Joint Precision Approach and Landing System (JPALS)

Program Overview
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CDR Brett Easler, USN
Chief of Naval Operations N885F1
Naval Air Systems Command PMA2135

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Precision Approach Capability Gap

- **No single interoperable DoD precision approach and landing system**
  - Only 30% of Navy and 50% of Army aircraft currently have Instrument Landing System (ILS)
- **PAR and Mobile Microwave Landing System (MMLS) are the only military deployable landing systems**
  - Navy and Army not MMLS capable
  - PAR and MMLS footprint too large for Expeditionary Operations
- **Joint operational forces lack a system with auto-land capability**
- **Designed to replace; SPN-46 & SPN-35 (shipboard PAR), Land-based PAR, ILS, MMLS, and TACAN at-sea.**
- **Provide future support for Unmanned Aircraft Systems (UAS) requirements**

Joint Interoperable Solution

USN

- Automatic Carrier Landing System (SPN-46)
- LHA/D Landing Sys (SPN-35)
- Shore Precision Approach Radar (PAR) (FPN-63)
- Ship TACAN (URN-25)
- Shore Training Radar (SPN-42)
- Shore Instrument Landing System (ILS)

USMC

- Shore PAR (FPN-63)
- Shore ILS
- MATCALS TACAN (TRN-44)
- MATCALS PAR (TPN-22)
- ATNAVICS (TPN-31A)

USA

- Fixed Base PAR AN/FPN-67
- Fixed Base ILS (Mark-20A)
- Tactical ASR/PAR ATNAVICS AN/TPN-31

USAF

- PAR (GPN-22)
- ILS (GRN-29)
- Mobile Microwave Landing System (TRN-45)
- Mobile PAR (TPN-19 & MPN-14K)

FAA

- Instrument Landing System

NATO

- Shore Precision Approach Radar
- Shore Instrument Landing System

JPALS

Sea-Based

Land Based, Fixed/Tactical

Spec. Ops Man Portable

Aircraft Avionics Integration

GBAS/LAAS
SBAS/WAAS

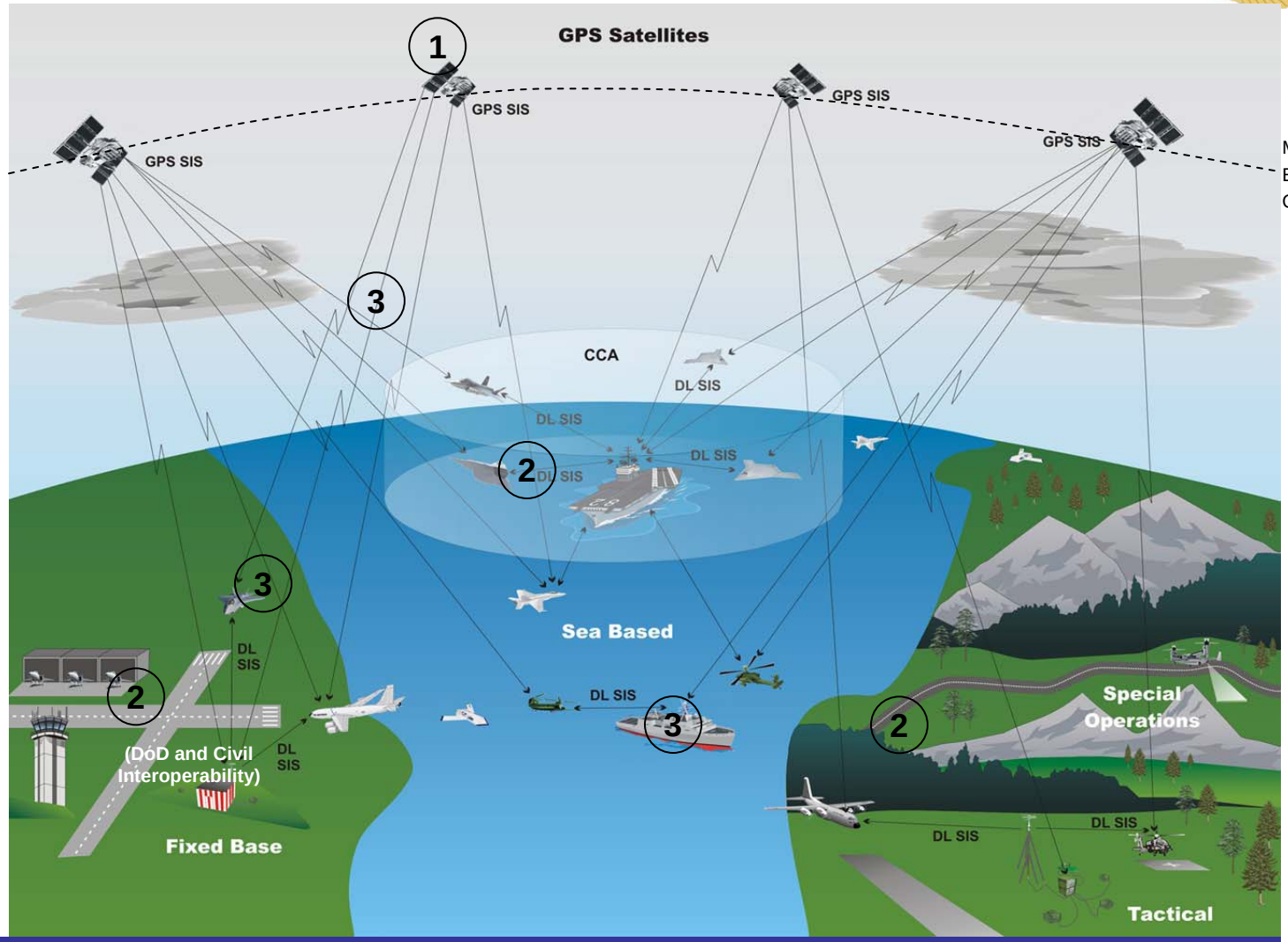
JPALS End State

Three System Components:

1. GPS
2. Ground Station
3. Aircraft Integration

Ground Station Variants

- Sea-Based: 2-way data link
- Shore-Based: 1-way data broadcast (fixed/mobile)



Global Precision Approach Capability

Military Utility of JPALS

Single System Capabilities	GBAS	ILS	D-ILS	MMLS	PAR
Straight-In Approach	X	X	X	X	X
Curved Approach	X			X	
Segmented Approach	X			X	
Variable Glidepath	X			X	
Displaced Threshold	X				
Simultaneous Multiple Airfields	X				
Simultaneous Multiple Runways	X				Parallel
No Clear Zones	X				X
Rapidly Support New Approaches	X				

Overarching Joint Program Strategy

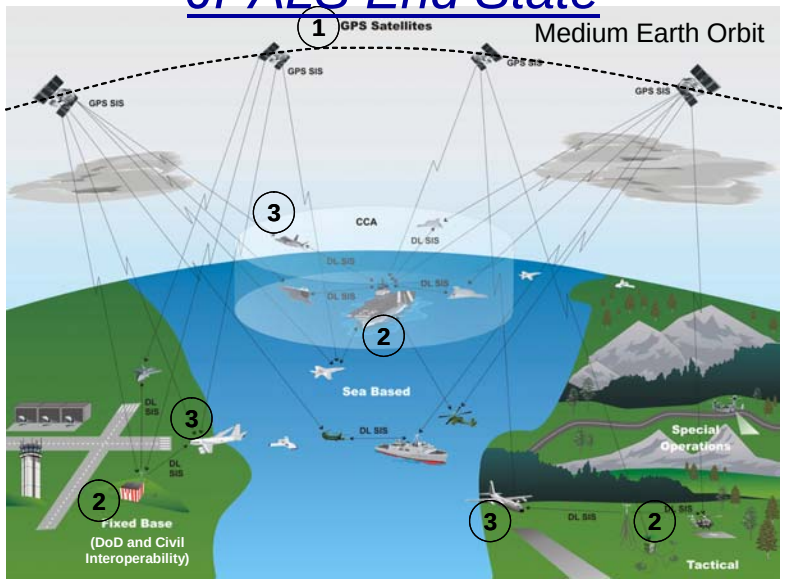
Inc-1A (SRGPS)	200 ft/ ½ NM Shipboard Relative GPS	Joint A/C Integration Guide	CVN LH-CLASS DDG-1000
Inc-1B	Sea-Based Lead Platforms Operational A/C Integration		
Inc-2 (LDGPS)	200 ft/ ½ SM – Land-Based Fixed and Tactical/Mobile Local Differential GPS, Autoland (FAA Certified)		

Future Landing System
Incremental Precision/Capability

Inc-3	100 ft/ ¼ SM – Auto-Land Mobile/Fixed –LDGPS
	200 ft/ ½ NM – Auto-Land Sea-Based –SRGPS
Inc-4	100 ft/ ¼ NM – Auto-Land Sea-Based –SRGPS (UAV Support)
Inc-5	Man-Pack –LDGPS (Marine Corps/Army)
Inc-6	Autonomous Enhanced Vision System (EVS)
Inc-7	Upgrade to Sea-Based back-up system

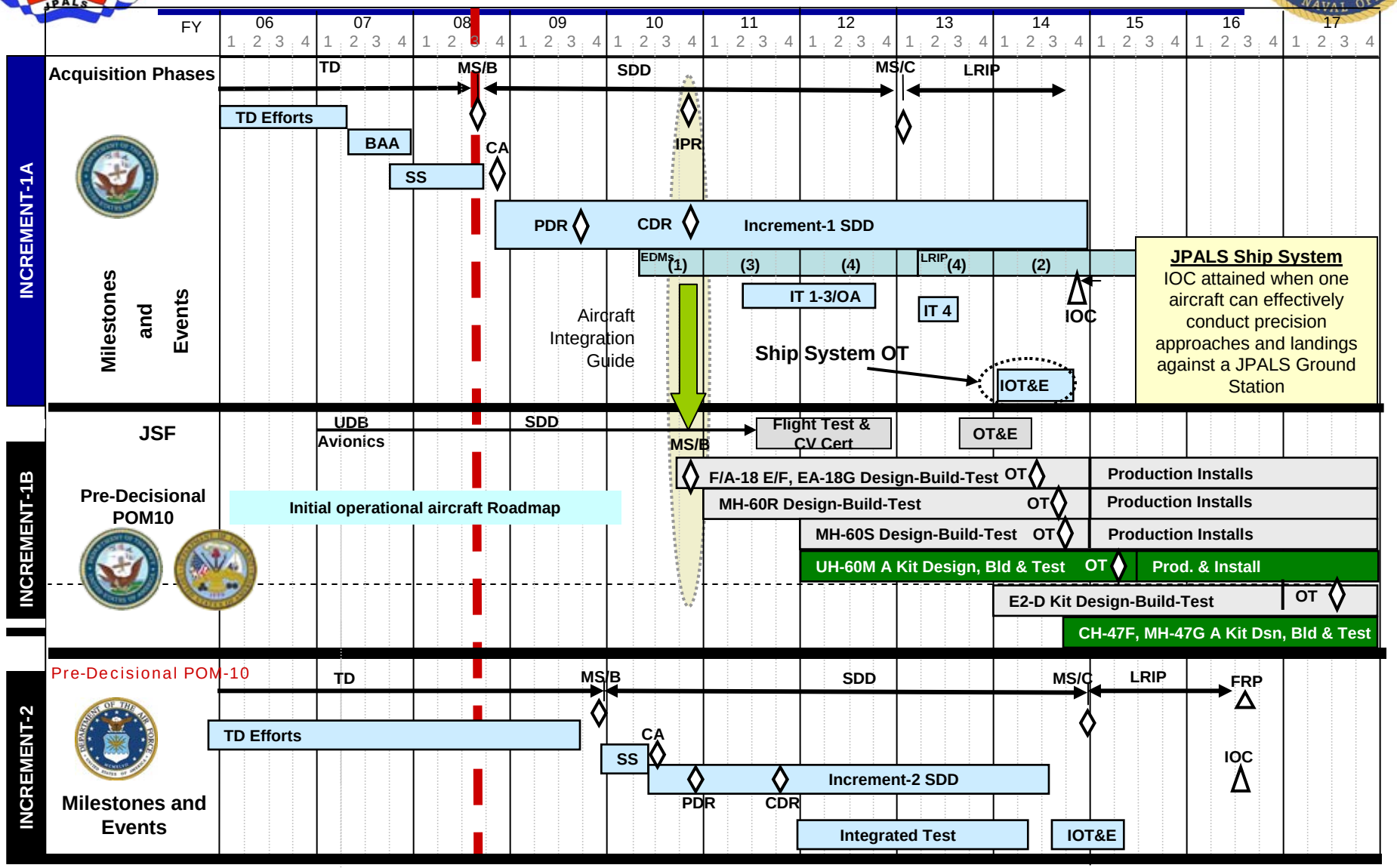
- Current CDD includes Increments 1 and 2 only Increment 1 validated

JPALS End State



Three System Components:
① GPS ② Ground Station ③ A/C Integration

JPALS Schedule



Synchronizing Service Requirements

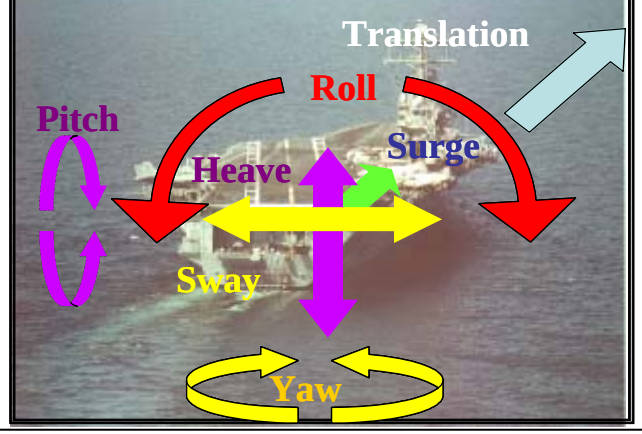
- **USN: Sea-Based Need Date – 2014**
- **USN: Fixed-Based Need Date – 2016**
- **USMC: Mobile Need Date – 2017**
- **USAF: Fixed-Based Need Date- 2018**
- **USA: Fixed-Based Need Date - 2020**

How does JPALS Ship System Work?

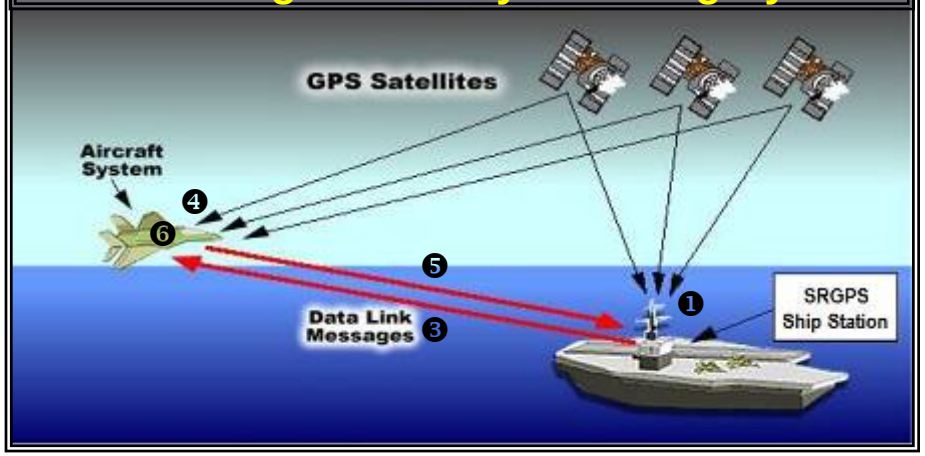
Shipboard Relative GPS (SRGPS)

1. Ship derives its precise position using GPS
2. Inertial navigation sensors provide Ships motion for glide-slope solution
3. Ship broadcasts ship position and glide-slope solution via encrypted UHF data link
4. Aircraft derives its precise position using GPS
5. Aircraft receives glide-slope data and reports back position via two-way data link
6. Software algorithms calculate corrections and drive aircraft displays to maintain glide-slope, may be coupled to flight controls

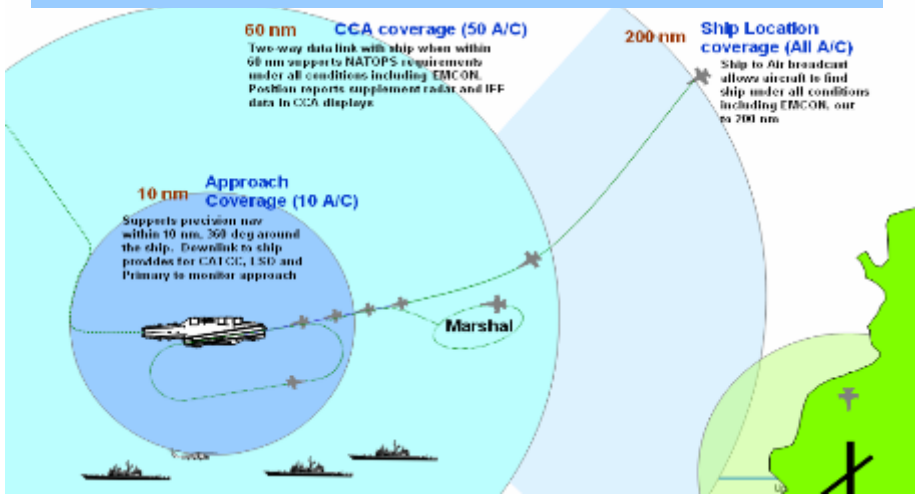
Inertial Navigation System data used to compensate for ship's motion ❷



Differential GPS gives relative position with high accuracy and integrity

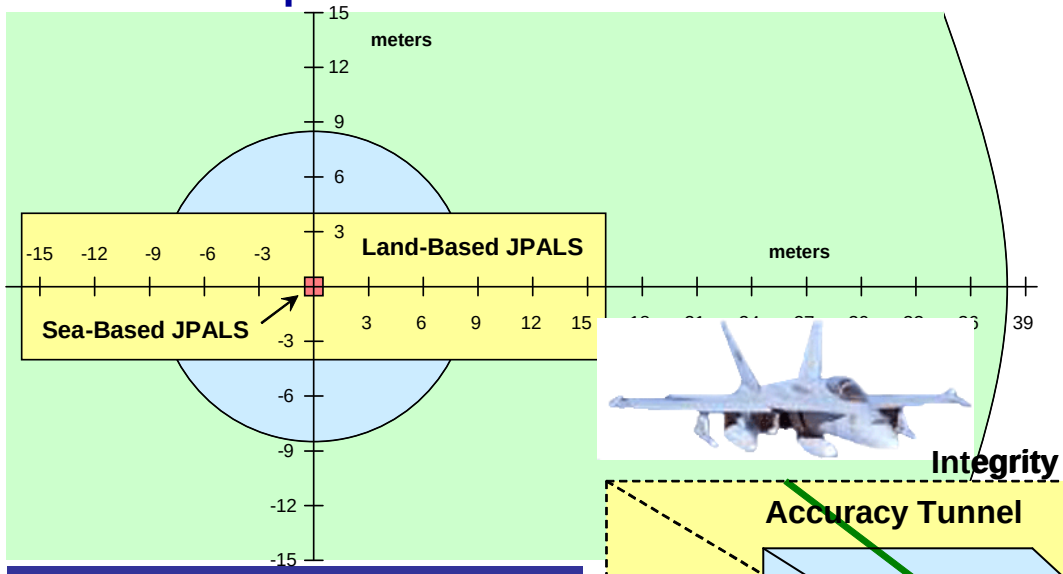


At Sea CONOPS Overview ❸



JPALS Accuracy Requirements

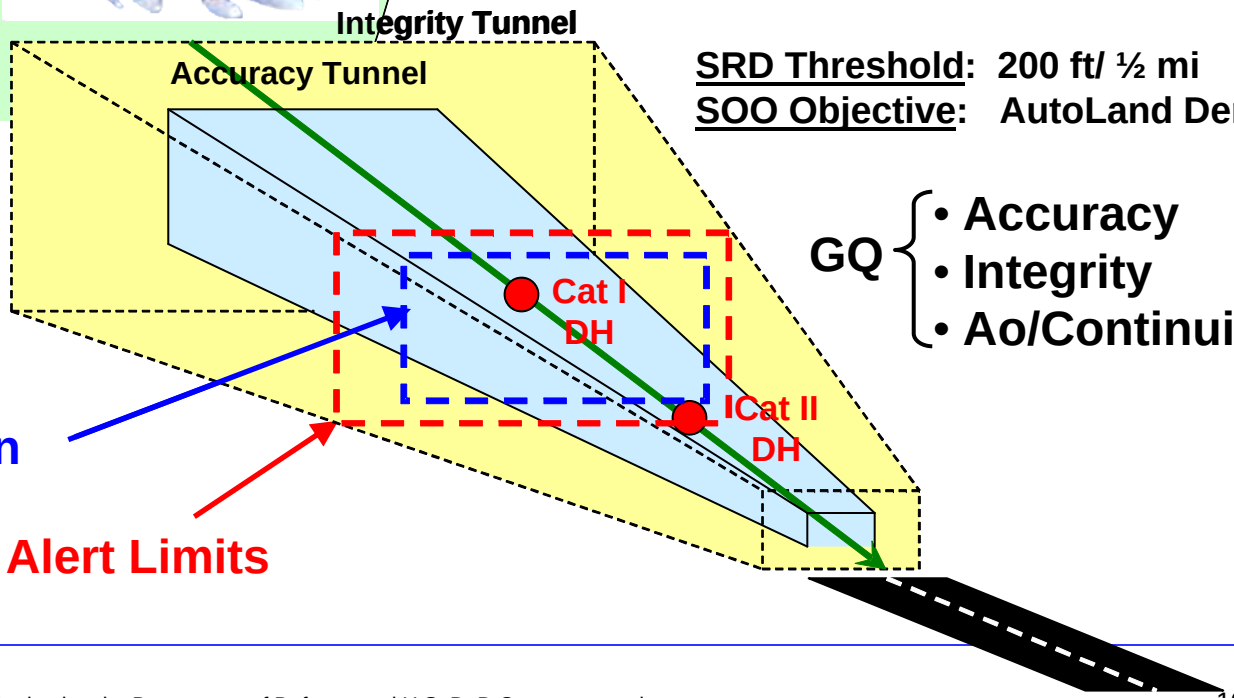
JPALS Compared to GPS Guided Munitions



JPALS Requires Augmented GPS
Better Guidance Quality (GQ) required as the aircraft gets lower and closer

Even better GQ required when the runway is small and/or moving (e.g., an aircraft carrier)

Sea-Based JPALS requires 22x and 94x greater accuracy than GPS Guided Munitions

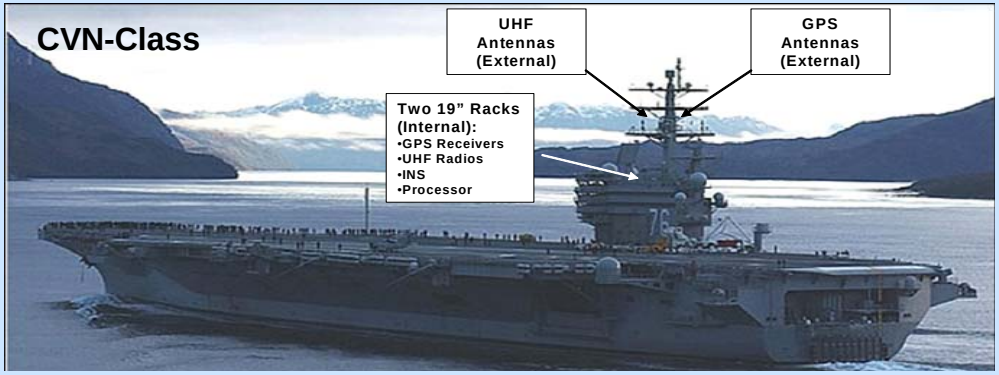


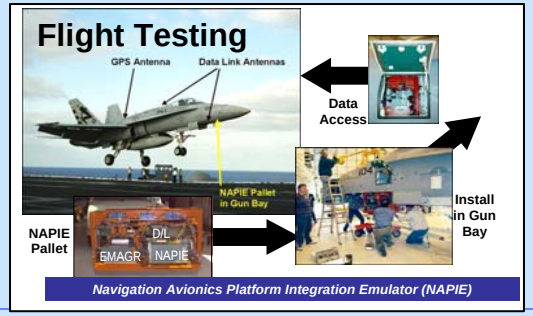
SRD Threshold: 200 ft/ ½ mi
SOO Objective: AutoLand Demo

GQ
- Accuracy
- Integrity
- Ao/Continuity

JPALS Increment 1A Ship System Development, Installation, and Test

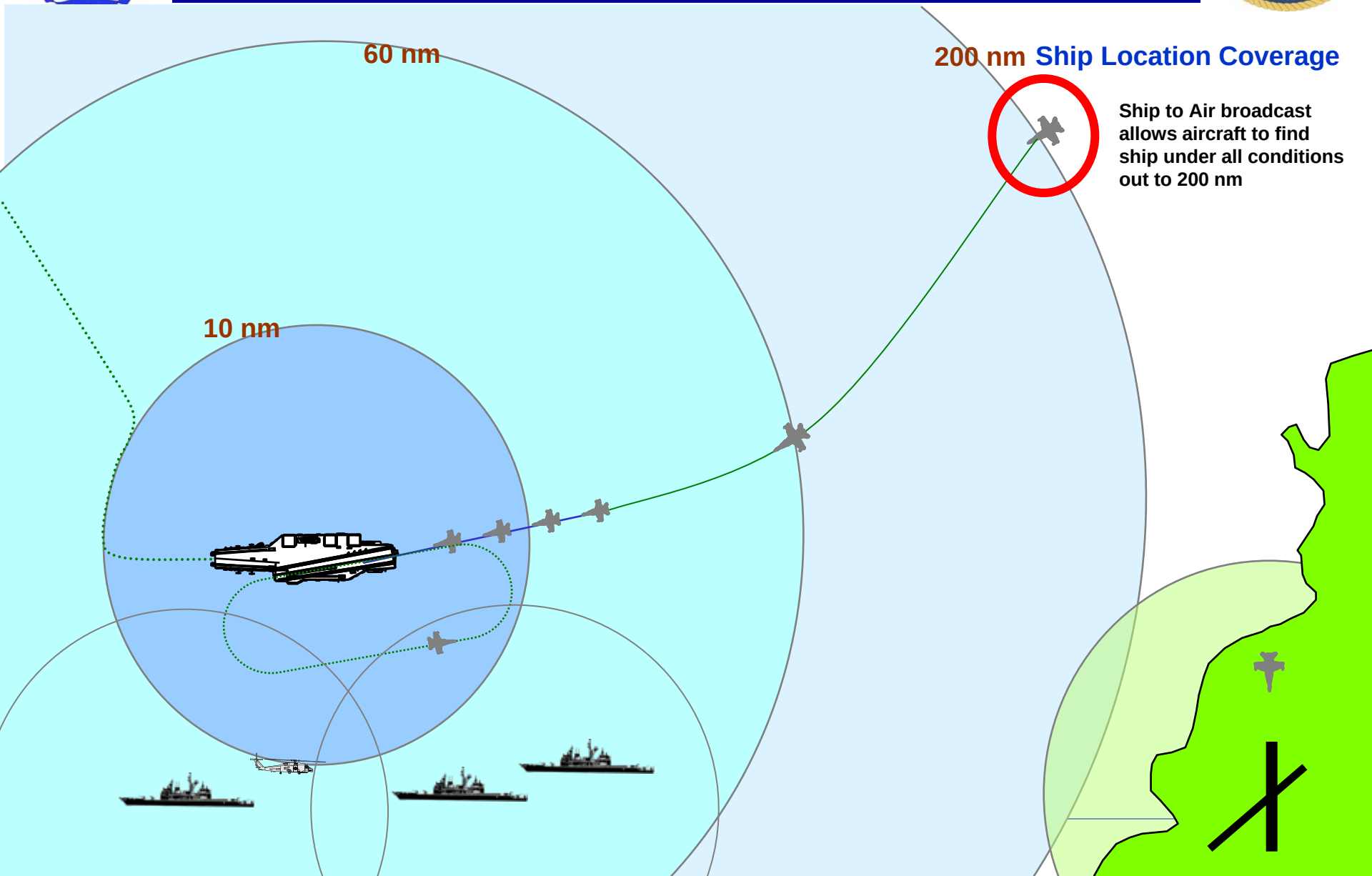
Retrofit





Forward Fit

Concept of Operations (ConOps)



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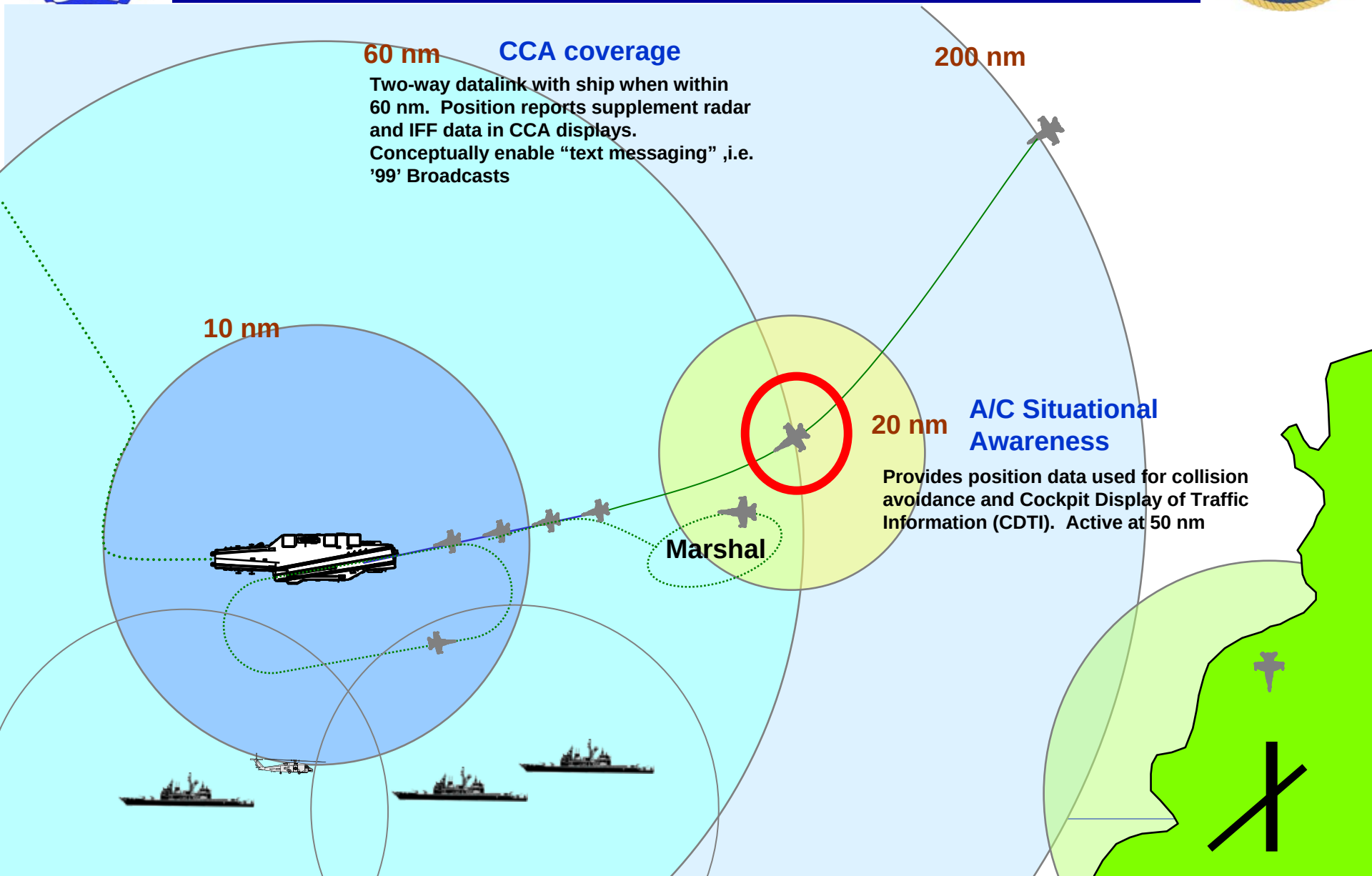

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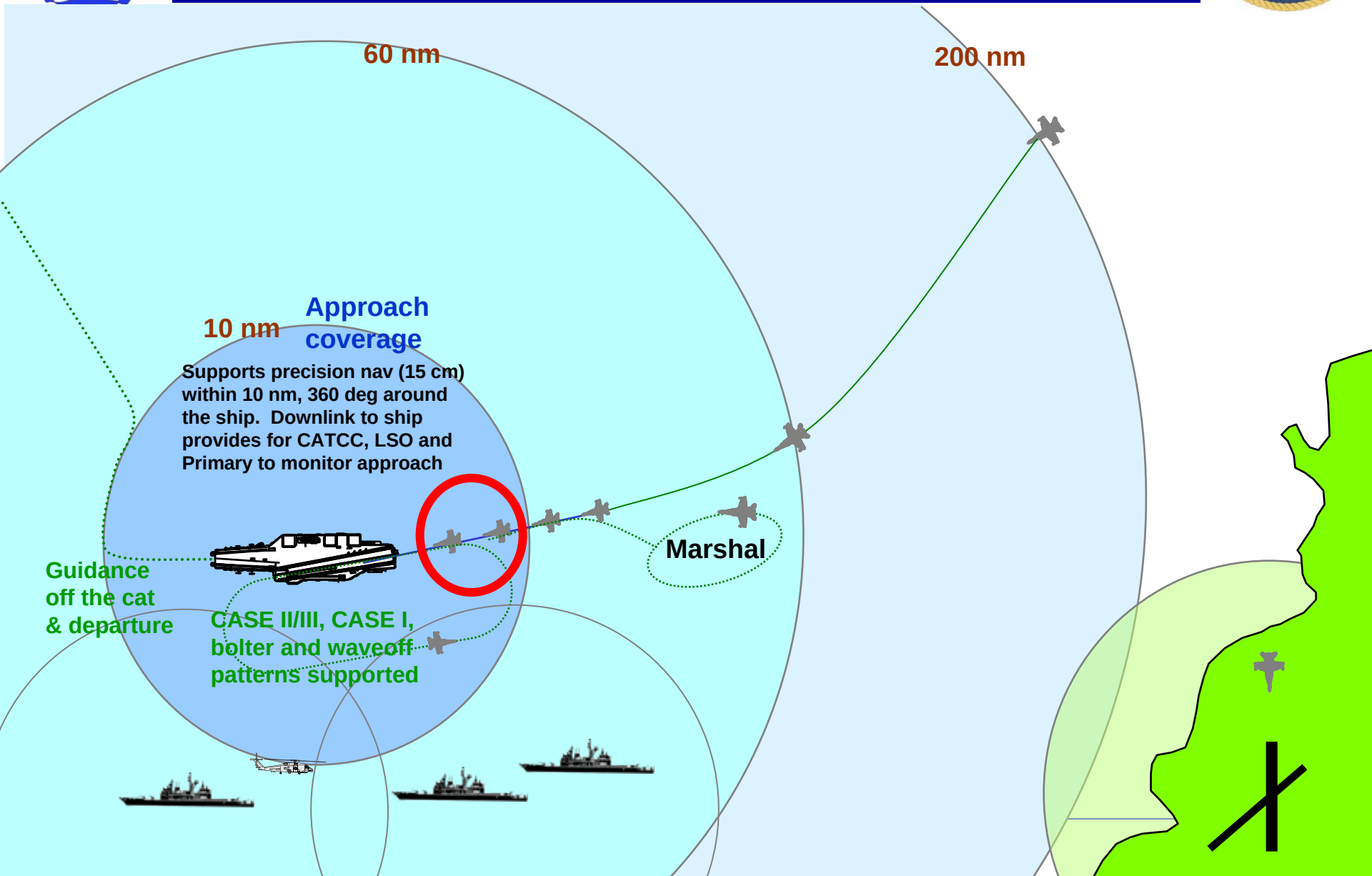

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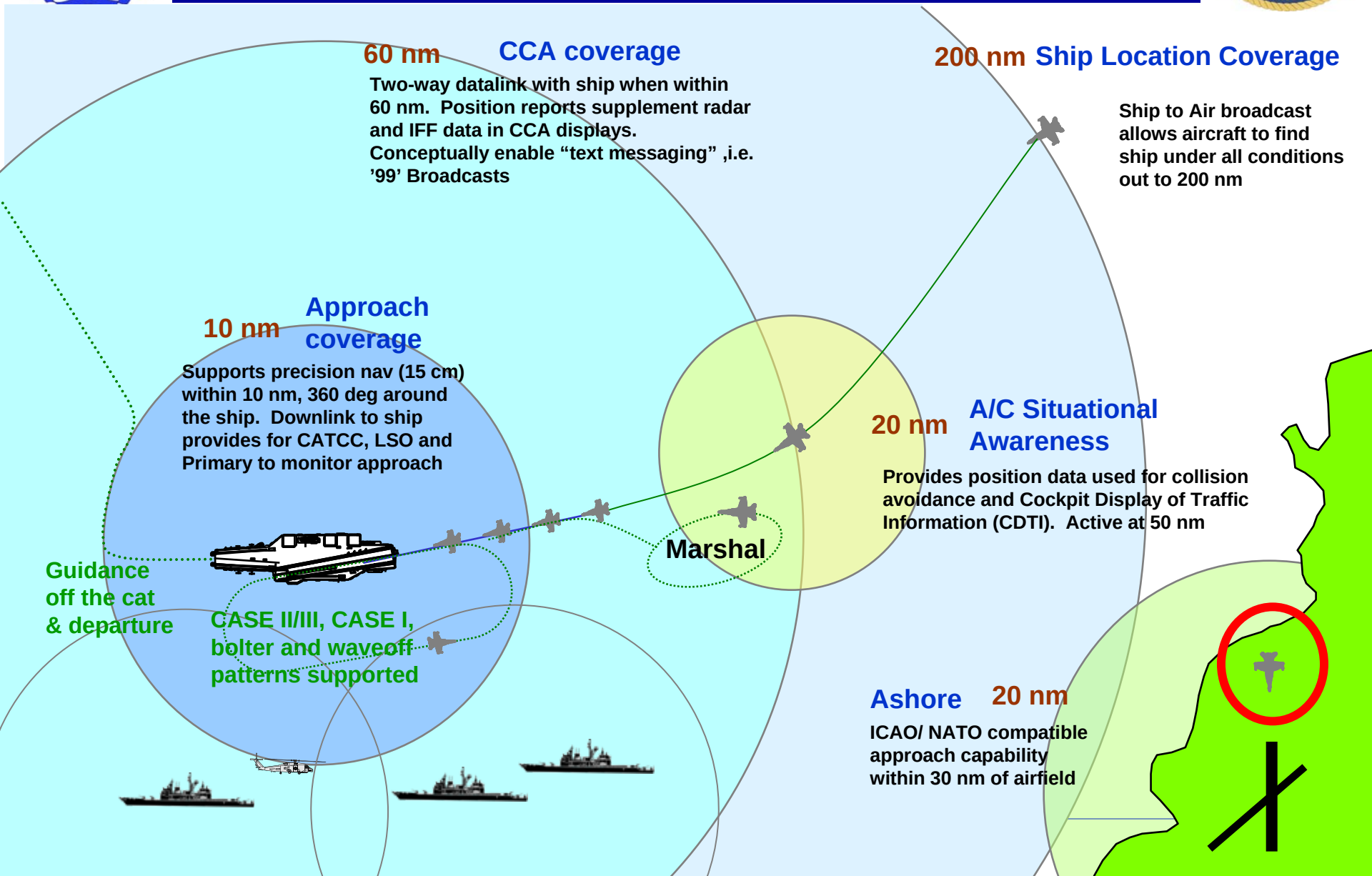
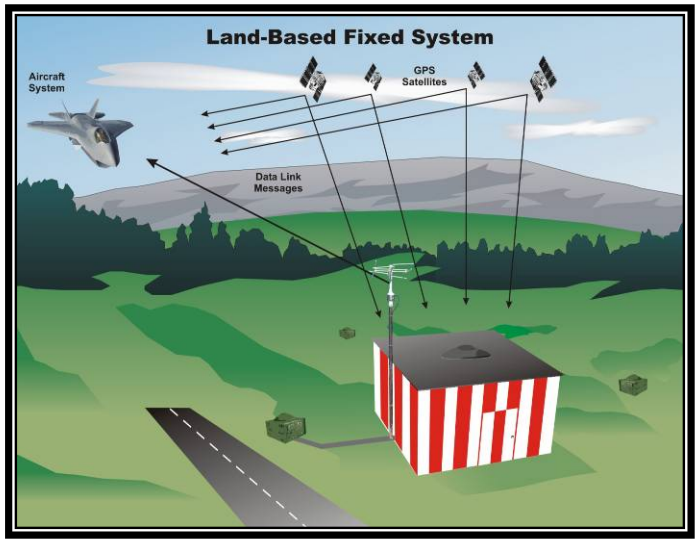
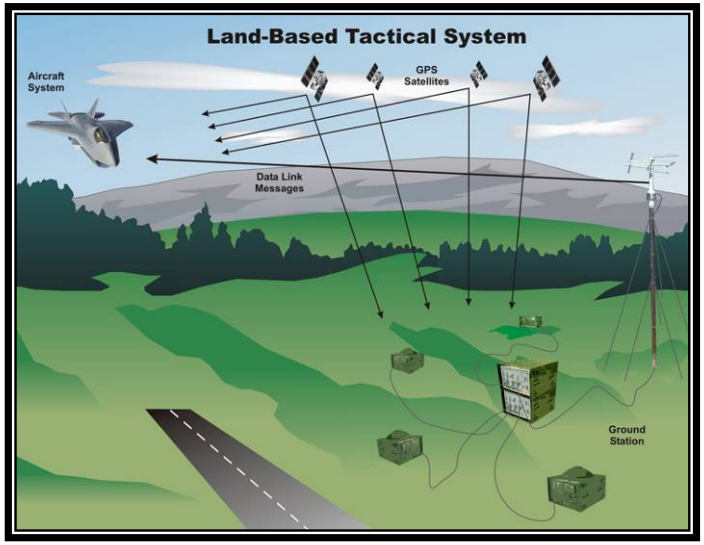


Land-Based JPALS

- **Uses local area differential GPS (LDGPS) to provide a precision approach and landing capability for fixed and tactical operations**
- **Aircraft receives data link messages from the ground station containing GPS range corrections and runway data used to derive a differentially corrected navigation solution**



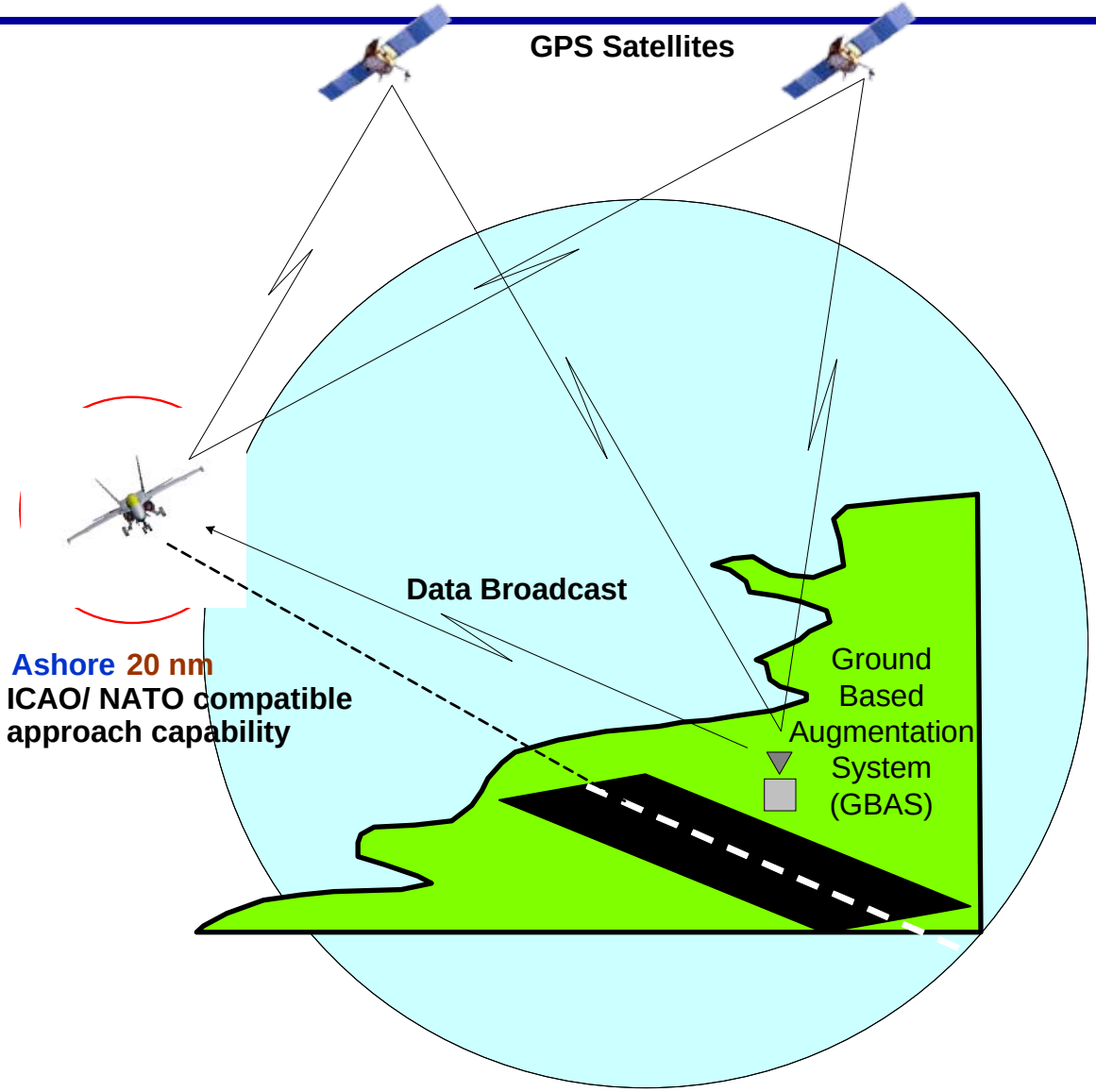


Man-Pack Prototype

- **641 ELSS began developing a Proof of Concept system in July 2007**
  - Demonstration ground system in two backpacks
  - Capable of landing an aircraft
  - Rapid prototyping
  - Minimal cost
  - Commercial off-the-shelf components
- Successfully demonstrated multiple precision approaches in November 2007 at the FAA Flight Tech Center
- Technology still in infant stages with size, weight, configuration and power challenges in order to support sustained operations

Deployed Man-Pack Prototype

Civil Interoperability



JPALS Current Status

- Navy became Lead Service March 2007
- Navy RDT&E lead for ship's system development
- Air Force RDT&E lead for land based development
- Ship's system contract award late summer 2008
- Aircraft Integration Guide in 2010
- Initial Shipboard testing 2012
- F/A 18 Lead platform, MH-60, C-2/E-2
- Ship's System IOC 2014
- Land Based IOC 2016

Summary

- GPS-based system comprised of Ship Systems, Aircraft Systems, and data link.
- Single Joint system replacement for multiple obsolete ship, shore, and tactical systems.
- Supports Joint Service, civil, and international interoperability.
- Ensures the availability of air assets at a time and place as tasked by higher authority
- Scheduled Initial Operational Capability (IOC) is in 2014, Full Operational Capability (FOC) is in 2024
- JPALS and Avionics integration over 10 year period results in maintaining legacy systems until FOC