



Bird[®]

RF Cable & Antenna Analyzer Family
SiteHawk/FlightHawk/RailHawk

Agenda

Introductions

Applications

Target Markets

Target Customers

Product Specification

Sales Tools



About: Expanding on the success of our Sitehawk Cable and Antenna platform we will discuss the launch of two new kits specifically designed to address the needs of the Aviation and Railway market. We will review product kit contents, applications, market segments and review potential customer personas for each product

Michelle Specht-Product Manager for Test & Measurement, Performance products

- Over 20 years experience as Product manager and Engineer in Aerospace, Automotive Tools, Outdoor Power Equipment and RF Test & Measurement
- Bachelor's degree in Aerospace Engineering
- Responsible for product planning and strategy for Bird's Performance Products Portfolio: RF Analyzers, Power Meters and Monitors, Attenuators/Loads, Power sensors

Gregg Moffett-Applications Engineer for Bird's Test & Measurement Products

- Bachelor's degree in Engineering Technology
- Over 15 yrs. with Bird and prior 24 yrs. at FMC Smith Meter

Joel Meltzer-Agile Engineering Manager, Bird's Test & Measurement Products

- Bachelor's degree in Applied Physics/Masters of Science in EE
- Engineering field for 28 years with prior involvement in Acoustical & Systems Engineering.
- Joel has been with Bird for over 22 years supporting the research and development of diverse products including RF loads and attenuators, RF analyzers, power meters & sensors, RF capture & playback and Booster/DAS systems.



SiteHawk Overview



SiteHawk-Base line of all our Cable and Antenna Analyzers

- 2 models available: SK-4500-TC (1-4500MHz) or SK-6000-TC (1-6000MHz)
- Frequency Domain Reflectometer compact, self-contained and user-friendly
- Provides rapid diagnosis of antenna, combiner and transmission line problems
- Visual display of VSWR, Return Loss, Cable Loss and Distance-to-Fault
- Long battery life, typically 10 hours between recharges
- Also functions as precision RF power meter with optional sensor
- 3-year warranty

DATA Handling

- USB, WIFI and Bluetooth interfaces, for sharing files with other devices
- Scans can be exported at CSV (for analysis in Excel, for example)
- Screenshots can be exported as jpg or png



SK-4500-TC

SK-6000-TC

Key Features of SiteHawk Analyzers



Features

Measure/Match – Frequency Response

- Results in a highly reliable assessment of the health of critical components in your system.

Cable Loss

- Measures Insertion Loss of the cable system over a given frequency range.

Fault Location or DTF mode

- Indicates VSWR or Return Loss levels at each point along the cable and antenna system length

Applications

- Cellular Networks 3G, 5G (2.4, 4.2 GHz & 600, 850 MHz)
- PCS/DCS, CDMA, GSM and LTE Protocols
- Broadcast
- Paging
- Government
- Tactical Military
- Microwave
- Public Safety
- Trunking, TETRA
- Network Coverage WLAN, WLL (802.11)

Why do I need a Cable and Antenna Analyzer?



System Commissioning

- Antenna system commissioning is a process whereby faults and potential faults are eliminated before they compromise the system, prior to the system being put into use. It is structured and methodical, but also thorough, with the goal of having 100% system uptime for effective communications.

Troubleshoot Existing Antenna Systems

- When there is a problem, quickly read the system and determine where the problem is.

Preventive Maintenance

- Perform sweeps, and compare to the sweeps saved during commissioning, to see where changes may have occurred and fix potential problems before they take the system down completely.



Other Uses-501XD Wideband Sensors

SiteHawk – use as a RF Power Meter with preinstalled RF Meter App

- Bird 501xD Wideband Power Sensors
 - Connect to USB Port of SiteHawk SK-4500 or SK-6000

6 versions:

- 5012D, 350MHz to 4GHz, 150mW to 150W average, 400W peak
 - 5016D, 350MHz to 4GHz, 25mW to 25W average, 60W peak
 - 5017D, 25MHz to 1000MHz, 500mW to 500W average, 1.3kW peak
 - 5017D-AV, 100MHz to 1300MHz, 500mW to 500W average, 1.3kW peak
 - 5018D, 150MHz to 4GHz, 100mW to 25W average, 60W peak
 - 5019D, 25MHz to 1000MHz, 100mW to 100W, 260W peak
-
- 5017D-AV is aimed at the Aviation market and covers all frequencies from VOR (108-118MHz) to TACAN and DME (900MHz to 1.3GHz)
-
- **NIST traceability** ensures power-meter **accuracy to 4%**



Other Uses – 7020 Power Sensors

SiteHawk – use as a RF Power Meter with preinstalled RF Meter App

- Bird 7020 RF Power Sensors
 - Connect to USB Port of SiteHawk
 - USB interface to SiteHawk

2 versions:

- 25MHz to 1GHz (part number 7020-1-030301) for Land Mobile Radio frequencies
- 350MHz to 4GHz (part number 7020-1-010101) for Cellular frequencies
- 150mW to 150W for the Cellular / LTE version
- 500mW to 500W for the LMR version
- NIST traceable accuracy to 4%



Sales Tools



SITEHAWK™
Cable & Antenna Analyzers

SK-4500-TC, SK-6000-TC

No More Swapnostics!

The SK-4500 and SK-6000 provide critical coverage with a wide frequency range from 1 MHz to 6000 MHz.

Discontinuities can be a real problem and cause significant reflections by damaged cables, loose or improperly installed connectors, and environmental factors.

With Bird's DTF (Distance to Fault) mode, SiteHawk finds the exact location of the problem "in true distance units".

Eliminate wasted time swapping out components until you determine the issue. Save critical time, components, and money by correctly identifying issues the first time to efficiently direct vital resources to implement solutions.

3 YEAR WARRANTY

PRODUCT FEATURES

- Test RF cables and antennas at the frequency of operation.
- Locate RF cable, connector and antenna problems at the source.
- FDR (Frequency Domain Reflectometry) measurement method results in a highly reliable assessment of the health of critical components in your system; ultimately providing a "heads-up" before a failure occurs.
- Fault location or DTF mode plots VSWR or Return Loss levels at each distance point along the cable and antenna system length.
- Cable Loss function measures insertion loss of the cable system over a given frequency range.
- OTG USB communication port for connection to Bird power sensors, storage devices and battery charging.

APPLICATIONS

- Cellular Networks 3G, 5G (2.4, 4.2 GHz & 600, 850 MHz)
- PCS/DCS, CDMA, GSM and LTE Protocols
- Broadcast
- Paging
- Government
- Tactical Military
- Microwave
- Public Safety
- Trunking, TETRA
- Network Coverage WLAN, WLL (802.11)

Prospecting Toolkit

- Datasheet
- Training Webinar
- Outbound Marketing
 - Target Advertising



Customer Meeting Tools

- Product Overview Presentation
- Application Notes
- Product Demos

WebEx Training

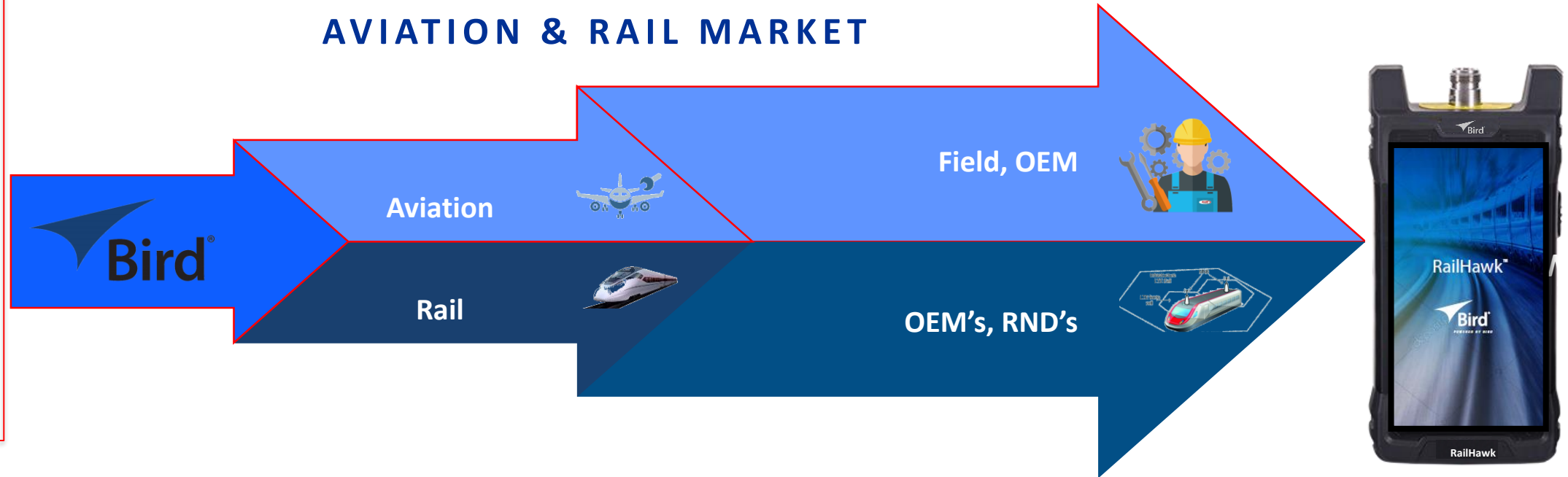
- Cable & Antenna Measurement Basics
- All about Distance to Fault Measurements



Bird[®]

**FlightHawk Aviation RF Cable & Antenna
Analyzer**

AVIATION & RAIL MARKET



SALES PLAN

To provide a total solution to the market, integrating complimentary Bird products.

Markets

Target Aviation and Rail Markets

End-Users

There are two distinct end-users –

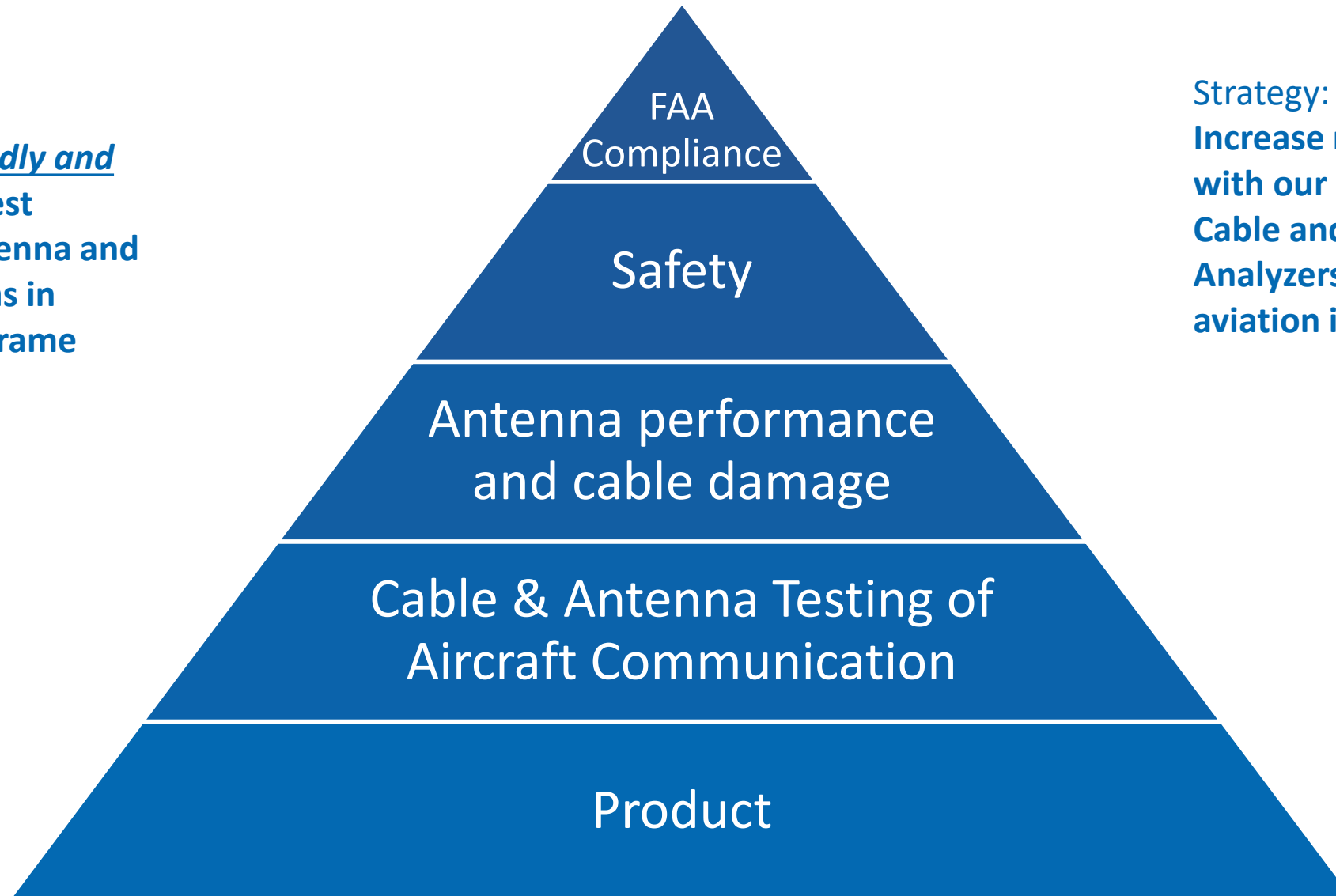
- Field application
- OEM's (Original Equipment Manufacture)

What is the Application

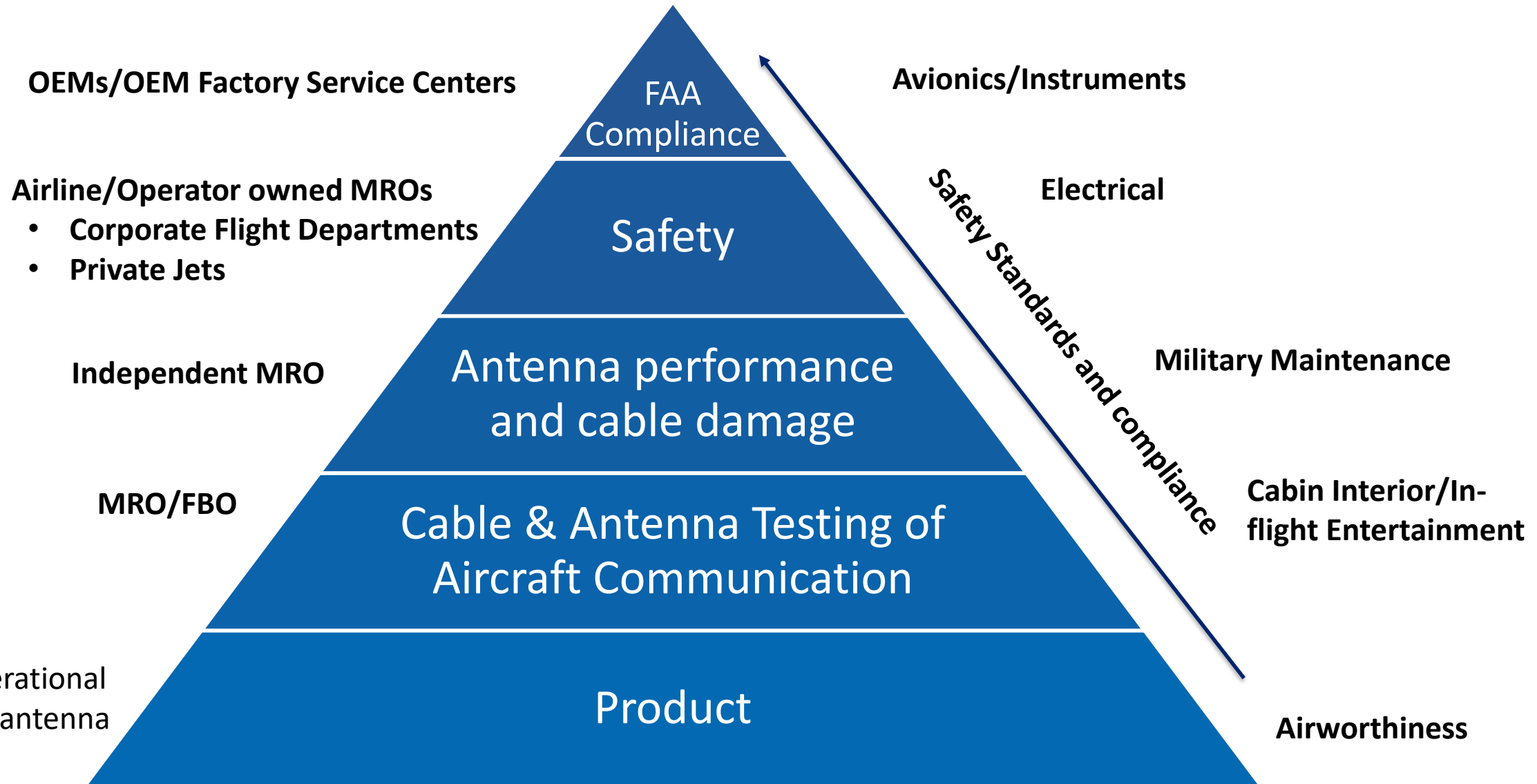


Application:
Need to rapidly and accurately test multiple antenna and cable systems in complex airframe systems

Strategy:
Increase market share with our SiteHawk Cable and Antenna Analyzers with the aviation industry



Who are the Customers?



Key Target Customer Segments

Primary target:
MRO's with Avionics
departments

Independent MRO's

- Independently Owned and service the entire aviation sector, general to OEM outsourcing

Airline/Operator
owned MROs

- Corporate Flight Departments
- Private Jets

OEMs Factory Service
Centers

What is an MRO?

Maintenance, Repair, Overhaul (**MRO**) facilities that repair, service or inspection an **aircraft** or **aircraft** component. It is essentially all the maintenance activities that take place to ensure safety and airworthiness of all aircrafts by international standards

MRO List By Type

Targeting MRO's and FBO's
increases opportunity

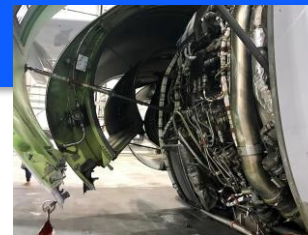
Avionics/Instruments



Cabin Interior/In-flight
Entertainment



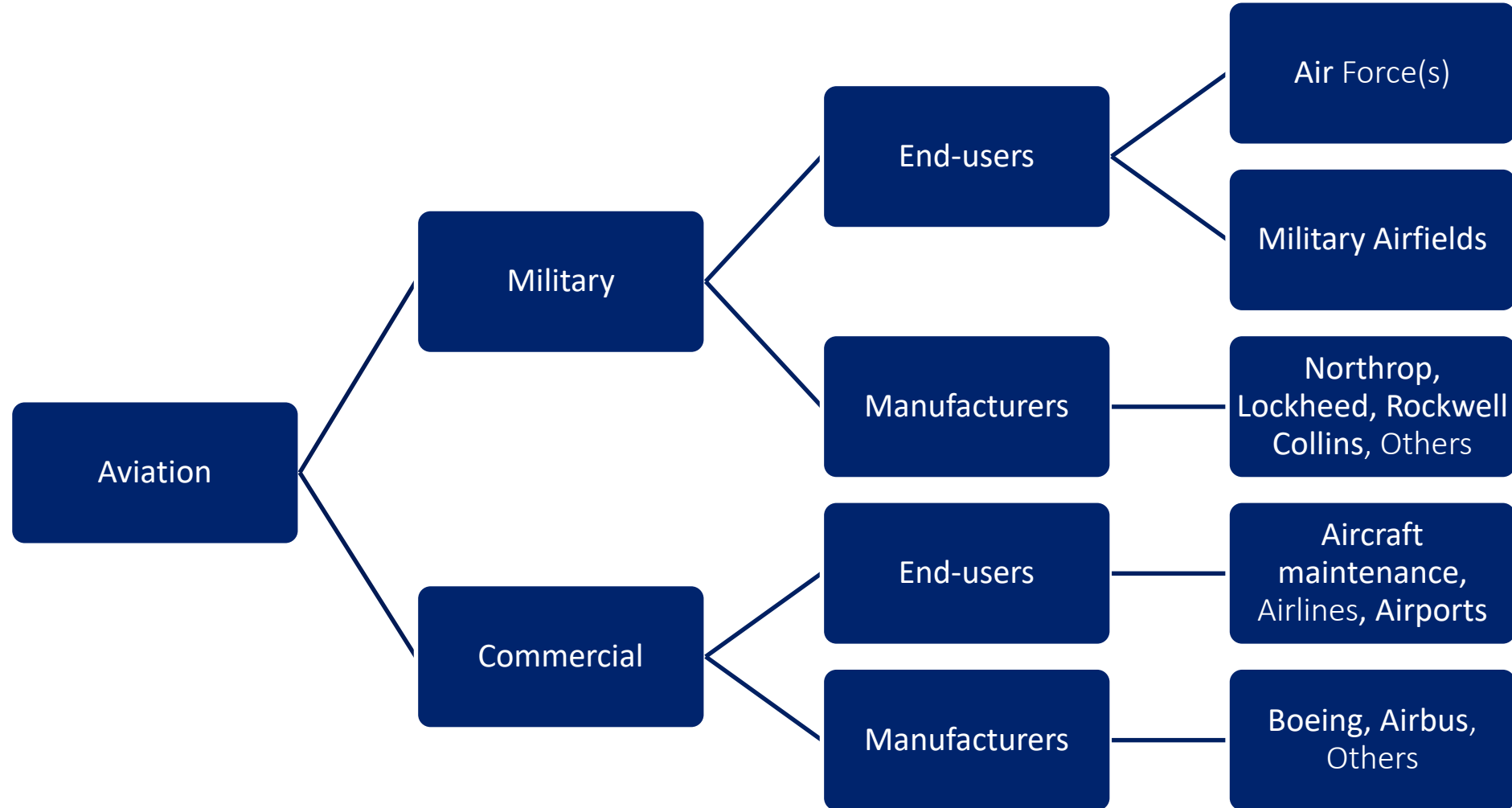
Military Maintenance

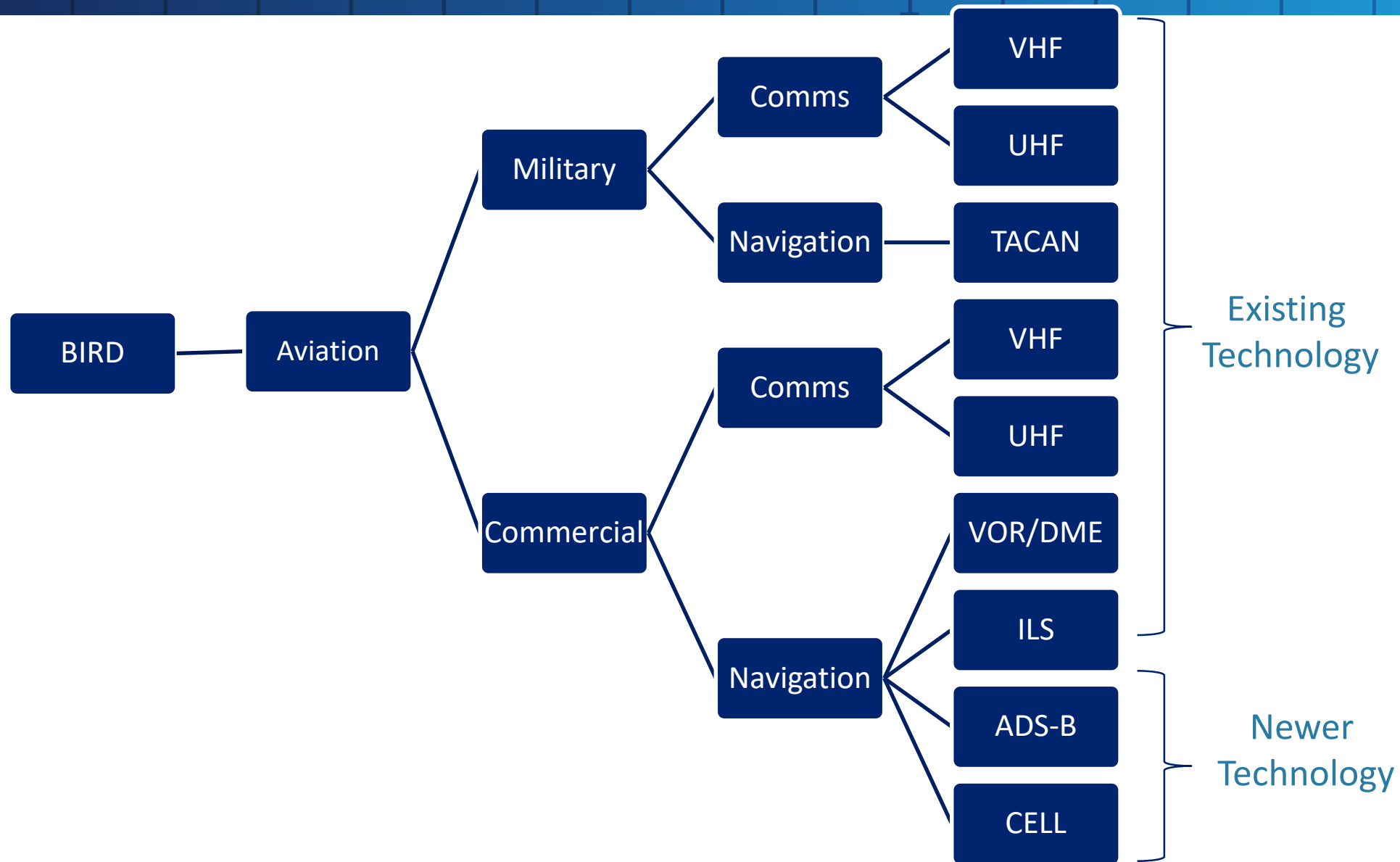


Electrical



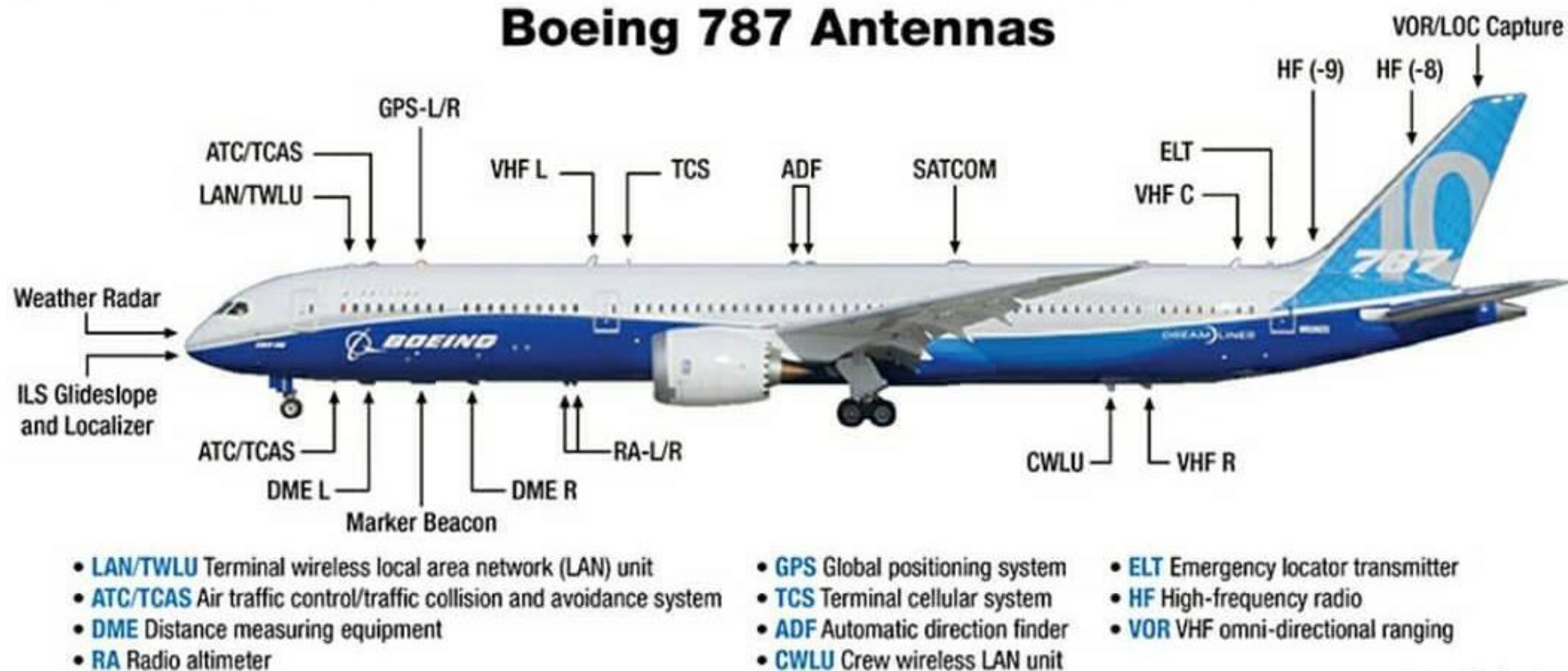
Strategic Customers: Aviation





Aeronautical Communications

The problem – how to *rapidly and accurately* test multiple antenna and cable systems in a complex airframe.



Source: Boeing

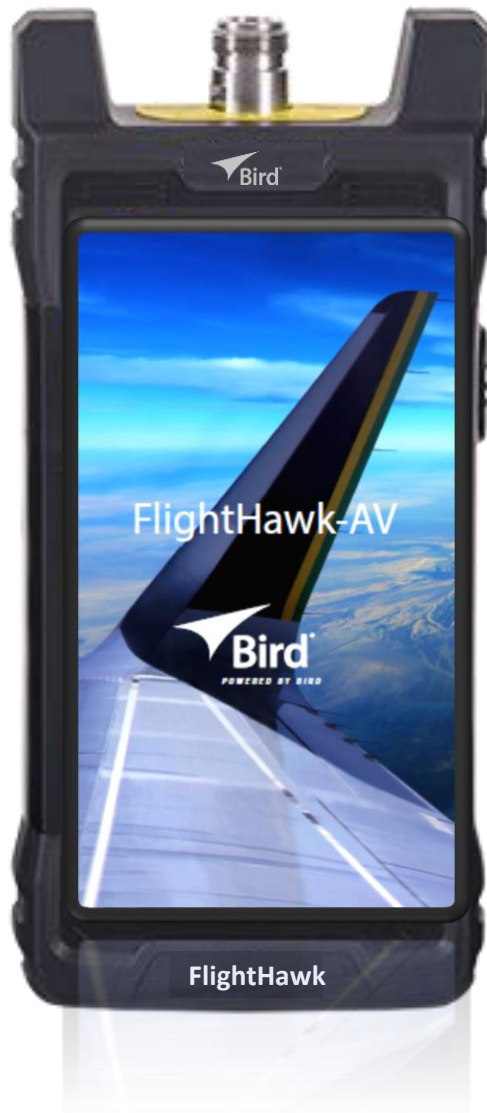
Types of Aviation Radio Signals



- **Low Frequency (LF)**-200 KHz to 415 KHz
 - Today, some low frequency beacons remain and are used for instrument landings
- **Medium Frequency (MF)**
 - Aviation radio is allocated a small portion of the medium frequency spectrum in a band from 2850 to 3000kHz
- **High Frequency (HF)**
 - High frequency continues to be used for voice communications for international flights
- **Very High Frequency (VHF)**
 - Operating in the 118.000 to 136.975 MHz band.
 - Aviation Terminal VOR and ILS Navigation
 - Aviation VOR Navigation
 - Aviation Communication



What are we doing?



Created a specific aviation brand and new target audience for the current SiteHawk Product Family

Create a marketing brand that can be pursued with Bird's Channel partners and Reps

Increase market presence in aviation beyond the OEM providing increased opportunity without the Red tape and long sales cycle

Expand opportunity by pursuing MRO (Maintenance Repair Organizations) and FBO (Fixed Based Operation) aviation market

Partner with OEM Manufacturing (Boeing, Gulfstream, Airbus) for exclusive Aviation test data Currently. – Boeing 737,767,737**

Allows us to support OEM specific software without increased inventory and model numbers

** Sold Separately

FlightHawk Opportunity



Bird has an opportunity to increase market share with our SiteHawk Cable and Antenna Analyzers within the aviation industry

Past: Bird launched this initiative with Barfield Aviation in 2019.

Objective: Bird to pursue the aviation industry through MRO (Maintenance Repair Organization) and FBO(Fixed Based Operations)

Short term: Develop new branding, component specific kit to target within the aviation Industry

Long term: Expand the portfolio of aviation kits that will market well to that segment

Other opportunities: OEM (Boeing, Airbus, Gulfstream, etc.)

Aircraft Operators (Part 91, 119, 121, 129, 133, 135)

Federal Aviation Regulations-established set of certifications and operational rules

Part 91: rules for all flights in the US

- Generally private flying. That is, no flying an airplane with paying customers *unless* those customers are government officials on government business. This rare exception is called "public use"...

Example: A guy who owns a jet to fly around in (or a company that owns a plane for business use) can be Part 91 as long as they don't sell seats or cargo space to the general public.

Part 121: rules for flights by a US airline

- Scheduled commercial air service with paying customers. Planes are flown on defined routes as often as the operator wants.
- **Example:** This is where companies like Delta and American operate.

Part 129: rules for flights by a foreign airline in the US

Part 135: rules for 'on demand' (usually charter) flights by a US operator

- On-demand and scheduled charter.
- **Example:** When you call a company and say "take me (or my freight) from LA to NY" you are likely talking about a Part 135 unscheduled charter. "Scheduled" charter is allowed but is limited to a few days a week



The Differences



In avionics Boeing and Cessna both make aircraft, but their needs are not identical.

“But what are the differences between private and commercial aircraft when it comes to communications/RF systems? ”

- All aircraft operating in high traffic areas must be equipped with **two-way communication radios**.
- All require **ELT (Emergency Locator Transmitter) VHF/UHF Antenna** (Distress signal 121.5- and 243.0MHz)
- Private small aircraft require much less due to the regulations of the FAA
 - In general aviation, the most common types of radios are VHF
 - Rely on Navigational Aids 108-118MHz
- **Communication**
 - **Pilots use RF communication equipment** (radios) to constantly communicate during flights and after landing.
 - On Air After takeoff, **aircraft has to maintain contact** with air traffic controllers for flight directions, altitude and updates on weather conditions.
 - VHF range of RF spectrum (specifically 118 MHz to 137 MHz) used in commercial aviation.
 - **Navigation**-Satellite navigation systems like GPS technology is also used by military and commercial aircraft for precise location information and navigation.
 - **Radar**-make accurate measurements of distance from ground to flights and exchange the information with flight instruments with low latency.
 - **Entertainment**-Most airlines provide on-board Wi-Fi accessibility during flight for entertainment.

Introducing - FlightHawk



Bird's FlightHawk Cable and Antenna Analyzer is a frequency domain reflectometer (FDR), that will test and verify the antennas and cables in your RF system individually or as a complete system.

It can test for Return Loss/Voltage Standing Wave Ratio (VSWR), Distance to Fault (DTF), and cable loss (or insertion loss). The display is touchscreen and based on the Android operating system.

Key Measurements:

- Return Loss Measurements
 - VSWR
 - Distance to Fault
 - Cable Loss
 - Bluetooth and WIFI file transfer to PC
-
- Simplifying user experience of testing RF equipment for non-RF maintenance airline crews
 - Supports the airline industry and validates their critical radio and communication systems.



Commercial aircraft utilize numerous radio frequency (RF) systems, such as TCAS (Total Collision Avoidance System).

Currently, if these RF systems are not functioning, the operators (such as United, Delta, American, etc.) operate in a break-fix method.

- This means that parts are replaced without testing/diagnosing what the problem truly is. They are maintaining their aircraft in a reactive state.
- This is costly and time consuming.
- Airplane OEMs, such as Boeing, are working to move operators toward proactive maintenance. In order to achieve proactive maintenance, operators must equip their maintenance crews with tools allowing them to quickly and accurately diagnose a problem.
- For RF systems, Bird has leveraged our existing SiteHawk Cable and Antenna Analyzer and transformed it from a standalone product into a complete test solution for the aviation market segment.

Airline maintenance crews are not well versed in diagnosing and maintaining RF systems.

Bird's Aviation Solution:

Provide an aviation kit and software that allows mechanics, who know how to rebuild jet engines (not RF), to quickly and simply test all the RF systems within an aircraft.



Name: Tyler, Avionics Technician, President/Owner

Segment: Avionics Shop

Age: 52 years old

Education: Computer Science/Physics

Objective: Comply with Part 135 requirements for avionics inspections, RVSM Reduced Vertical Separation Minimum installations and inspections as well as Part 91 checks

This can be a personal mechanic purchase or a shop purchase. Tyler noted since he is the main Avionics repair technician, who would purchase for himself.



Persona-Tool Support

Name: Edwin, Material Supervisor

Segment: Independent Leaser

Age: 65 years old

Education: Business Administration

Support effective, efficient and safe aircraft maintenance through the management of allocation, procurement, repair, and distribution of materials.

This person maintains the equipment needed in the shop for scheduled aircraft maintenance repairs or AOG's.

Budgets yearly for equipment and is owned by the Company and used by several technicians



How would you use a FlightHawk?



Perform a health check of the Radio Frequency (RF) system's coaxial cable and antenna.

- Use a FlightHawk **to locate opens, shorts, improper crimps, bends, moisture, loose connectors and defective antenna elements that lead to weak or intermittent RF operation.** These issues change the system's impedance resulting in a reflected or standing wave
- **Utilize the FDR function to perform a VSWR(voltage standing wave ratio) test** by transmitting a continuous RF sweep of the cables and antenna at their operating frequencies and monitoring the absorption of the wave by the antenna.
- The FlightHawk is an **easy to use handheld tester**, with a Go/No-Go function by the use of a limit line and simple distant to fault measurement.
- **Identifies issues easily from the equipment rack, eliminating the need to disassemble the airplane to test the RF system.**
- Note that each antenna system has a designated Start/Stop frequency, System Operating Frequency and Maximum Voltage Standing Wave Ratio



What is being used today and the differences

What method does the FlightHawk use? What are the differences?

Time Domain Reflectometer (TDR)

produces a pulsed DC signal which is “inserted” into or sent down the line.

The pulse does not contain nearly as much power as the transmitter output, but the TDR is an extremely sensitive device able to detect low level signals.

Time Domain Reflectometers	Frequency Domain Reflectometers
Use DC pulse to test line, Connectors, etc.	Use radio frequencies to sweep system
Cannot check frequency specific components	Will check frequency specific components
Antennas	Antennas
Filters	Filters
Quarter wave lightning arrestors	Quarter wave lightning arrestors
Duplexers	Duplexers
Cannot “see” past a frequency specific component	Will “see” past a frequency specific component

Frequency Domain Reflectometer (FDR)

produces a test signal that uses radio frequencies.

Using the frequencies of operation, the FDR is able to look at each component in the system at its own operating frequency.

Key Takeaways:

Time domain reflectometers (TDR’s) are less expensive and much smaller, coming in hand-held packages, but **will not show frequency specific faults of components** operating well at DC frequencies, but not at higher frequencies.

Frequency Domain Reflectometer (FDR) use the frequencies of operation and look at each component in the system at its own operating frequency. **Faster and most efficient**

Win MS – Wire Network Monitoring Solutions

Aviation & Space



Aero Smart-R kit

The easiest tool to perform fast and accurate troubleshooting on electrical wiring systems.



Aero HD

Unique and fastest solution to test, inspect and diagnose HF/RF cables and antennas.



Aer'Optic

High resolution OTDR for aviation locating broken fibers, connector issues and more.

The Aero Smart R kit is an innovative tool providing quick and accurate diagnostics to troubleshoot complex wiring systems. Our solution can identify, detect and locate permanent or intermittent electrical faults as short/open circuits, bad connections or shield issues.

More functionality when identifying electrical wiring system problems

Base model starting at \$ 40,000



Kaelus Accessory Kit for iVA Cable & Antenna Analyzer



Basic kit for VSWR, Return Loss
Measurement & Distance to Fault

Display not included- PC Required
Limited data

Base model starting at \$ 2,700



Product Comparison



Included	SK-6000-TC	FH-AV-KIT
SK-6000	Yes	Yes
Cal Kit	Yes	Yes
Stylus	Yes	Yes
AC Adapter	Yes	Yes
RF Cable	1.0m	3.0m
USB Drive	Yes	Yes
USB Adapter	Yes	Yes
4240-401 Adapter Kit	No	Yes
Avionics Adapters	No	Yes
N(m) to SMA(f) Adapter	No	Yes
N(m) to SMA(m) Adapter	No	Yes
Soft Case	Yes	No
Hard Case	Yes	Yes** FOD
5017D-AV Sensor	No	Yes
25W load	No	Yes
Aviation Software Option Boeing	No	No

Please note the Boeing Aviation Software Option and the “Disabled” WIFI and BLE is at an additional charge and to be added as a line item to the order if the Customer chooses.

**FH-AV-CC case is specially designed to quickly determine if any parts (adapters, etc.) are not replaced in the case before closing the unit.

7003A001-SW-BOE Software, Aviation, Boeing List \$ 2580.00 (737/767/787)

7003A001-WD Wireless Disable, SiteHawk List \$ 200.00

Kit Specifics



Retail List \$ 8500.00



FH-AV-CC
FOD Design



5017D-AV
100MHz-13GHz



SK-CAL-MN-C6
Calibration Combo



25-T-MN
25W RF Termination



Including:
4240-401 Adapter Kit
4240-500-23, Adapter N(M) – SMA(M)
4240-500-10, Adapter N(M) – SMA(F)
4240-443, Avionics Adapter, Coax Plug to SMA Jack
4240-444, Avionics Adapter, 5 pin Coax Contact to SMA Jack

Optional:

7003A001-SW-BOE
7003A001-WD

Software, Aviation,
Wireless Disable,

Boeing Covers 737,767,777,787
FlightHawk

Automatic Software - Boeing



Bird is working with OEM providers like Boeing to create additional software for purchase that works on a Pass/Fail mode on specific aircraft and selected RF System.

This software allow any technician to quickly diagnose problems with the navigation system.

The automatic mode features Boeing 737,767 and 787 coax and antenna configurations.

Simple steps allow any technician with limited experience in cable sweeping to run a test on a specific system and retrieve a Simple PASS or FAIL.

If a FAIL occurs, you can quickly enter manual mode and perform a VSWR and DTF analysis.



Optional Purchase

When reviewing the buying cycle for a test & measurement product in Aviation Industry, there are 3 buying processes.

- **Technician purchase**-Most Airframe and Powerplant (**A&P**) mechanics and Avionic technicians will invest to increase productivity
- **Maintenance Supervisors**-Purchase to keep their hangar working efficiently and keep downtime at a minimum
- **Service Center** –Shop purchase to support AOG (Aircraft on Ground)



- Introductory questions-Talk about them, what type of Aircraft do they service?
- How many aircraft do you service monthly?
- How do you currently test for Cable & Antenna failures?
- Do you do repairs and installations for Antenna systems?
- Would you be interested in a solution which simplifies the specific needs of your industry?



Sales Tools

FLIGHTHAWK™
Aviation RF Cable & Antenna Analyzer

FH-AV-KIT

Minimize AOG Downtime

Avoid the Aircraft on Ground (AOG) downtime and expense that results from trial and error testing and component swapping.

Bird's FlightHawk™ RF Aviation Test Kit combines a unique set of components specifically designed for avionics testing and measurement. In a single rugged case, the kit includes the proven antenna and cable testing functionality of the FlightHawk™ handheld analyzer, Bird's wideband power sensor – designed specifically to test aircraft RF systems and power measurement, and all necessary adapters and cabling. In addition, Bird's easy to use aviation testing software will allow anyone on the maintenance team to test and verify all antenna systems in the fleet.

The Aviation Test Kit offers an intuitive user experience for both experienced and beginner RF maintenance crews. Based on aircraft OEM specifications, technicians can locate RF cable, connector and antenna problems at the source with clear visual indicators as to the pass/fail status of the system.

PRODUCT FEATURES

- Test RF cables & antennas at the frequency of operation
- Locate RF cable, connector & antenna problems at the source
- FDR (Frequency Domain Reflectometry) measurement method results in a highly reliable assessment of the health of critical components in your system, ultimately providing a "heads-up" before a failure occurs
- Fault location or DTF mode plots VSWR or Return Loss levels at each distance point along the cable and antenna system length
- Cable Loss function measures insertion loss of the cable system over a given frequency range
- OTG USB communication port for connection to Bird power sensors, storage devices and battery charging

CRITICAL MEASUREMENTS

- FDR trace of precision return loss vs. frequency
- Return loss vs. distance
- Voltage standing wave ratio (VSWR)
- Cable loss and distance-to-fault (DTF) measurements

Includes the Bird RF Meter App!



3 YEAR Warranty



Prospecting Toolkit

- Datasheet
- Training Webinar
- Outbound Marketing
 - Target Advertising

Points of Differentiation

- Questions to Ask
- Competitive Selling Guide
- Sales Video



Customer Meeting Tools

- Product Overview
- Data Sheet
- Application Notes
- Product Demos
- WebEx Training

Get to know the Industry



Here are some good organizations and publications to follow:

<https://aea.net/AvionicsNews/>

<https://marketplace.aviationweek.com/>

<https://www.globalair.com/directories/Repair-31.html>

<https://www.aviationtoday.com>



Carriers of Operation

- Part 91 General Operating and Flight Rules
- Part 119 Certification of Air Carriers and Commercial Operators
- Part 121 Domestic, Flag, and Supplemental Operations.
- Part 129 Foreign Air Carriers and Foreign Operators of U.S. Registered Aircraft Engaged in Common Carriage.
- Part 133 Rotorcraft External-Load Operations
- Part 135 Commuter and On Demand Operations and Rules Governing Persons On Board Such Aircraft.

- **FOB(Fixed-base operator)**-is an organization granted the right by an airport to operate at the airport and provide aeronautical services such as fueling, hangaring, tie-down and parking, aircraft rental, aircraft maintenance, flight instruction, and similar services. In common practice

- **MRO(Maintenance and Repair Organization)**-a company which specializes in performing maintenance actions on aircraft and their components, such as jet engines and landing gear.
 - MRO must have proper certificates which allow it to perform certain tasks on aircraft in accordance with their approval schedule.
- **TACAN**-Tactical Air Navigation System
- **ADS-B** Automatic Dependent Surveillance Broadcast

MRO & COVID-19: Dealing With Parked Or Idle Aircraft & Engines



QUICKPOLL

The biggest maintenance challenge to having thousands of aircraft parked temporarily due to COVID-19 is:

Select one of the following:

- ☐ Maintaining the aircraft where they're parked
- ☐ Regulatory requirements to maintain airworthiness
- ☐ Supply chain shortages, difficulty of getting parts
- ☐ Managing fleets with paper instead of digital tools

Poll in progress for attendees only.

Submit



QUICKPOLL

The biggest maintenance challenge to having thousands of aircraft parked temporarily due to COVID-19 is:

Poll Results:

Maintaining the aircraft where they're parked	44%
Regulatory requirements to maintain airworthiness	26%
Supply chain shortages, difficulty of getting parts	26%
Managing fleets with paper instead of digital tools	4%

Something to think about

Stored airplanes during significant downtimes are susceptible to corrosion, rodent damage to wires and general deterioration

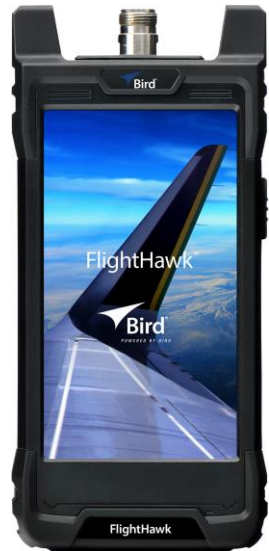




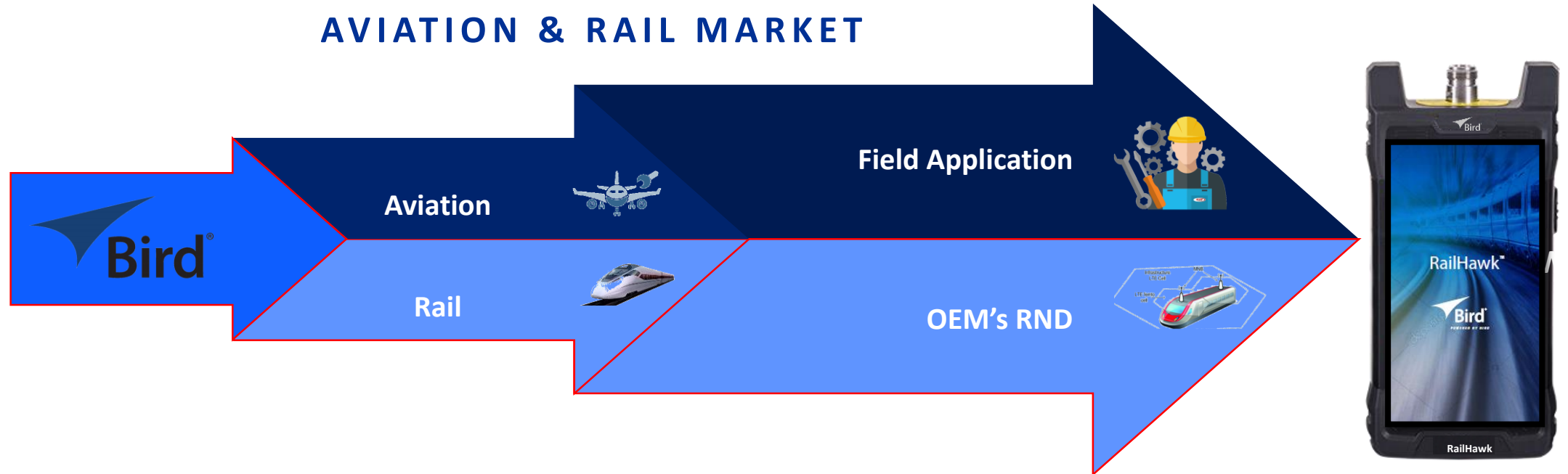
Bird[®]

**RailHawk Railway RF Cable & Antenna Analyzer
Coming Soon**

Aviation/Rail Plan



AVIATION & RAIL MARKET



SALES PLAN

To provide a total solution to the market, integrating complimentary Bird products.

Markets

Target Aviation and Rail Markets

End-Users

There are two distinct end-users –

- Field application end-users and
- OEM's RND(Railroads for National Defense)

What is the Application

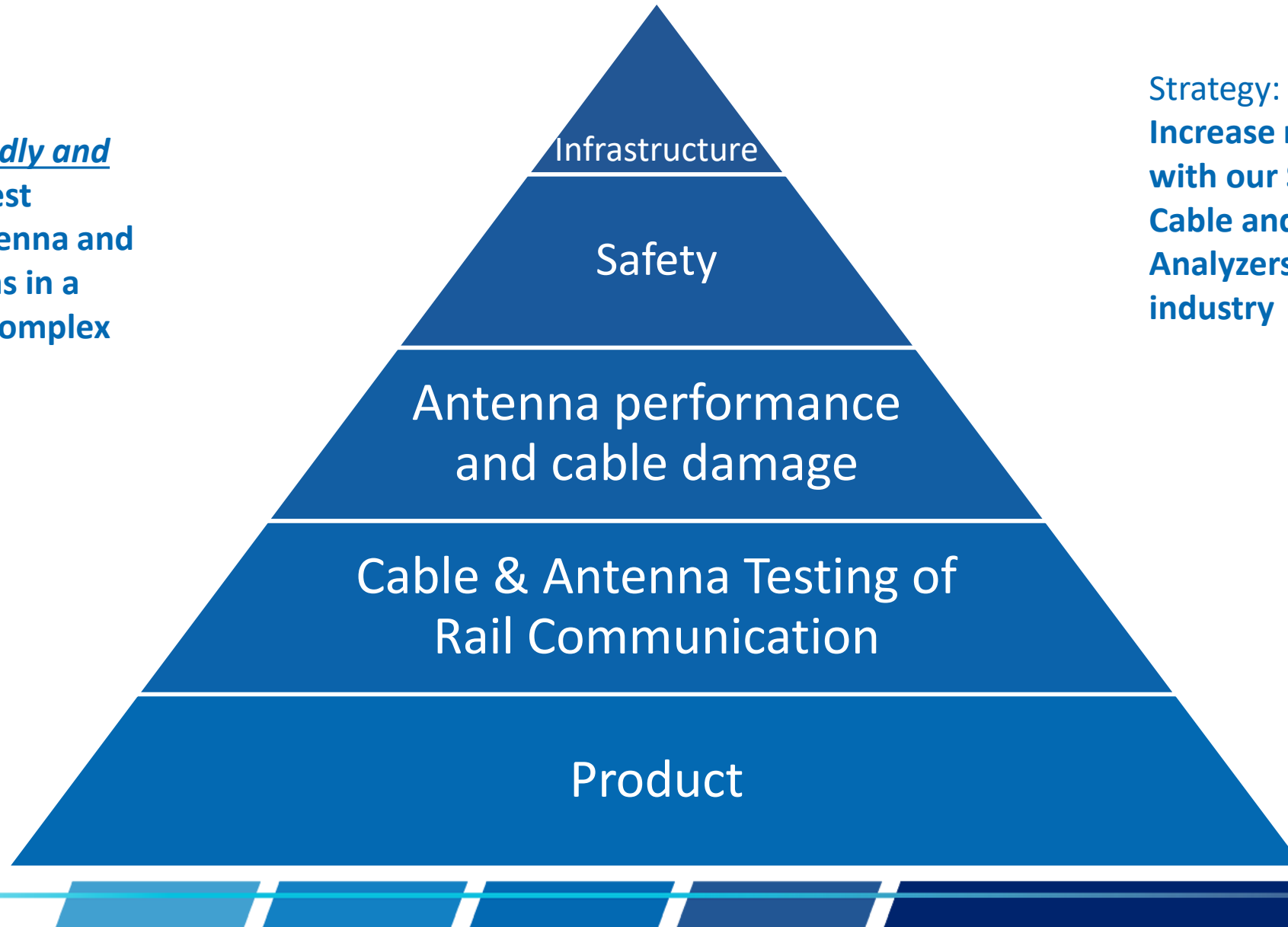


Application:

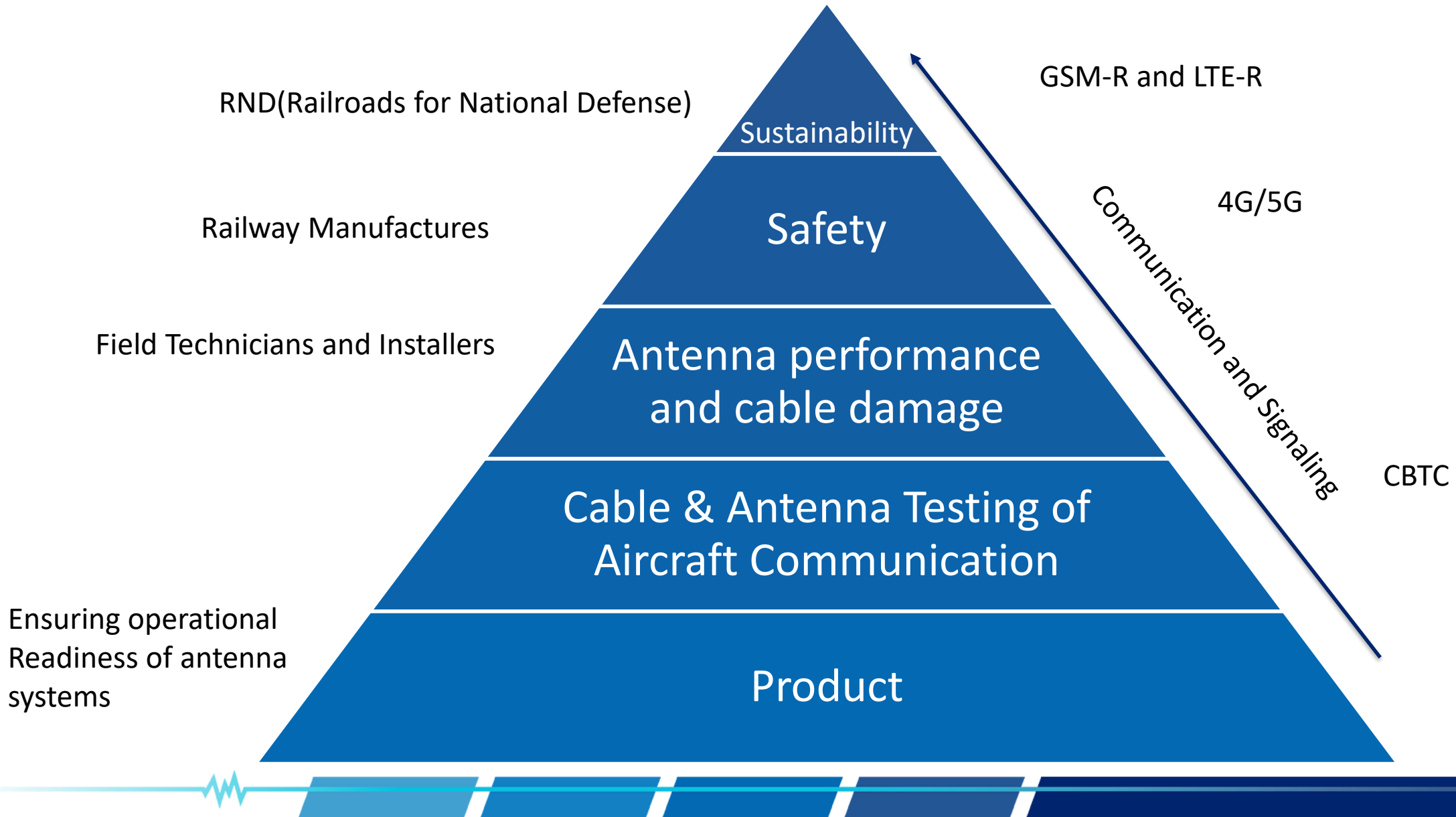
Need to rapidly and accurately test multiple antenna and cable systems in a simple and complex rail systems

Strategy:

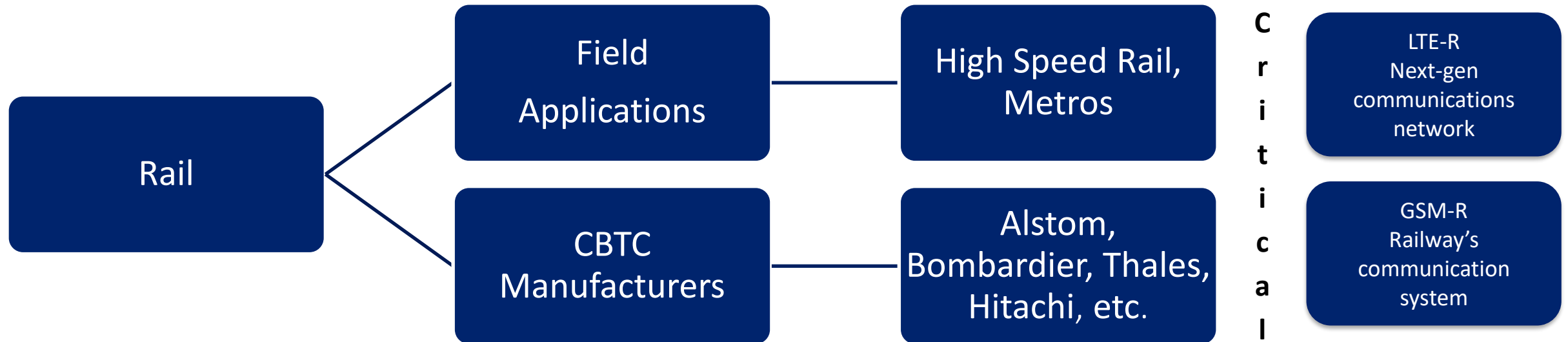
Increase market share with our SiteHawk Cable and Antenna Analyzers with the Rail industry



Who are the Customers?



Strategic Customers: Rail



Issues facing the railway industry:

Smart railway systems require the use of critical communications for operation and control, and to improve performance, reliability, and passenger experience. However, rain, snow and extreme temperatures can cause transponders to fail, cables to experience water ingress and antennas to be damaged from objects thrown from the rail bed.

- Trouble shooting RF issues in critical communication systems
- Test RF components prior to installation or existing cables and antennas.
 - Positive Train Control system
 - Train-to-Infrastructure communication systems
 - Inter-wagon communications
- Antenna design for current communications bands (1–6 GHz), mainly for critical communications and for future mmWave bands (24–34 GHz) for passengers and payload

Bird's Railway Solution:

Provide a railway kit that allows technicians, to maintain high quality of service networks is based on the use of redundant communications to increase reliability and maintainability.



Name: Marvin, Electronic Technician Foreman

Segment: Union Pacific

Age: 39 years old

Education: BS Electronic Systems

Objective: Responsible for overseeing installations, assemble, repair, adjust, test, and maintain telecommunications equipment such as wired and wireless telecommunications systems devices, microwave, automatic equipment identification(AEI) systems, IP Networks, VoIP, Cameras, Radio Frequency (RF) Communications systems, Voice & Data communications, front and end of train devices, and soldering electrical/electronic components.



Situation: Rail Customer installing new cab radios: Why?

- Their previous radio was a PTT-over-Cellular device for GSM-R
 - Wanted to reduce interference to the GSM-R communications as trains pass GSM sites
 - Facilitate new applications for example using train-mounted accelerometers and real time monitoring with new LTE-R data bandwidth.
- **Goal:** Identifying a suitable antenna and cable tester and re-writing the installation instructions based on the new test instrument.
- **Results:** Tested the SK-4500 with various antennas and now is written in the installation manual.

Wireless Communications for Rail

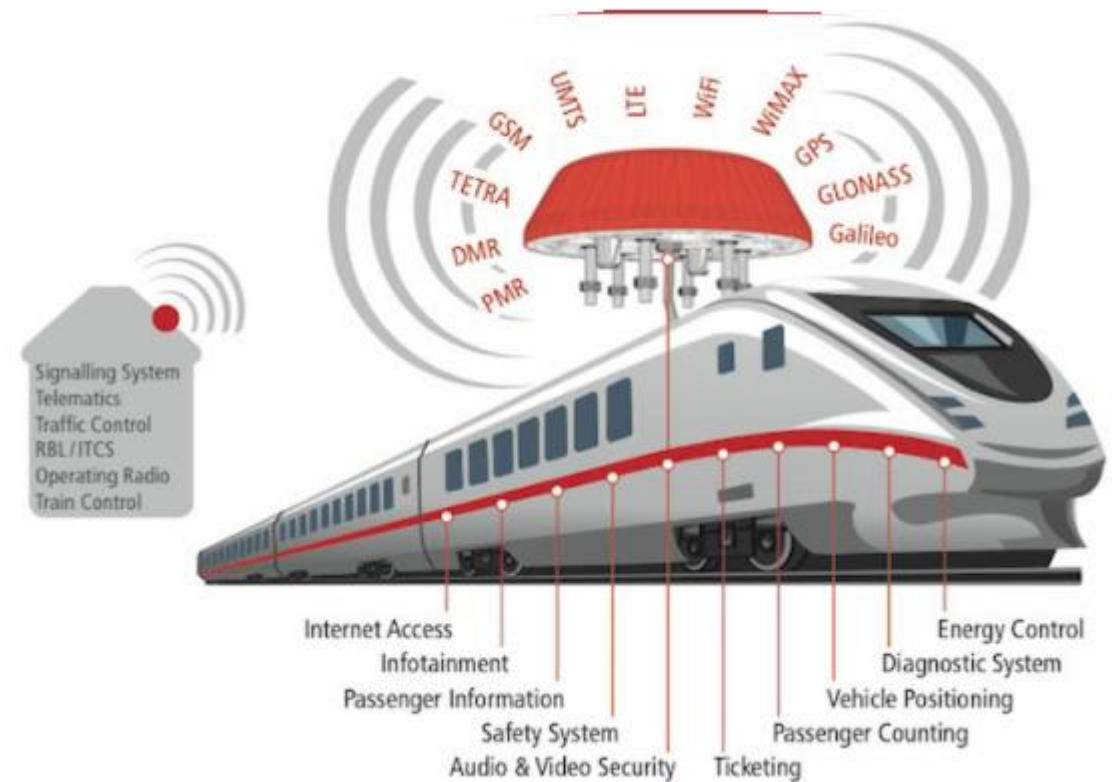
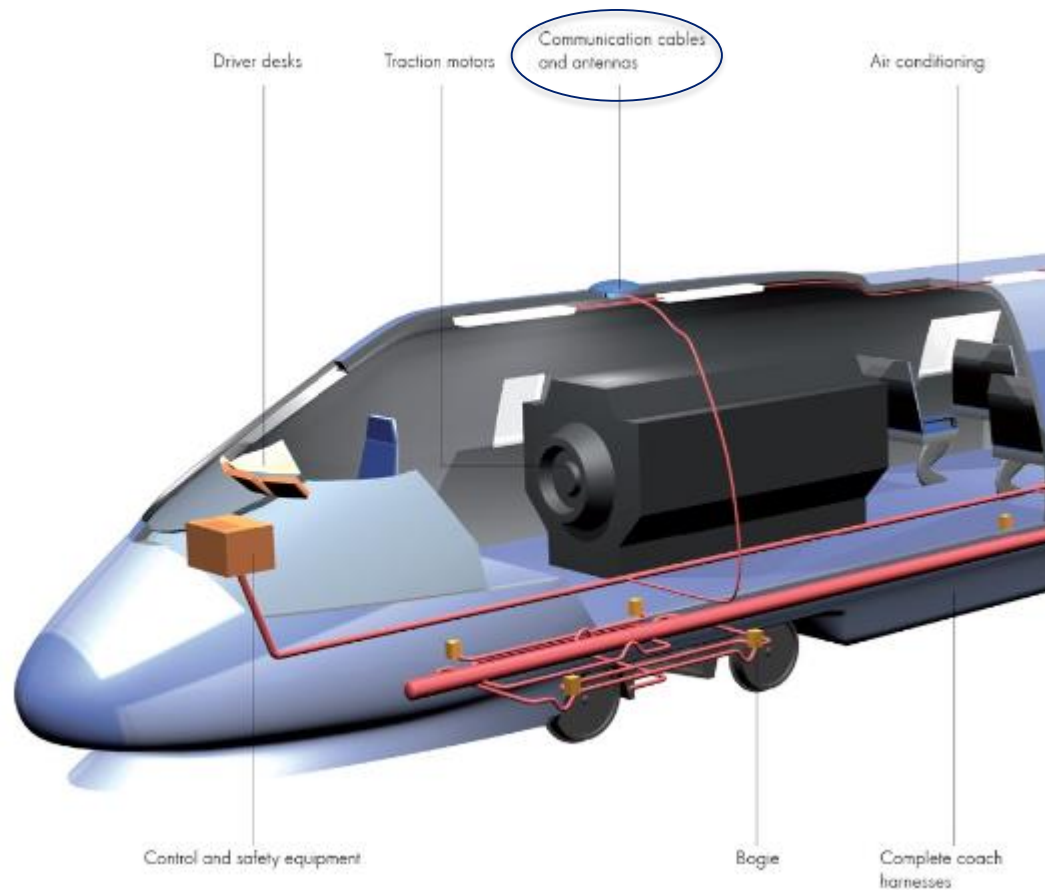


Example of different wireless communications systems customized for critical and noncritical communications.

Parameter	Critical		Noncritical		
	GSM-R	LTE-R	LTE	WLAN 802.11xx	Satellite
Frequency	Uplink: 876–880 MHz downlink: 921–925 MHz	450 MHz, 800 MHz, 1.4–1.8 GHz	800 MHz, 1.8 GHz, 2.6 GHz	2.4/5.7 GHz, 24/28/33 mmW	12/14 GHz
Bandwidth	0.2 MHz	1.4–20 MHz	1.4–20 (100) MHz	80 (160) MHz	10–16 MHz
Modulation/multiple access	GMSK	QPSK	M-QAM	M-QAM	QPSK
	FDD + TDM	FDD + OFDM	FDD + OFDM	TDD + OFDM	FDD
Peak data rate, downlink/uplink	172/172 Kbps	50/10 Mbps	100/50 Mbps	433.3 Mbps	10/1 Mbps
Peak spectral efficiency	0.33 bps/Hz	2.55 bps/Hz	16.32 bps/Hz	4.8 bps/Hz	1 bps/Hz
Maximum transmission delay	<50 ms	<100 ms	<1 s	<1 s	<1.5 s
Data transmission	Requires voice call connection	Packet switching	Packet switching	Packet switching	Packet switching
Packet retransmission	No (serial data)	UDP packets, 0 retransmissions	IP packets with up to 5 retransmissions	IP packets, up to 5 retransmissions	IP packets, 0 retransmissions
MIMO	SISO (diversity)	2 × 2	2 × 2, 4 × 2,	4 × 4, up to 15	no
Mobility	Max. 500 km/h	Max. 500 km/h	Max. 350 km/h	Max. 250 km/h	>500 Km/h
Handover success rate	≥99.5%	≥99.9%	≥99.5%	≥99.5%	—
Handover procedure	Hard	Soft	Hard/soft	Hard/soft	No handover
All IP (native)	No	Yes	Yes	Yes	yes

Cable and Antennas

Cable Types: LMR400



RailHawk kit was designed to help novice and expert users alike find problems before they become time-consuming, expensive repairs of the:

- Positive Train Control system (PTC)
- Train-to-Infrastructure communication systems
- Inter-wagon communications



7020-1-010101
350 MHz - 4 GHz, 0.15 to 150W, RF Power Sensor

4240-401
7/16 DIN, Precision RF Adapter Kit



SK-CAL-MN-C6
Type-N Male, Calibration Combo



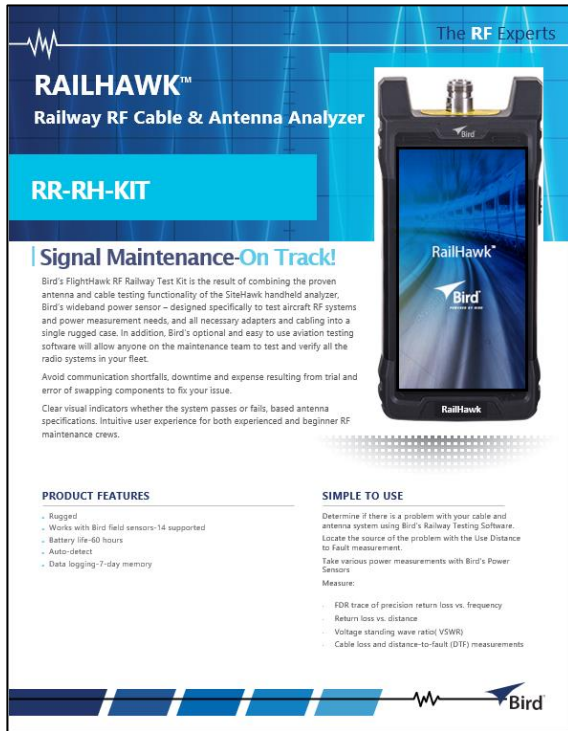
25-T-MN
25-Watt, Convection-Cooled Dry Termination

- Introductory questions-Talk about them, how long have they been servicing railways
- How do you currently test for Cable & Antenna failures?
- Do you do repairs and installations for Antenna systems?
- How are you currently verifying cell site RF transmission settings, cable feedline and antenna systems.
- Would you be interested in a solution which simplifies the specific needs of your industry?



Sales Tools

Coming Soon Nov 2020



Prospecting Toolkit

- Datasheet
- Training Webinar
- Outbound Marketing
 - Target Advertising

Points of Differentiation

- Questions to Ask
- Competitive Selling Guide
- Sales Video



Customer Meeting Tools

- Product Overview
- Data Sheet
- Application Notes
- Product Demos
- WebEx Training

Get to know the Industry



Here are some good organizations and publications to follow:

<https://www.aar.org/campaigns/ptc/>

<https://railway-news.com/products-services/train-health-monitoring/>



Questions



Thank you!

