

SPACE-BASED RADIO  
FREQUENCY (RF) MONITORING:  
EQUIPPING ANALYSTS WITH A  
POWERFUL  
TOOL FOR GEOSPATIAL  
INTELLIGENCE

Dr. Rao Ramayanam  
Senior Sales Executive - International

INDO-PACIFIC GEOI NTELLIGENCE FORUM  
NEW DELHI  
6-7 MAY 2023

Unclassified Imagery and Information  
Presentation contains no "Technical Data"  
Contains Information that is Only Representative of Information that  
can be Produced from the Use or Operation of a Defense Article





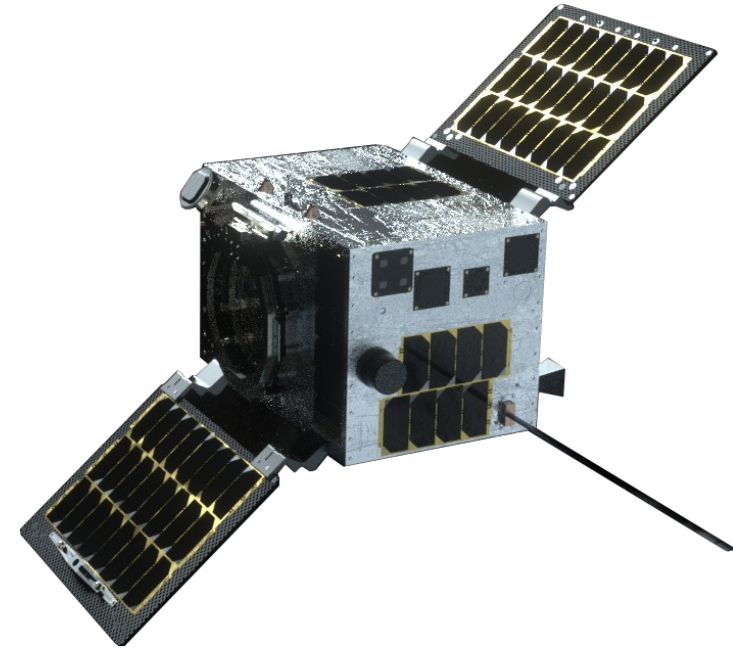
01  
ADVANCING  
SPACE-  
BASED RF  
COLLECTION



# WHAT IS HE360 DOING?

## ➤ First commercial RF sensing constellation

- + Cluster 1: launched December 2018 (R&D Mission, SSO)
- + Cluster 2: launched in January 2021 (SSO)
- + Cluster 3: launched in June 2021 (SSO)
- + Cluster 4 & 5: launched in April and May 2022, respectively (SSO)
- + Cluster 6: launched in January 2023 (40.5° inclination)
- + Clusters 7: launched in April 2023 (SSO)
- + Clusters 8 & 9: to launch in October 2023 (40.5° inclination)







# SIGNAL TRILATERATION

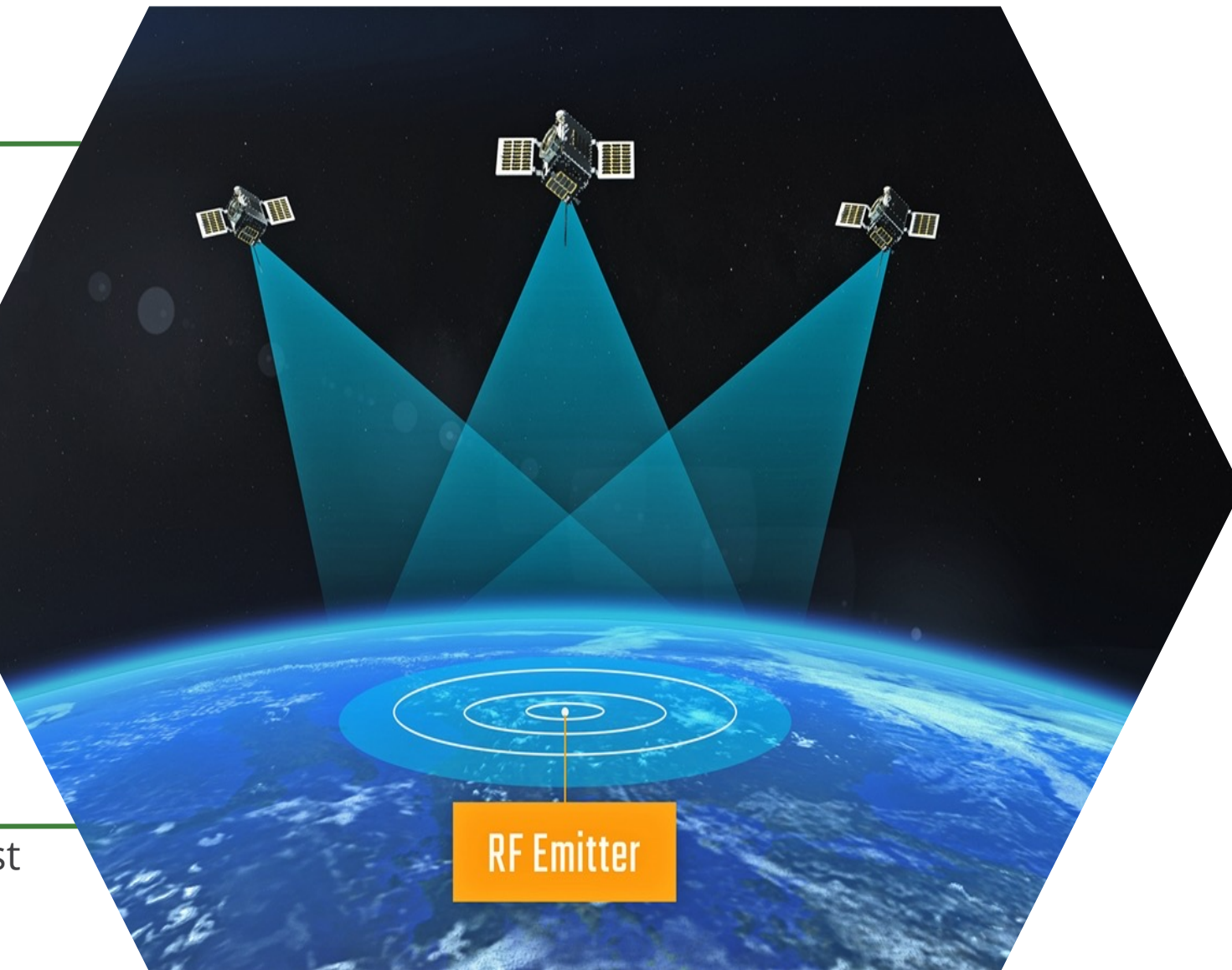
Three Satellite Cluster  
Flies in Formation

Independently Geolocate a  
Variety of Radio Signals

Patented Processing Methods  
and Proprietary Algorithms

Both Time Difference and  
Frequency Difference of Arrival

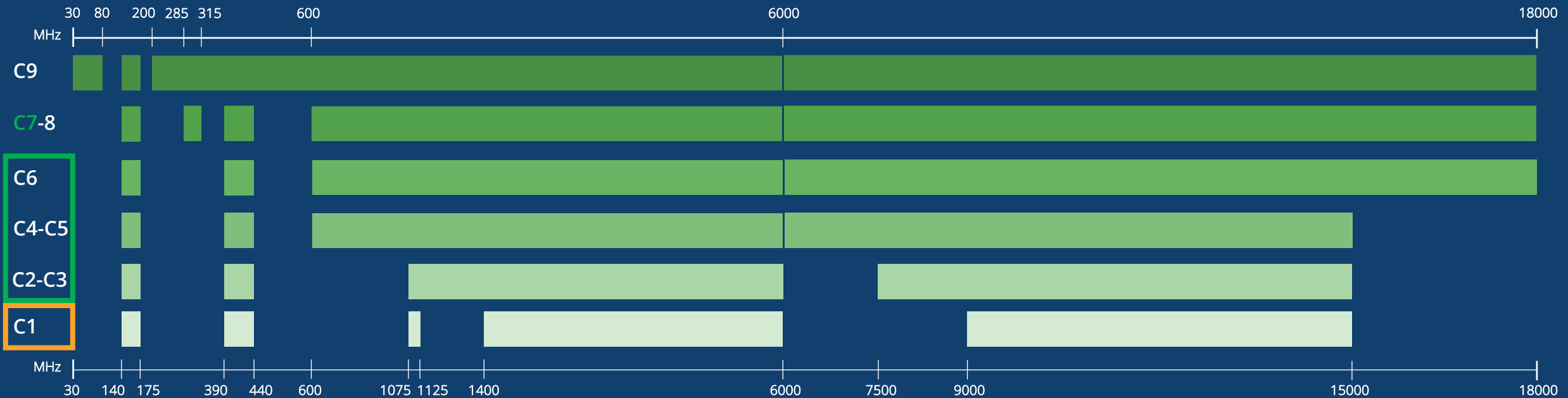
Identifies and Describes the  
Behaviors of Signals of Interest





# GROWING CAPABILITIES

Flexibility to collect data in many different RF bands, depending on mission needs.



Note: Approximate illustration that is subject to change. The satellites do not collect instantaneously across the full RF spectrum displayed, but can tune within these frequency ranges.

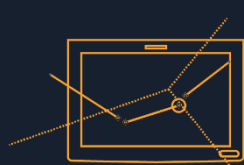
Graph not at scale

Generally, any radio signal in the mentioned frequencies coming from emitters above 5W of power, potentially as low as 1W if the signal properties are well-known

# SIGNAL COVERAGE EXAMPLES



VHF PUSH-TO-TALK  
RADIOS



AUTOMATIC IDENTIFICATION  
SYSTEM (AIS)



EMERGENCY  
RADIOBEACONS



UHF  
PUSH-TO-TALK RADIOS



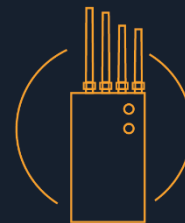
L-BAND SATELLITE  
MOBILE DEVICES



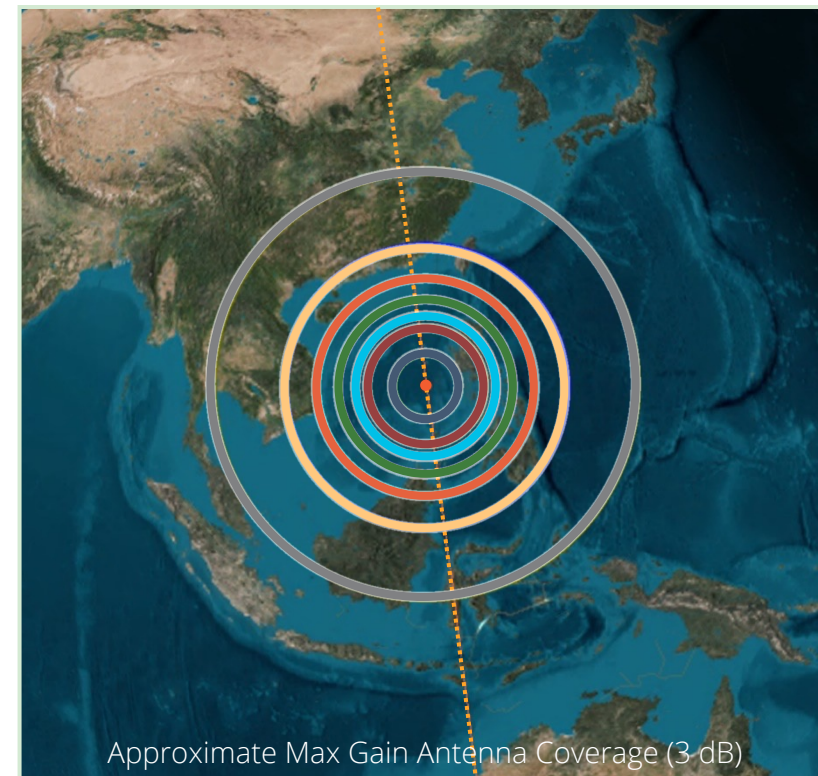
X-BAND MARINE  
NAVIGATION RADAR



S-BAND MARINE  
NAVIGATION RADAR



GPS  
INTERFERENCE



Satellites can selectively tune within most of the frequency range from 144 MHz to 15 GHz.





02  
EXAMPLES  
OF  
RF GEOINT



# INSIGHTS AROUND THE WORLD

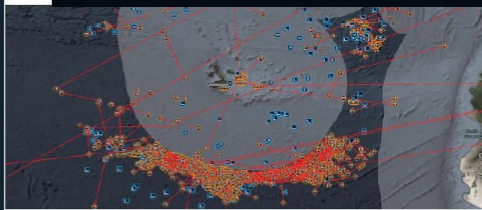
**1** Marine Traffic Drops During COVID Lockdown



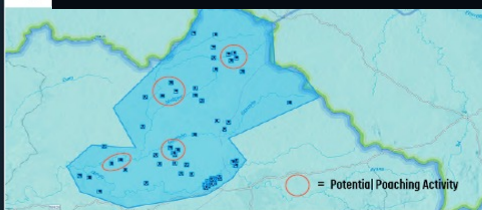
**2** Searching US Border for Unusual Activity



**3** Chinese Fishing Encroaches on Galapagos



**4** Protecting Garamba Endangered Wildlife



**12** Demonstrating Detection of GPS Interference



**11** Tracking Iranian Air Defense Radars



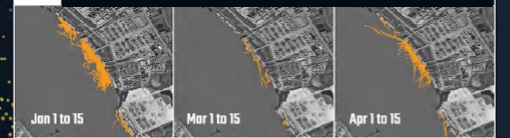
**10** Observing Attacks on Nagorno-Karabakh



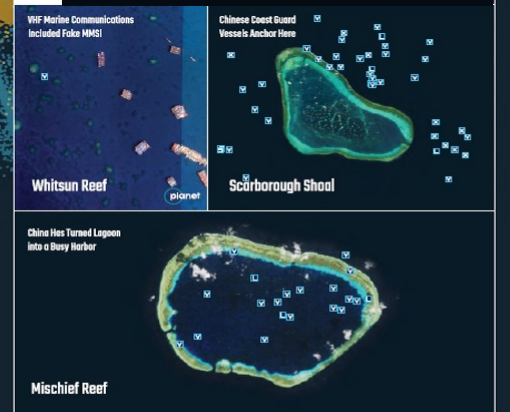
**9** Discovering Buildup Along India/China Border



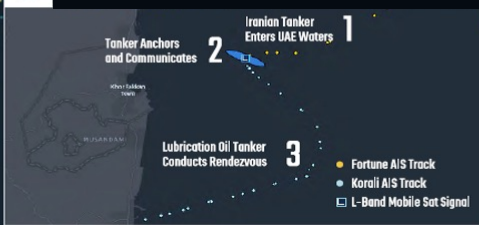
**8** Impact of COVID Lockdown on Wuhan's Ports



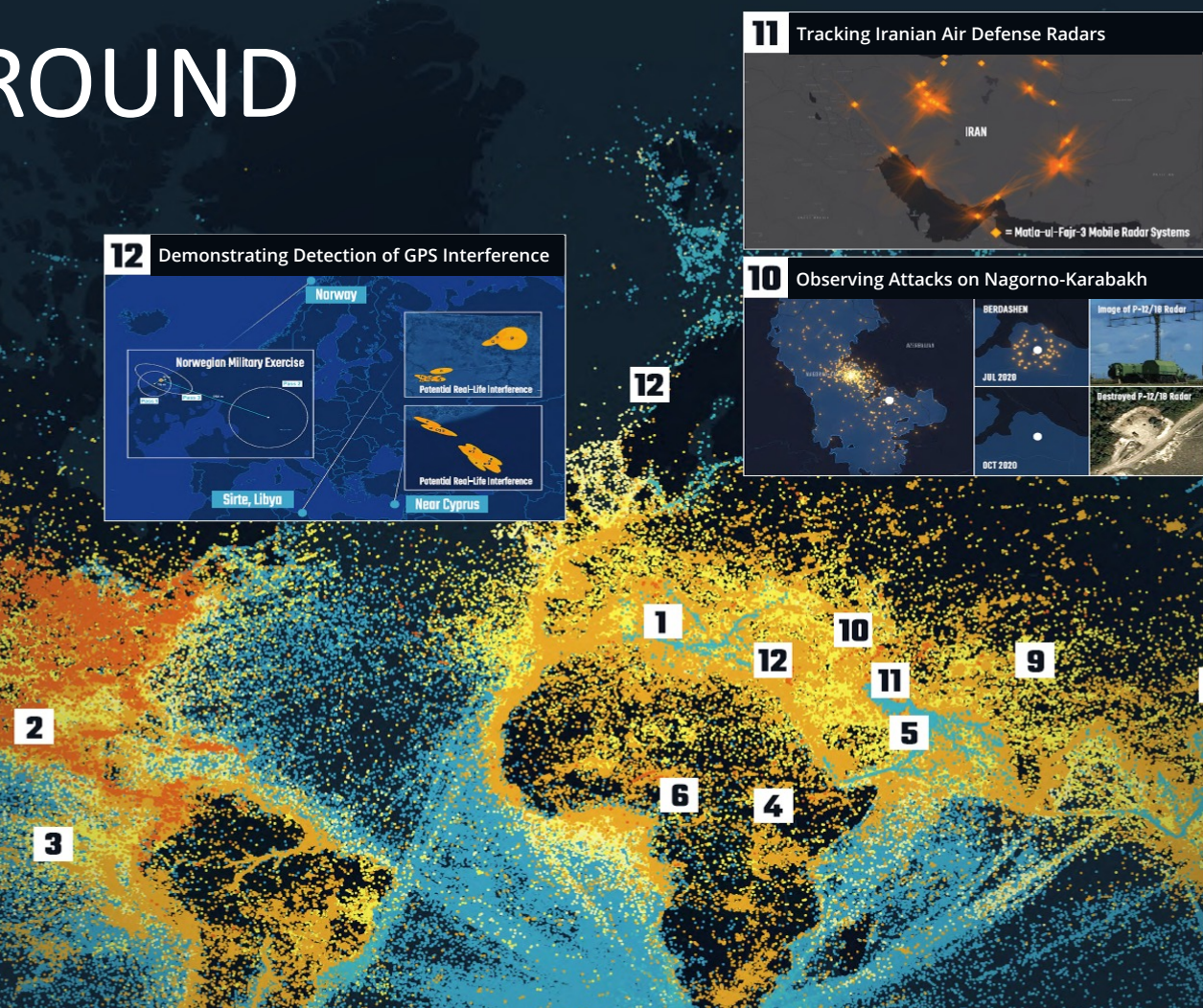
**7** Monitoring Activity Across South China Sea



**5** Uncovering Vessel Bunkering During Smuggling



**6** Searching Nigeria for Potential Boko Haram



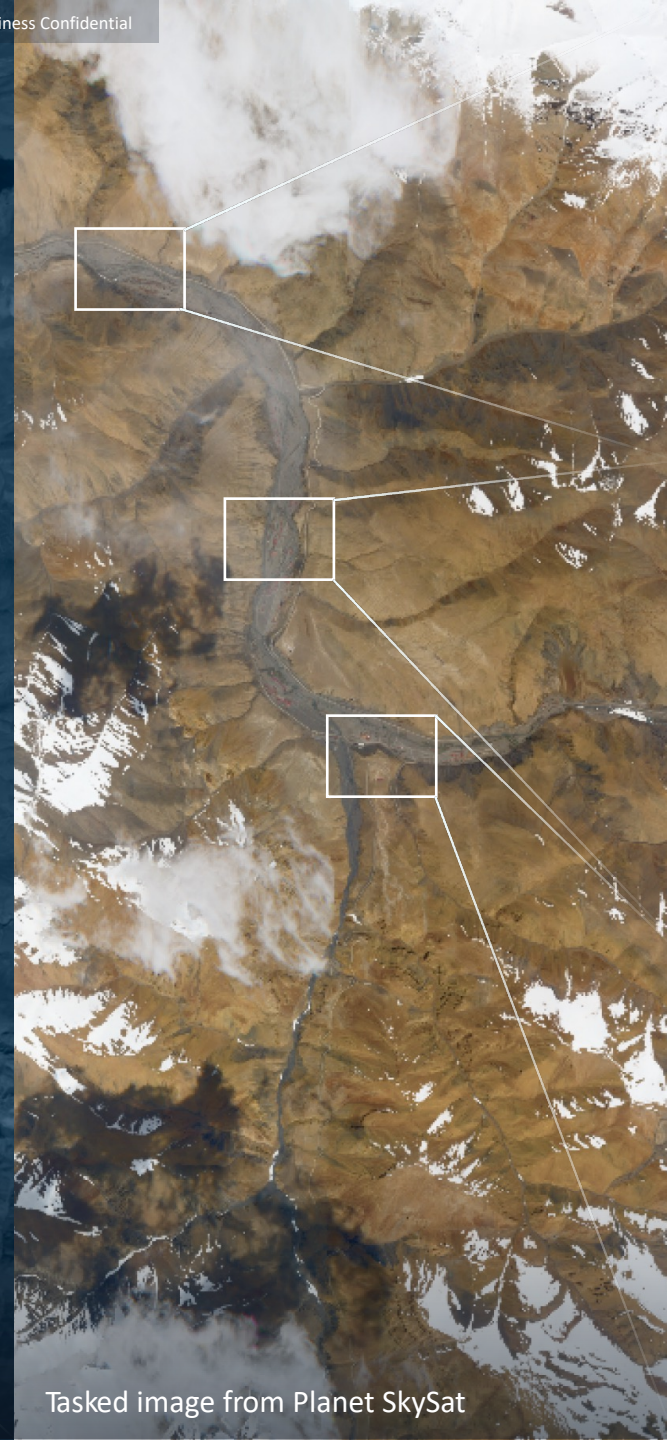


# China & India Dispute- Galwan River Valley

Galwan Kangri



HawkEye 360 detected increased RF activity in the Galwan River Valley and tasked EO assets to verify Chinese military buildup



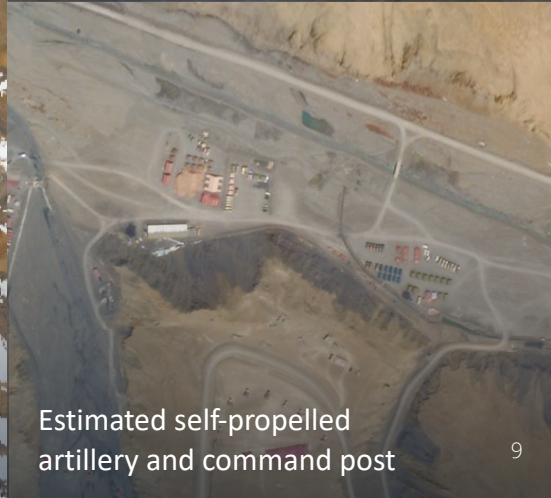
Tasked image from Planet SkySat



Estimated armored personnel carriers and trucks



Camouflage-netted trucks and equipment



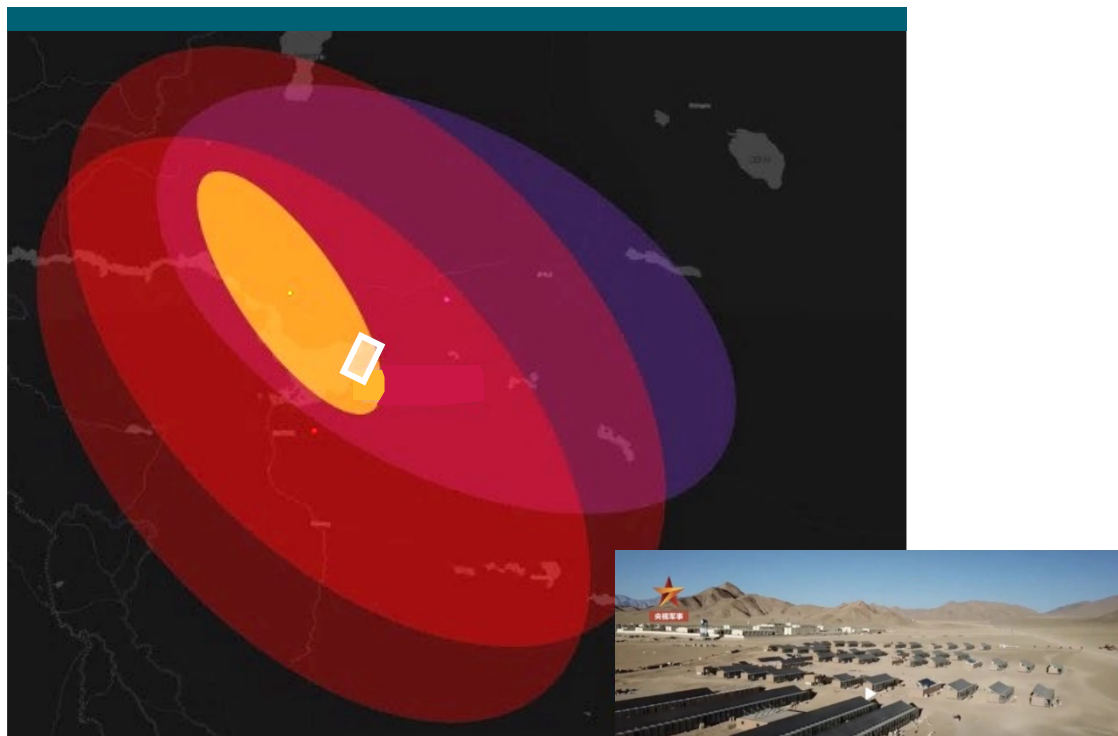
Estimated self-propelled artillery and command post





# UNCOVERING CHINESE ARMY MOVEMENTS

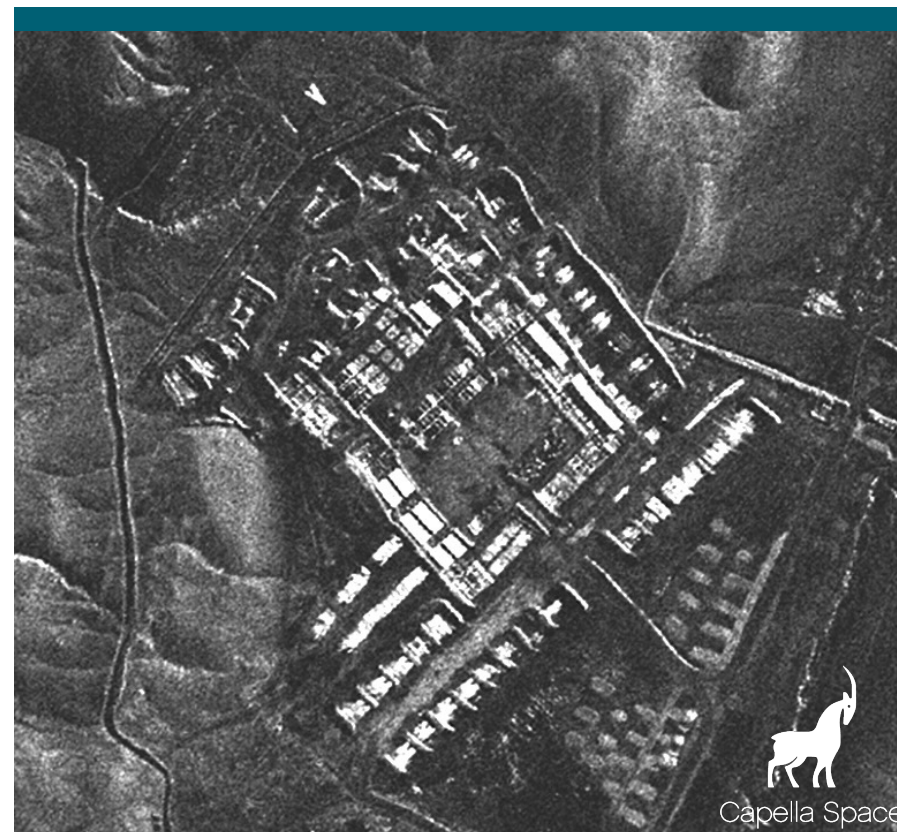
**01** RF activity pointed to NE of Rutog, where Chinese forces relocated after Feb 2021 disengagement.



Prefabricated structures rapidly deployed at Rutog.



**02** Tasking SAR for the site in June 2021 continues to show additional shelters being deployed.



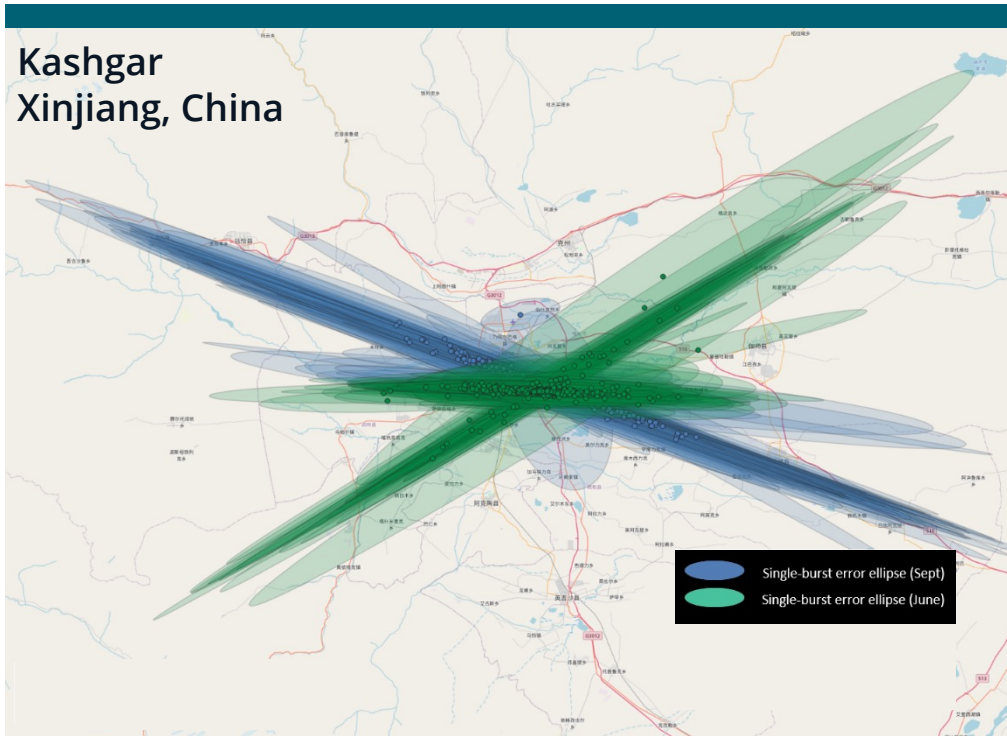
HawkEye 360's RF data can be an early indicator when large forces are shifted to new locations.





# SATCOM FACILITY EXPANSION

**01** L-band activity where Indian Army claims link to China's Technical Reconnaissance Bureau.



**02** Imagery shows many mast positions for new satcom dishes, with 17 affixed as of 17 June 2021.

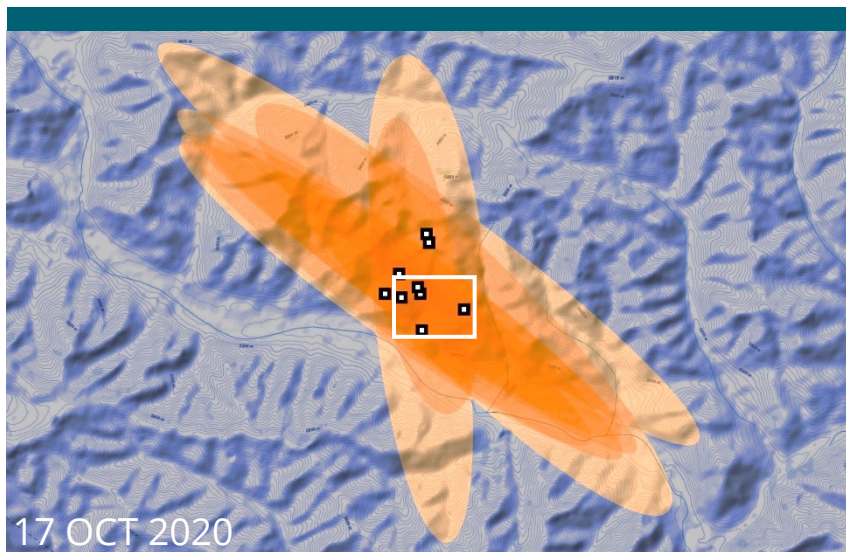


Directing attention to where satcom is present and assisting with characterizing baseline activity.

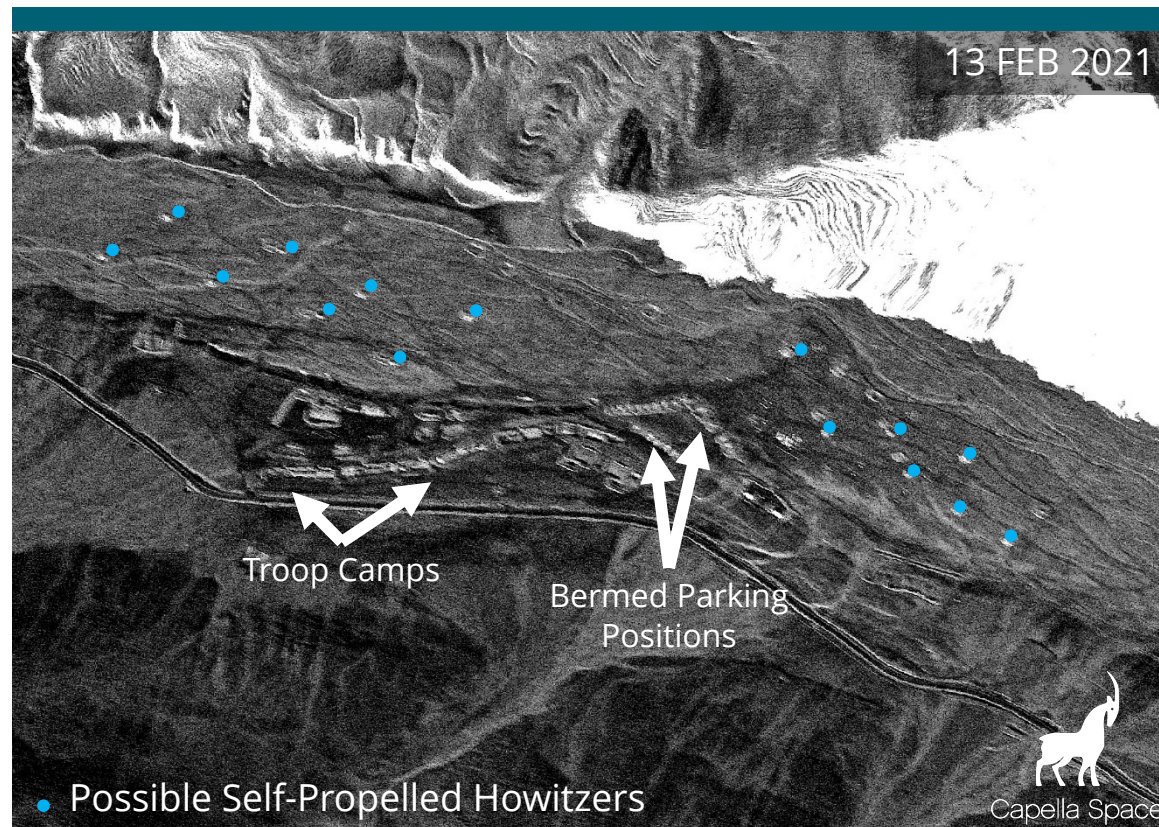


# TIPPING SAR TO UNCOVER A CHINESE BATTALION

**01** HawkEye 360 detected RF activity in cloud covered mountains.



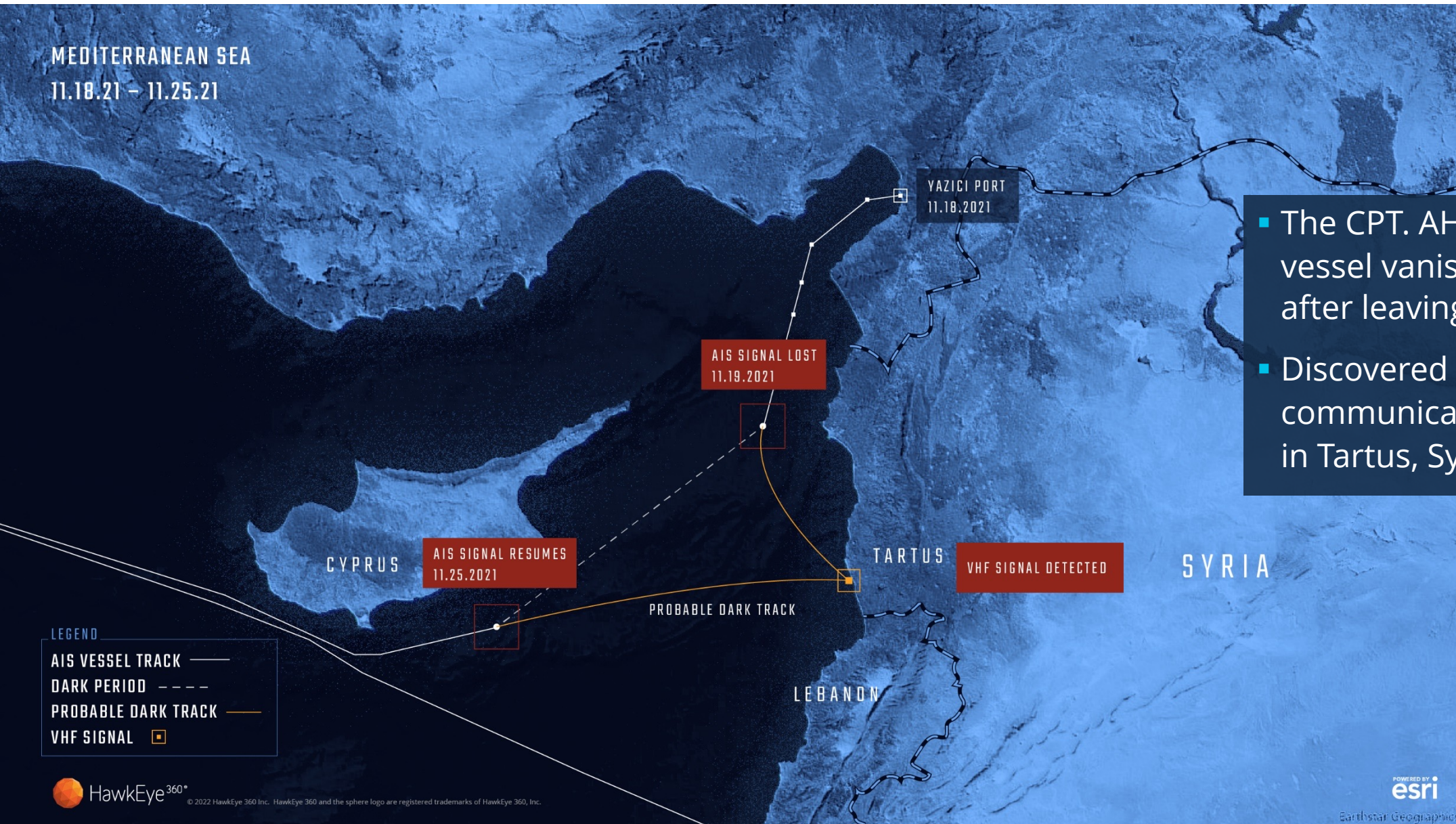
**02** Tipping a SAR image uncovered an ongoing Chinese military presence with a heavily defended position.



HawkEye 360's RF data can find important locations even when hidden by cloud cover.



# DETECTING DARK TRACK

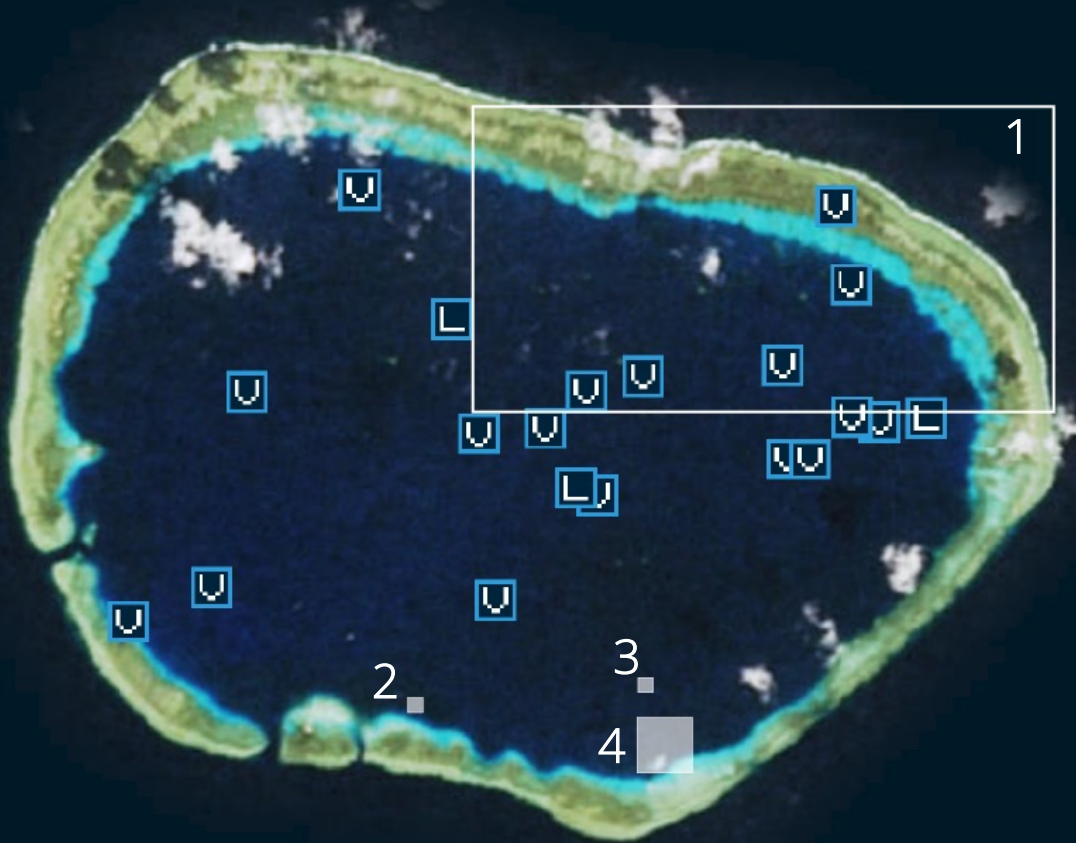




- The CPT. AHMAD II cargo vessel vanished soon after leaving port
- Discovered based on VHF communications signals in Tartus, Syria





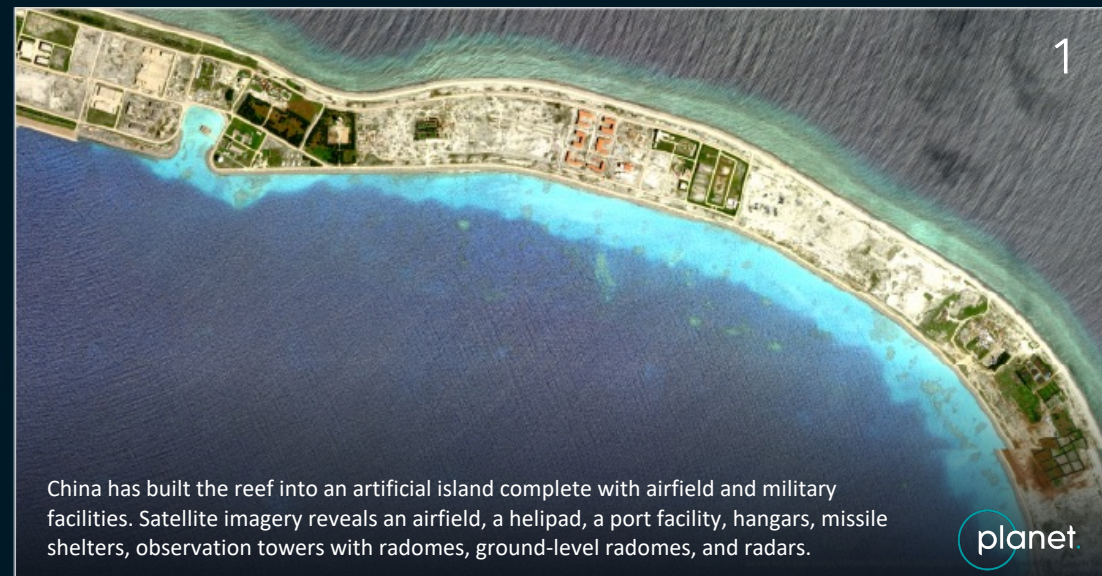
# RF INDICATES CHINESE PRESENCE AT MISCHIEF REEF



-  VHF
-  L-BAND

**October 2020**

A density of RF activity within Mischief Reef's lagoon indicates that China is using it as an anchoring point and protected harbor.





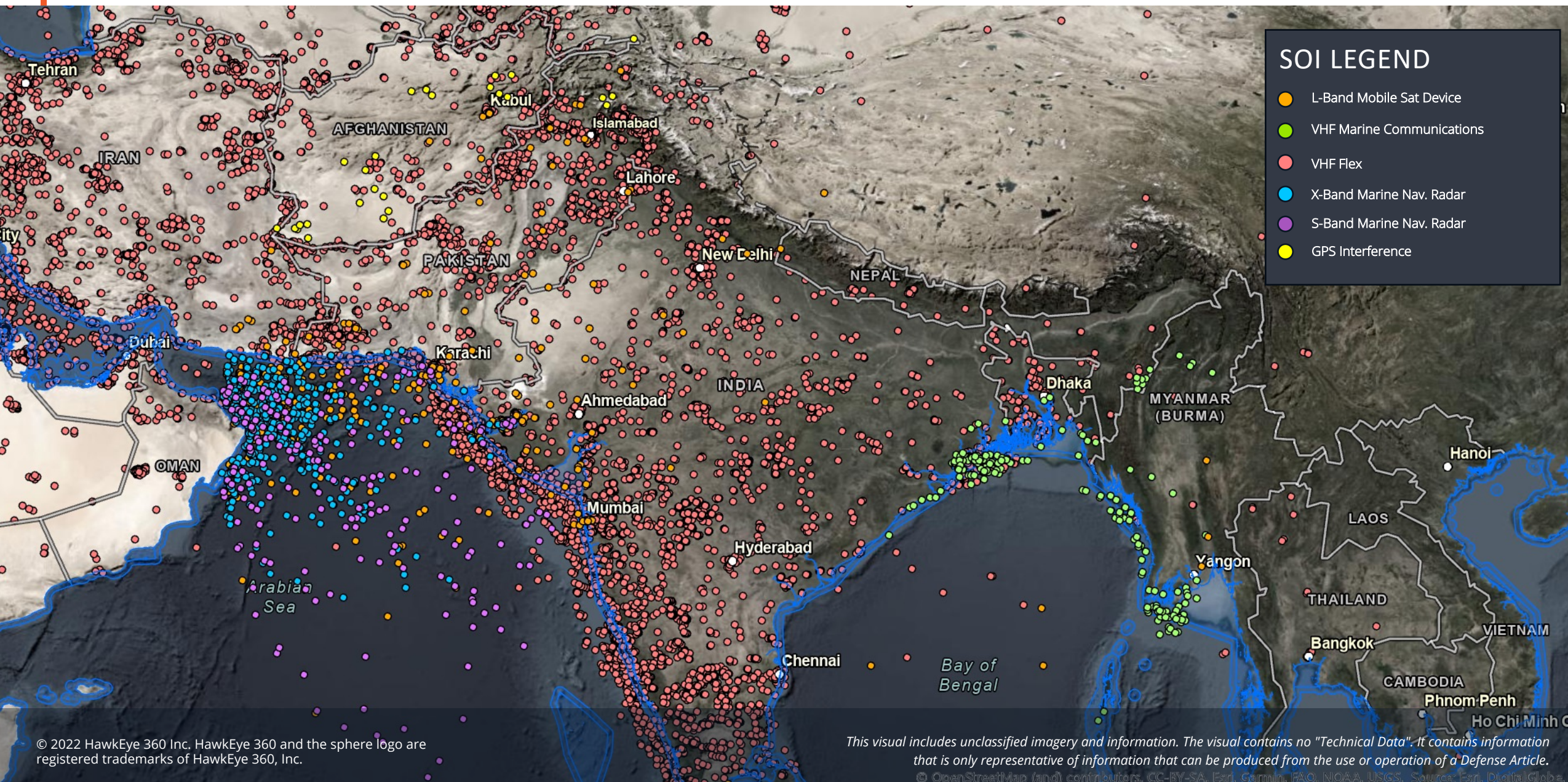
# 03

EXAMPLE OF SIGNAL  
COLLECTIONS OVER THE  
REGION OF INTEREST





# RF ACTIVITY IN THE REGION- SEP 2022





# QUESTIONS?

Contact Info

Dr. Rao Ramayanam

[Rao.Ramayanam@he360.com](mailto:Rao.Ramayanam@he360.com)

+17202200669

[www.he360.com](http://www.he360.com)