceivers
- Custom Potted Solutions
- Ethernet Switch
- Panel Mount Transceivers

Switches & Data Concentrators

- RJs, SFFs
- LC-Rs, LC-Ts,
- Complex & Simplex Cable Assemblies
- Ethernet Switch
- Panel Mount Transceivers

Cameras & Data Recorders

- RJs, RCPs
- Fiber Cabling
- Panel Mount Transceivers

Fiber Optic Backbone

- SFFs, RJs, SPOT
- HD Cable Assemblies
- Panel Mount Transceivers

Radar Applications

Sensors

- RJs, RCPs, SFFs
- Simplex Cable Assemblies
- LC-R termini
- Optical Multiplexers
- Panel Mount Transceivers

Large Area Displays

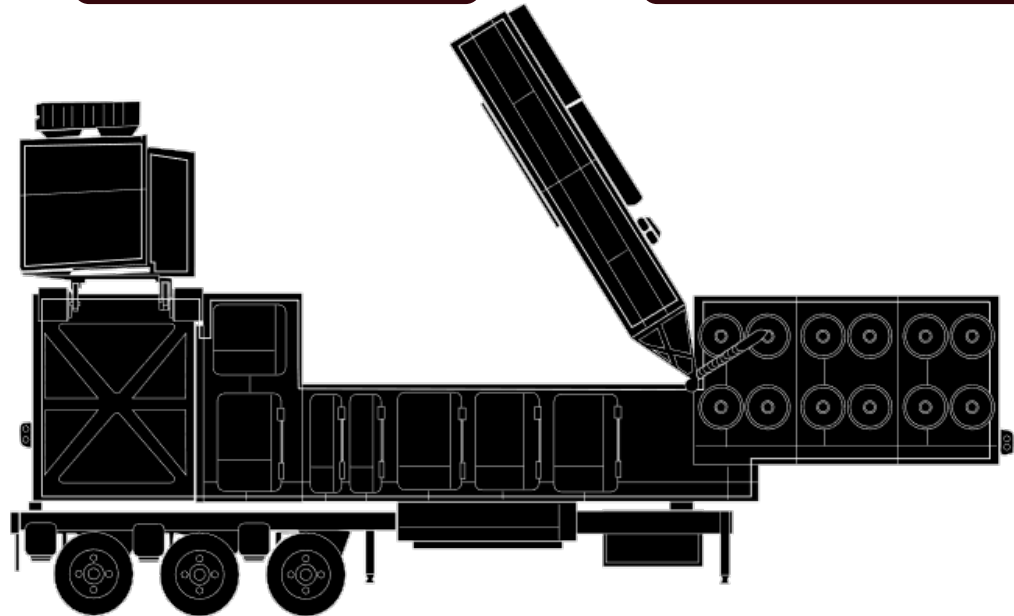
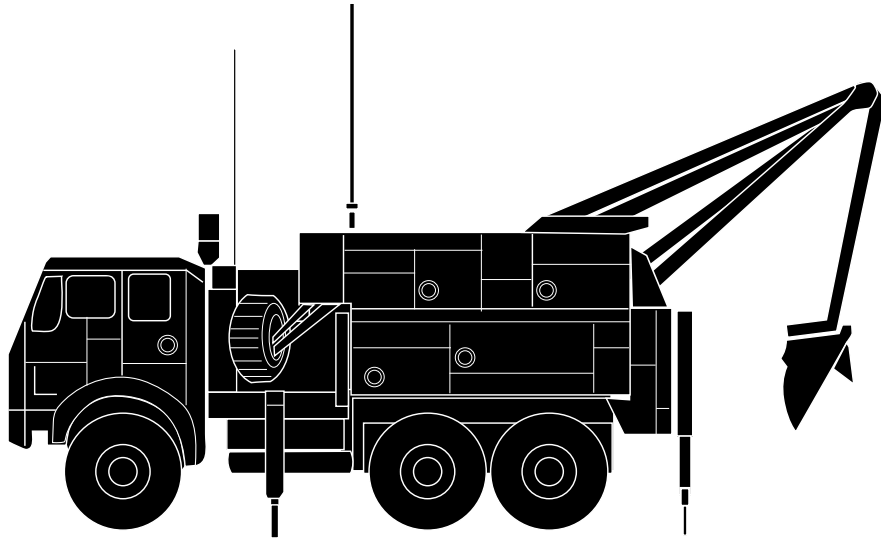
- RJs
- Complex Cable Assemblies
- Panel Mount Transceivers

Fiber Optic Rotary Joint & Wave Division Multiplexers

- DWDMs, CWDMs
- MUX

AESA Radars

- RJs
- Complex Cable Assemblies
- Panel Mount Transceivers



Switches & Data Concentrators

- QSFPs, SFPs, HD
- LC-Rs, LC-Ts,
- Complex & Simplex Cable Assemblies
- Ethernet Switches
- Ethernet Media Converters

Fiber Optic Backbones

- HD Transceivers
- HD Cable Assemblies
- Panel Mount Transceivers

System Displays

- SFFs, SFBs
- Simplex Fiber Optic Jumpers
- LCs to ARINC 801s
- Panel Mount Transceivers

Subsea Networking Applications

Sensors

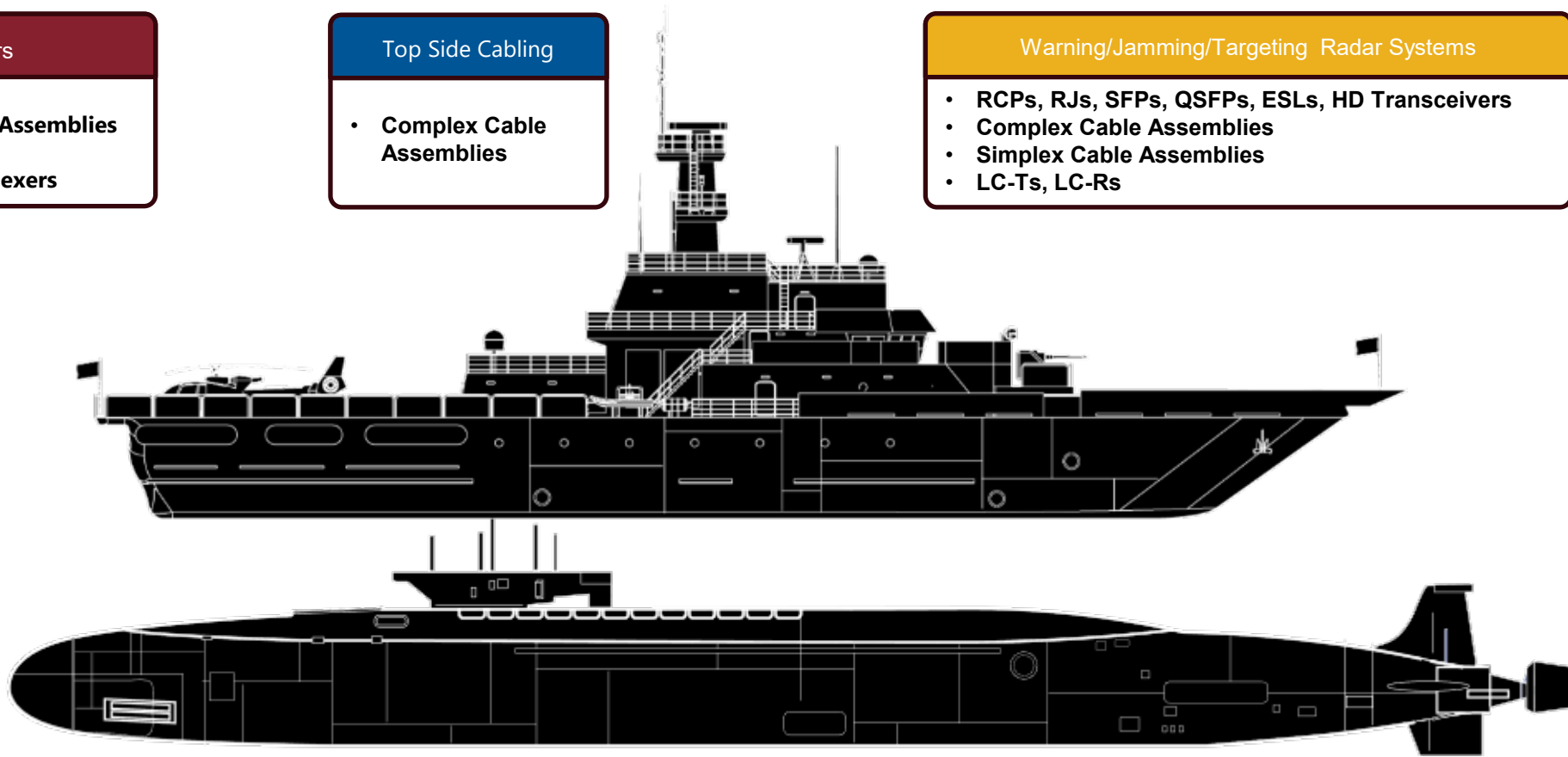
- RJs, RCPs, SFFs
- Simplex Cable Assemblies
- LC-R termini
- Optical Multiplexers

Top Side Cabling

- Complex Cable Assemblies

Warning/Jamming/Targeting Radar Systems

- RCPs, RJs, SFPs, QSFPs, ESLs, HD Transceivers
- Complex Cable Assemblies
- Simplex Cable Assemblies
- LC-Ts, LC-Rs



Towed Array

- SFBs, SFPs
- Custom Transceivers
- Complex Cable Assemblies

Camera

- RJs, WDMs, BiDis, SFPs
- Complex Cable Assemblies

Remote Switches & Data Connectors

- RJs, SFFs
- LC-Rs, LC-Ts
- Complex & Simplex Cable Assemblies
- Ethernet Media Converters

Fiber Optic Backbone

- SFFs, RJs, HD Transceivers
- HD Cable Assemblies

Summary



Worldwide manufacturer

Critical applications

*70+ years of heritage in
the aerospace and defense markets*

*Dedicated, talented, innovative people
across all disciplines*

*Prioritizing social
and environmental responsibility*

Committed to our customers, partners, employees, and planet

Company Information

Quality System:

ISO 9001:2015 + AS9100:D CERT-0136100

ATEX Compliant, OP IS

S20.20 ESD program

J Standard electronic parts work

Compliant to FAR 52.204-2, DFARS 252:204-7012

NIST 800-171 Compliance in process



Aerospace and Electronics
Industry Quality Standards



FDA/CDRH Laser Safety Test
and Manufacturing Support



International Traffic in
Arms Regulations



ESD handling and Facility Testing,
Operation, and Certification



Harsh environments including
Oil and Gas compliance



Foreign Object Debris Procedures,
Auditing, and Training

Company Information:

EIN/Tax ID: 20-4055028

Vendor License: 18-90016

CAGE Code: 49T62

ECCN: EAR99

ITAR: M37737

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