A Methodology for Network-Centric Electronic Attack Evaluation

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Agenda

- Background
- Network Centric (NC) EA Evaluation Methodology
  - ITT Network-Centric EA Model
  - Extended Air Defense Simulation (EADSIM) Model
- Applications of NC-EA and EADSim Models
  - Assessment of Jamming Effectiveness
  - Re-alignment of Jamming Assets
  - Trade Study of Radar Cross Sections
- Summary

Network-Centric Electronic Warfare

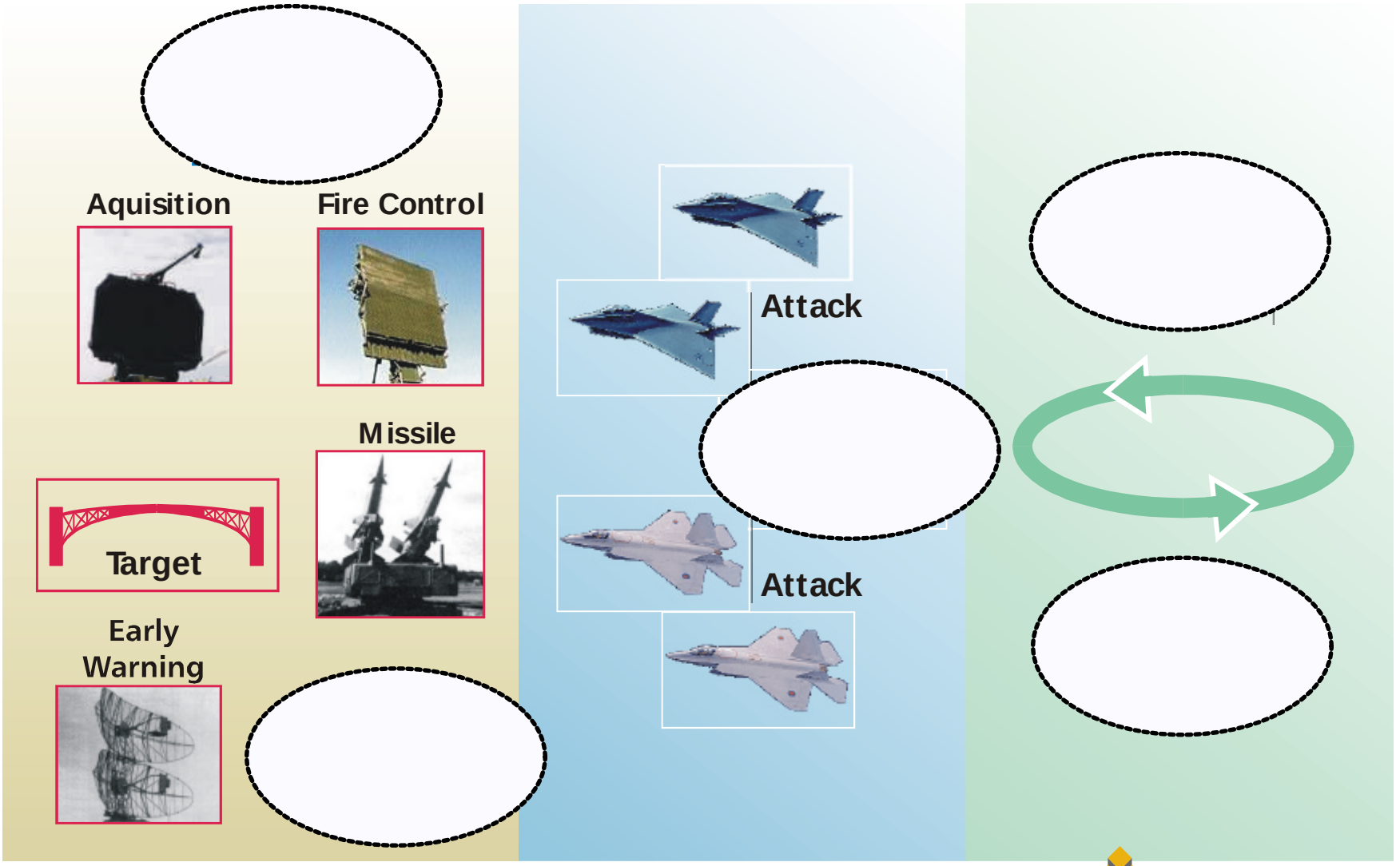
- **Network Centric Architecture:**
  - **An operational architecture that closely couples the capabilities of sensors, command and control, and shooters to maximize the effects of geographically dispersed resources in electronic warfare**

- **Network Centric Electronic Attack:**
  - **Optimum control and utilization of a network of dispersed electronic attack (EA) assets to provide a wide area suppression of enemy integrated air defenses (IADS) in a dynamic manner**

Network-Centric Electronic Attack Evaluation

- **Evolution from Platform-Centric to Network-Centric (NC) EA Requires New Methodology to Develop and Evaluate Systems:**
  - **Uses NC-EA Simulator and EADSim Model**
- **ITT Interactive NC-EA Simulator**
  - **Implements radar jamming equation**
  - **Generates jamming effectiveness contour map in area of interest**
  - **Allows selection of optimum EA for Stand-off, Stand-in, Escort and Close-in systems based on J/S contours and "protected area"**
- **Extended Air Defense Simulation (EADSim) Model**
  - **Includes all IADS radars (3-D patterns) and detailed C^2**
  - **Uses NC-EA Simulator results to quantify jamming effectiveness in aircraft protection (reduction in number of missiles launched)**

NC-EA Elements (Notional)



ITT Interactive NC-EA Simulator

- Inputs:
  - IADS Laydown (Radar Locations)
  - Threat Radar Characteristics (ERP's, Antenna Patterns,..)
  - Jamming Platform Locations
  - Jammer Characteristics (ERP's, Allocations,…)
  - Attack Aircraft Flight Path
  - Attack Aircraft RCS

- Outputs:
  - Jam/Signal Ratio Contour Plots
    - One-on-One: One jammer vs one radar
    - Composite: "N" jammers vs "M" radars
  - Percentage of "Blue Zone" in Area of Interest
  - 1 NM x 1 NM Cell Resolution illustrating Mainbeam Effect in Support Jamming

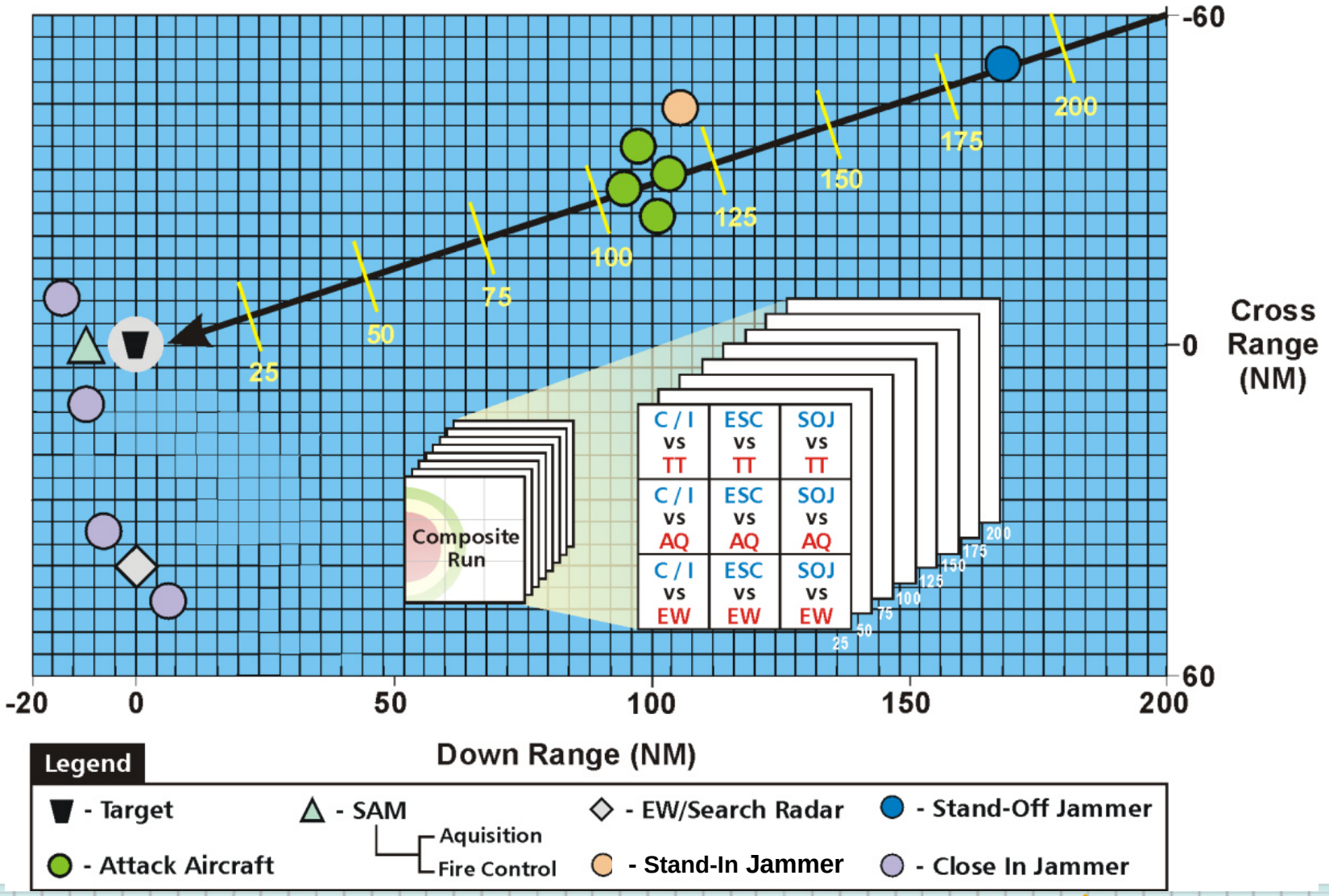
Extended Air Defense Simulation (EADSim) Model

- **Extended Air Defense Simulation - U.S. Army Space and Missile Defense Command Model**
- **A DoD standard mission-level stochastic model**
- **Focuses primarily on**
  - **Events occurring within an Integrated Air Defense System (IADS) including:**
    - **C^2 decision logic**
    - **SAM and AI operations**
    - **Intelligence, Surveillance and Reconnaissance**
    - **Electronic Attack and Suppression of Enemy Air Defense (SEAD)**
  - **Ballistic and Cruise missile employment & defense**

EADSim Electronic Attack Modeling Capability

- **Ability to model EA systems to a high level of fidelity**
  - **Platforms (Stand-off, Stand-in, Close-in, Self Protection)**
  - **Techniques (Deception, Noise, Decoys)**
- **Calibrated to match NC-EA model**
  - **Radar coverage defined by detailed antenna pattern diagram**
  - **Calibrated J/S and burn-through range with NC-EA jammers**
- **Graphical Outputs**
  - **Vertical coverage plots displaying radar antenna pattern with and w/o jamming**
  - **Intervisibility plots displaying detection area with and w/o jamming**
- **Analytical Outputs**
  - **Denied/delayed detection by EW/Acquisition/Fire Control radars**
  - **Reduced number of SAM shots due to EA**

Modeling Scenario



Jamming Effectiveness Assessment

Interactive Simulation Model

Table 1: IADS Example

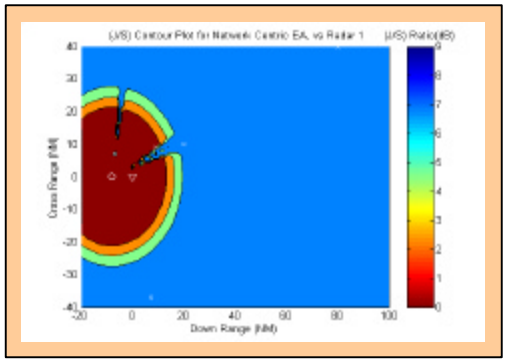
	Cross Range, NM	Down Range, NM
Target	0	0
R1, SAM 1, Tracking Radar	0	-8
R2, SAM 1, Acqu Radar	0	-8
R3, SAM 2, Tracking Radar	16	16
R4, SAM 2, Acqu Radar	16	16
R5, Early Warning Radar	-36	0

Table 2: NC-EA Assets Example

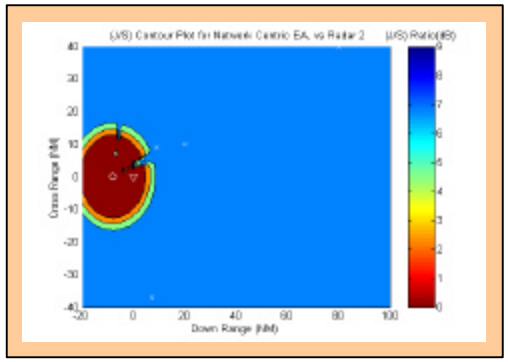
	Cross Rng (NM)	Down Rng (NM)	Jamming vs R1	Jamming vs R2	Jamming vs R3	Jamming vs R4	Jamming vs R5
Stand-off	40	80	50 KW	25 KW	50 KW	25 KW	1 KW
Stand -In	10	20	10 KW	2.5 KW	10 KW	2.5 KW	
Close-In 1	7	-7	100 W				
Close-In 2	7	-7		100 W			
Close-In 3	9	9			100 W		
Close-In 4	9	9				100 W	
Close-In 5	-37	7					50 W

NC-EA Model Calibration

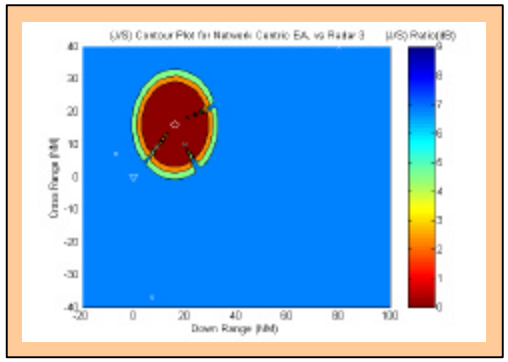
Jamming Effects on Individual Threats (A/C RCS = A dBsm)



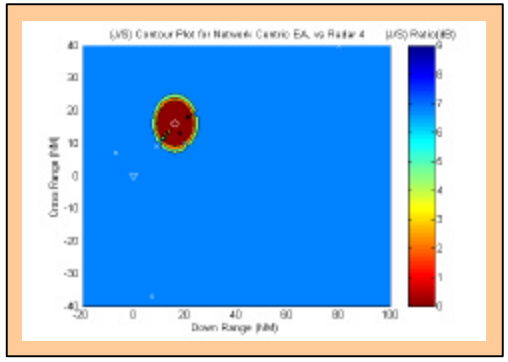
Jamming on R1



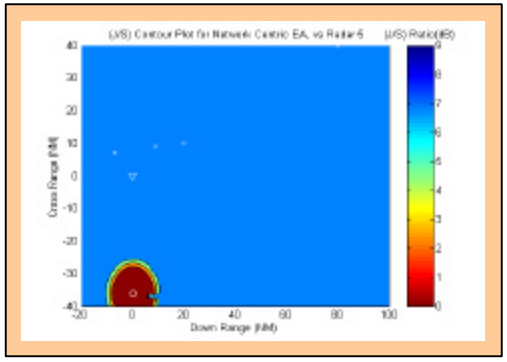
Jamming on R2



Jamming on R3



Jamming on R4



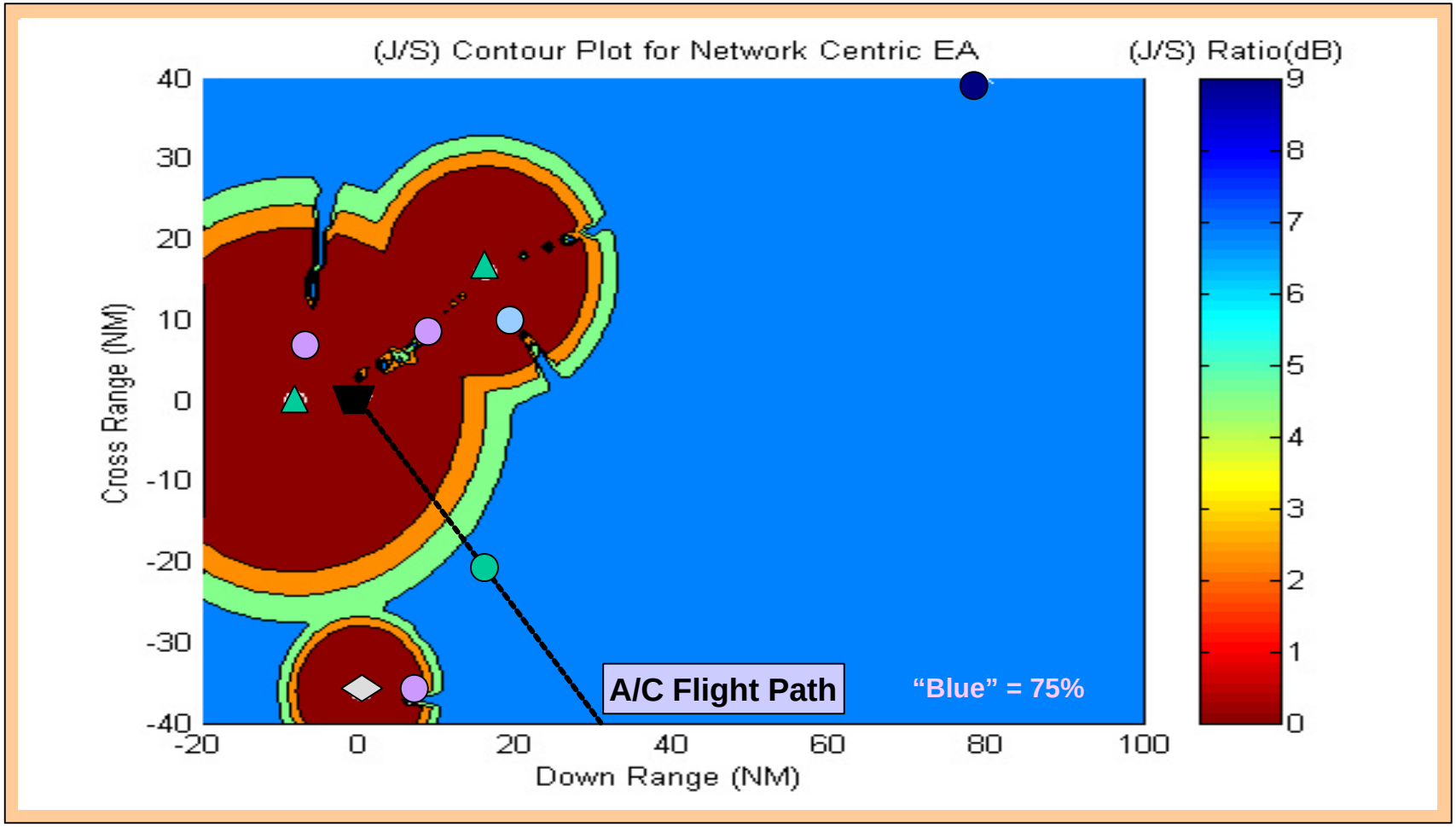
Jamming on R5

Target SAM (Acq / Track) Early Warning

Attack A/C Standoff Jammer Stand-In Jammer Close-In Jammer

NC-EA Model Results

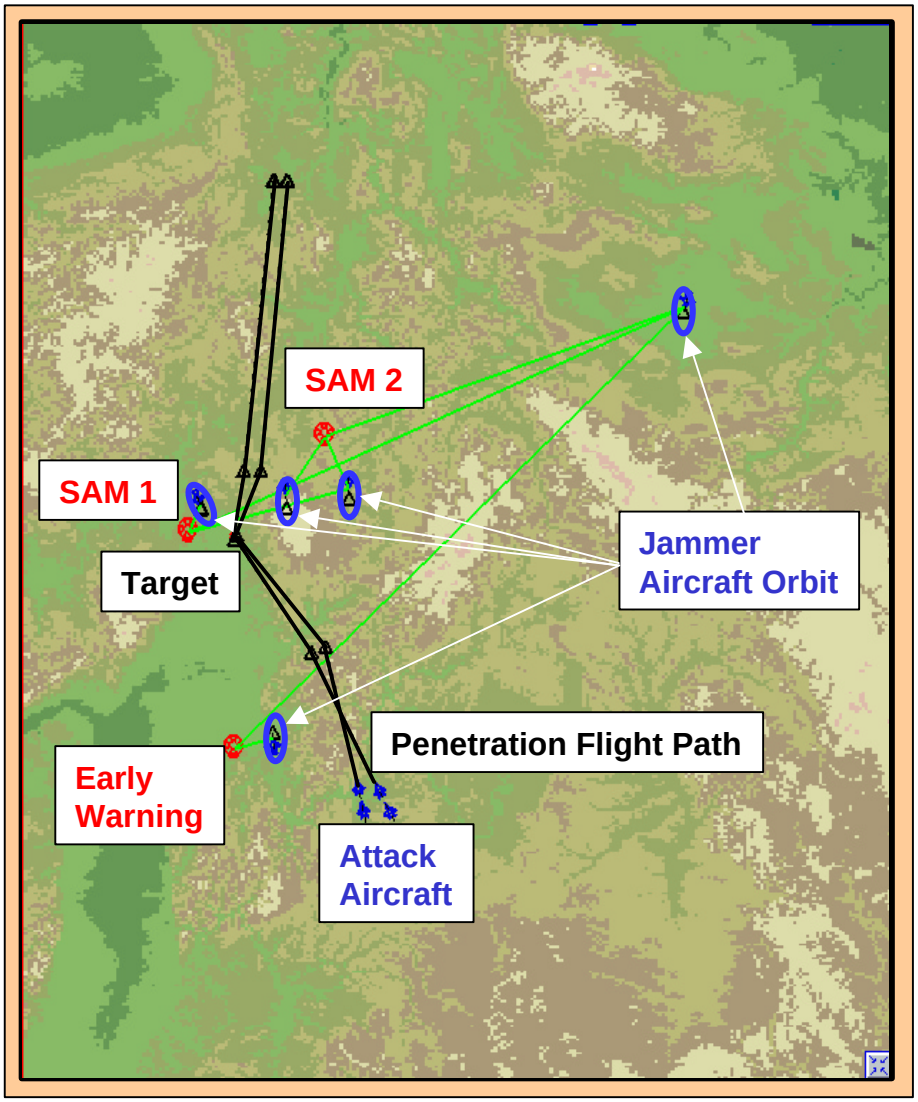
(Attack Aircraft RCS = A dBsm)



Target SAM (Acq / Track) Early Warning

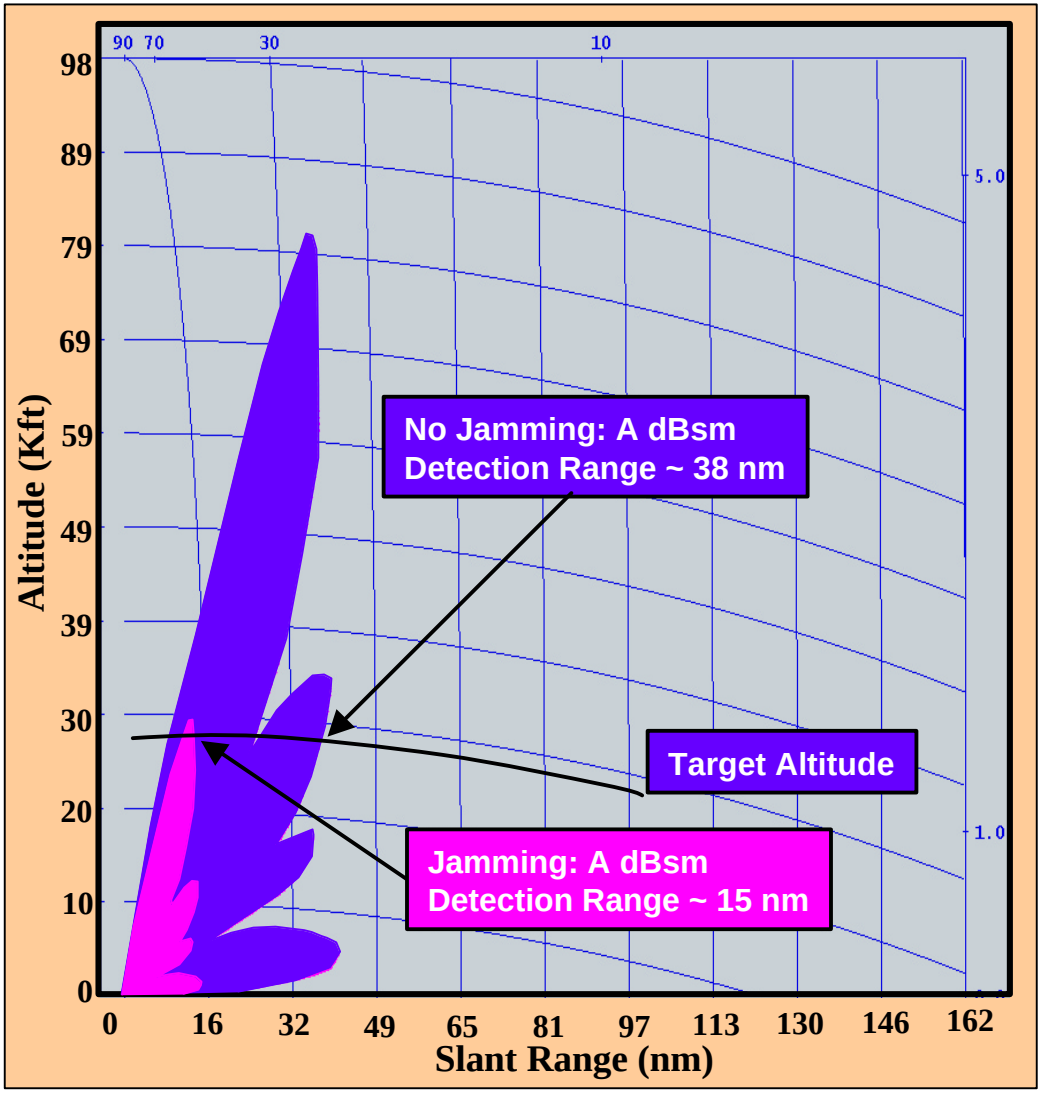
Attack A/C Standoff Jammer Stand-in Jammer Close-In Jammer

EADSim Scenario and Laydown Description



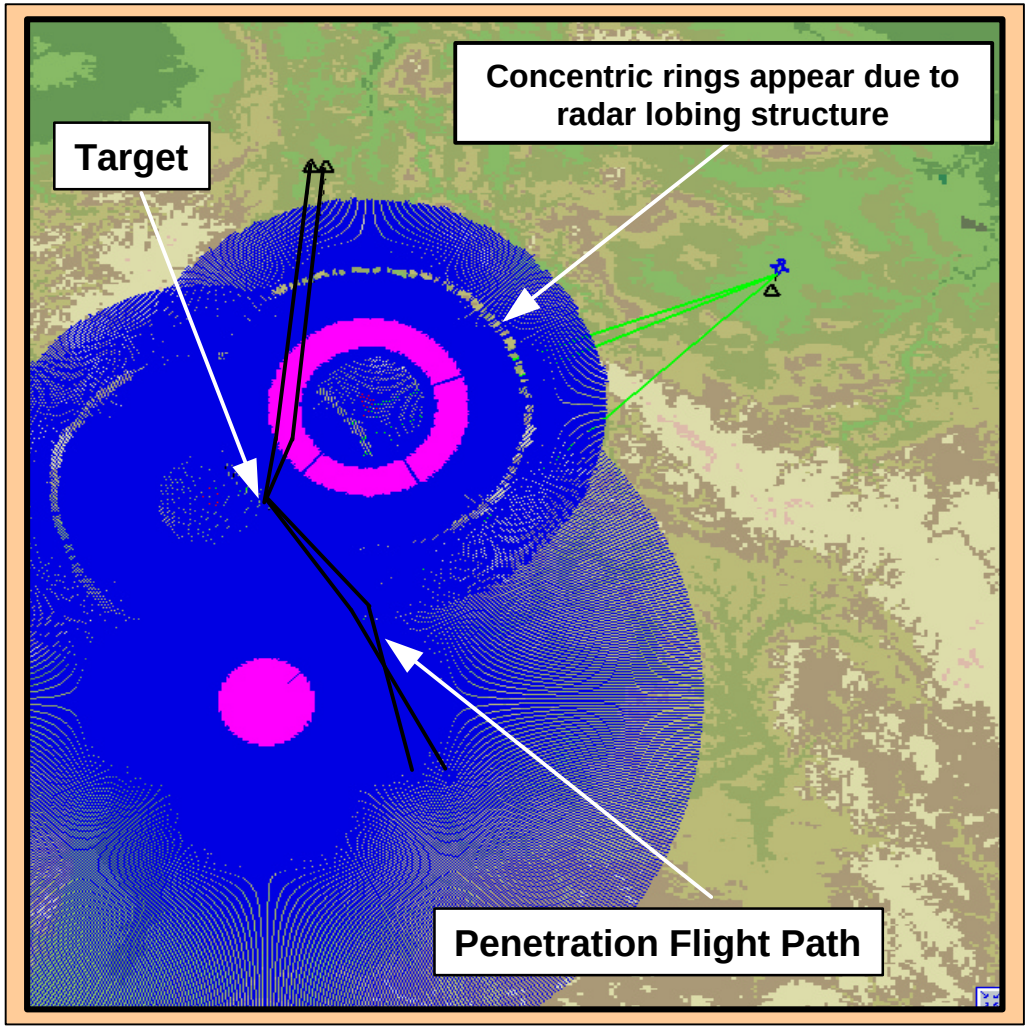
- Threats (consistant with NC-EA model)
  - One Early Warning Radar
  - Two SAMs (Acquisition & Target Track Radar)
- Blue Systems
  - Four Attack Aircraft
    - Speed = 350 Knots
    - Altitude = ~ 27K ft.
    - Flight path: South to North
    - Two – 2 ship flights
  - Seven Jammer Aircraft
    - Altitude = ~ 27K ft.
    - Flying short orbit legs

EADSim Results
Elevation Coverage Plot for Acquisition Radar



- Modeling Radar in EADSim
  - Basic parameters (frequency, beam dimensions, scan parameters, power, losses, etc.)
  - Ability to input complex antenna pattern to define radar coverage in detail

EADSim Results
(Intervisibility Plot Coverage for Attack A/C RCS = A dBsm)

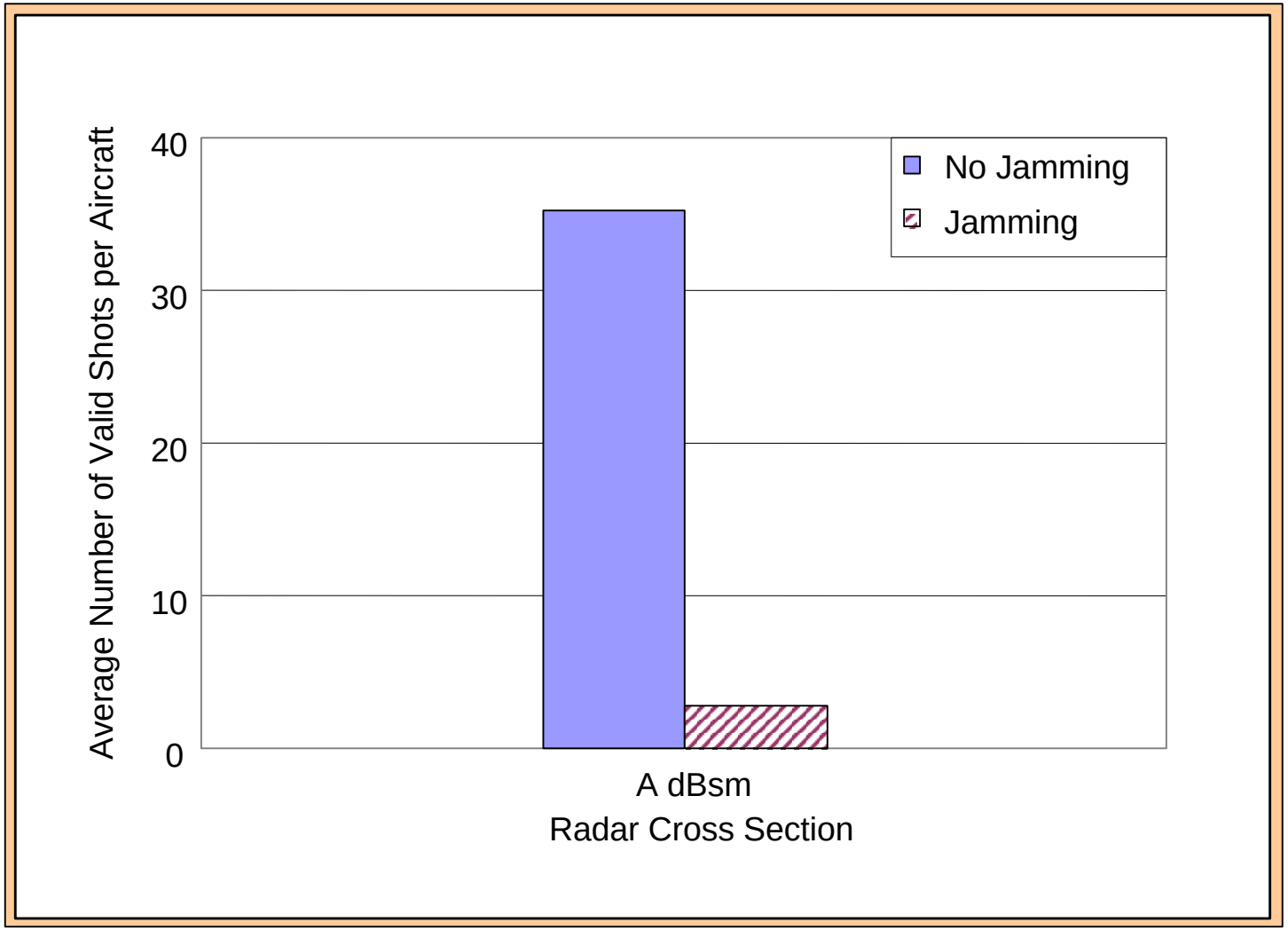


Detectability Region

- No Jamming
- Jamming

Electronic Attack opens corridors for ingress by limiting detection capability of SAM acquisition radars

EADSim Results
Impact of Assets on Attack Aircraft



Re-Alignment of NC-EA Assets

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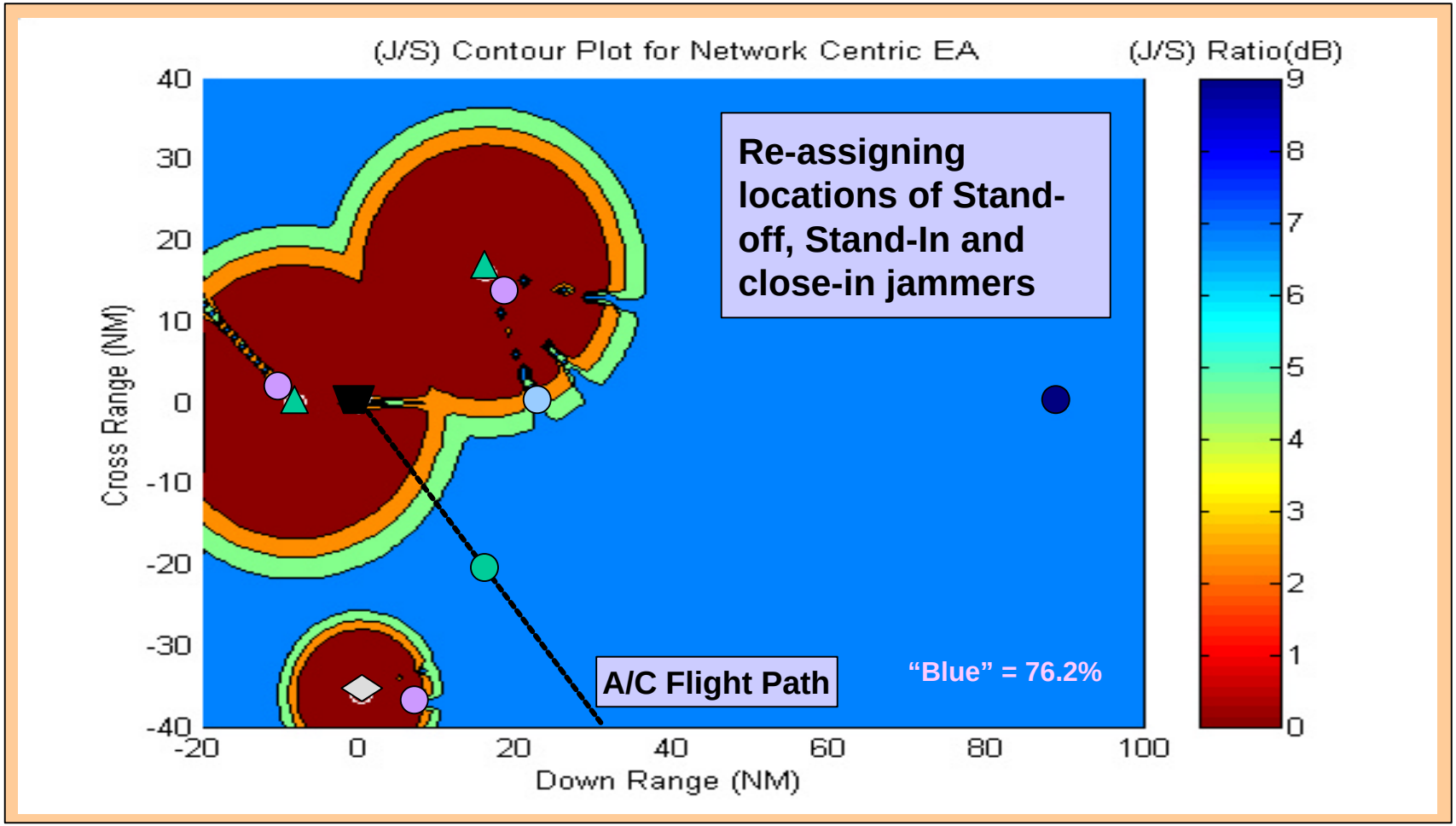
NC-EA Model Results

(Attack Aircraft RCS = A dBsm)

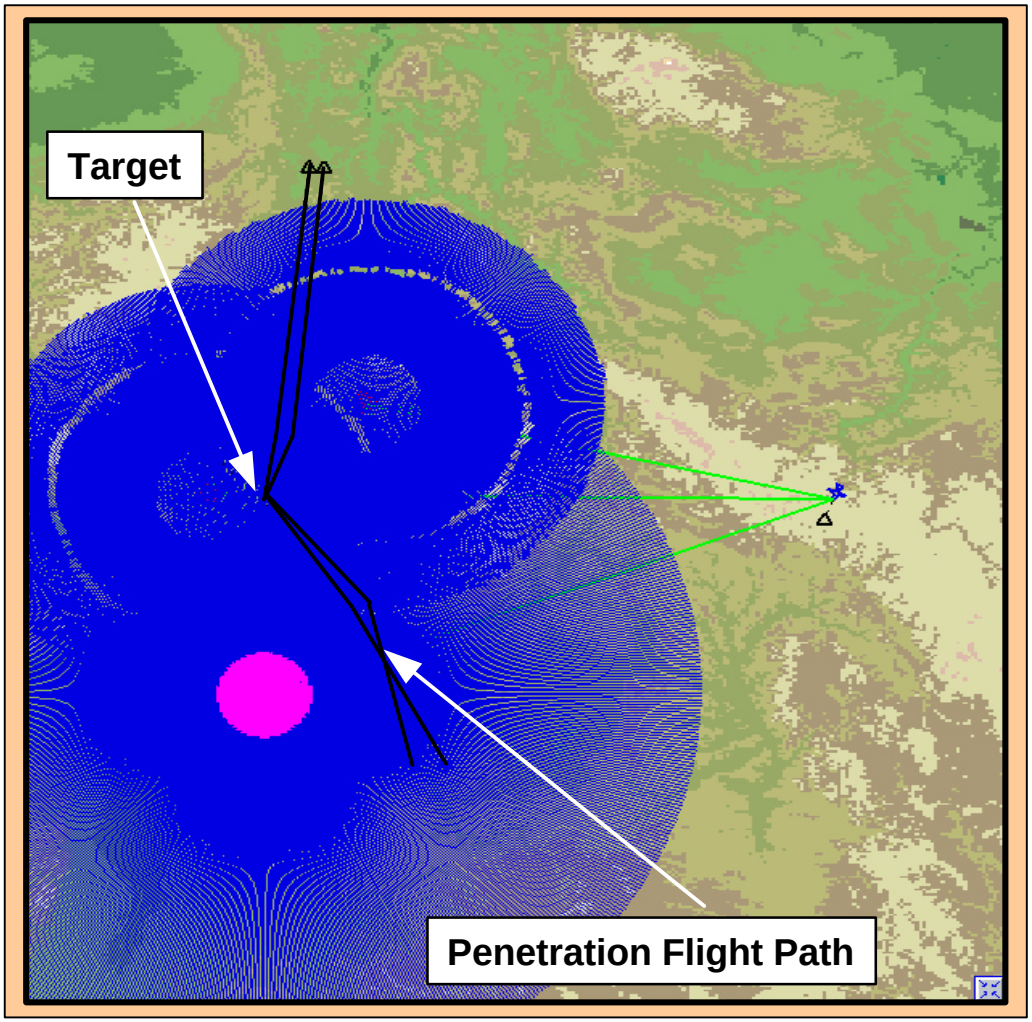


Target SAM (Acq / Track) Early Warning

Attack A/C Standoff Jammer Stand-in Jammer Close-In Jammer

EADSim Results

(Intervisibility Plot for Attack A/C RCS = A dBsm)



Detectability Region

- No Jamming
- Jamming

Re-aligning assets results in complete overflight of SAM acquisition radars

Trade Study of Radar Cross Sections

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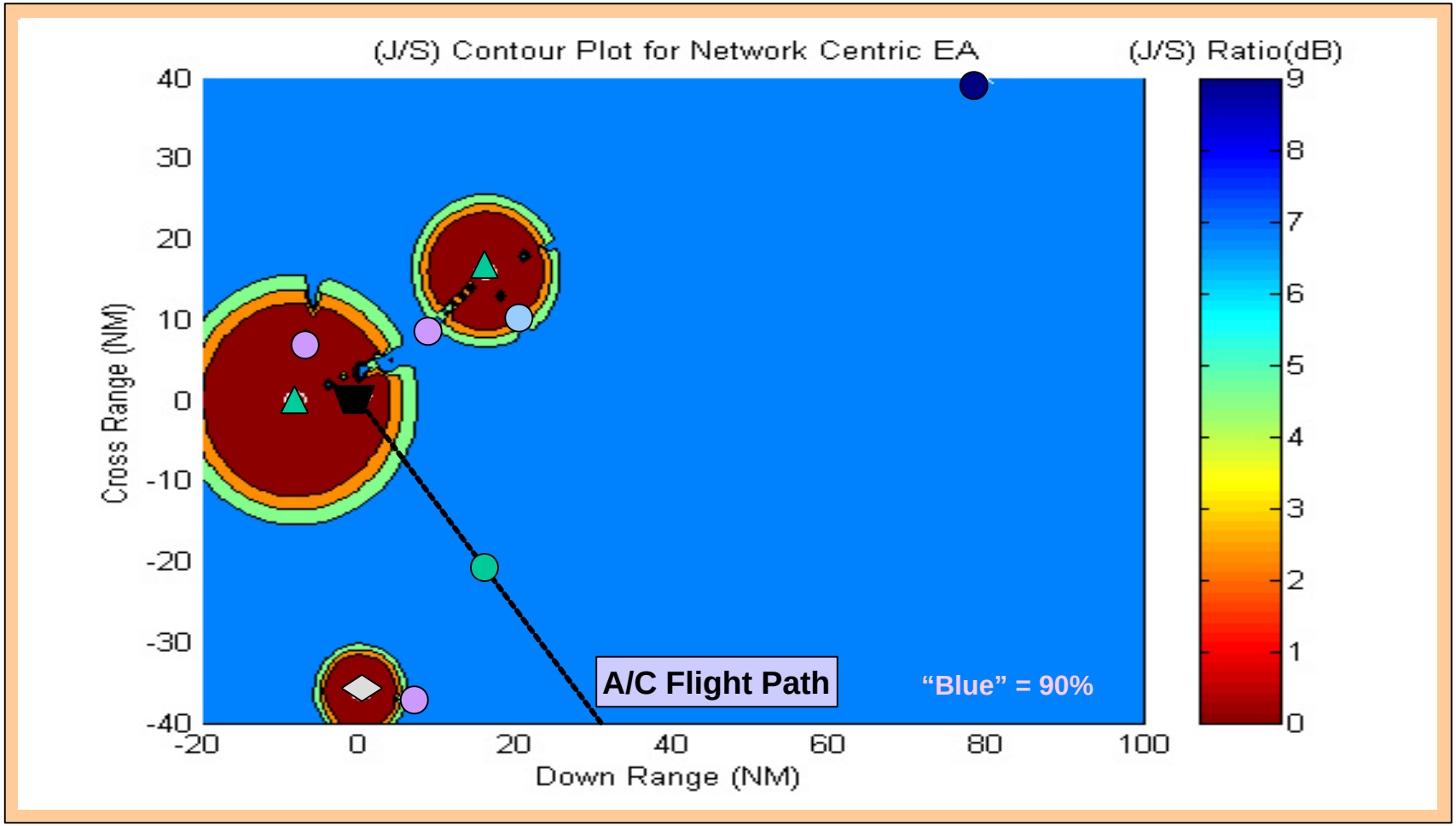
NC-EA Model Results

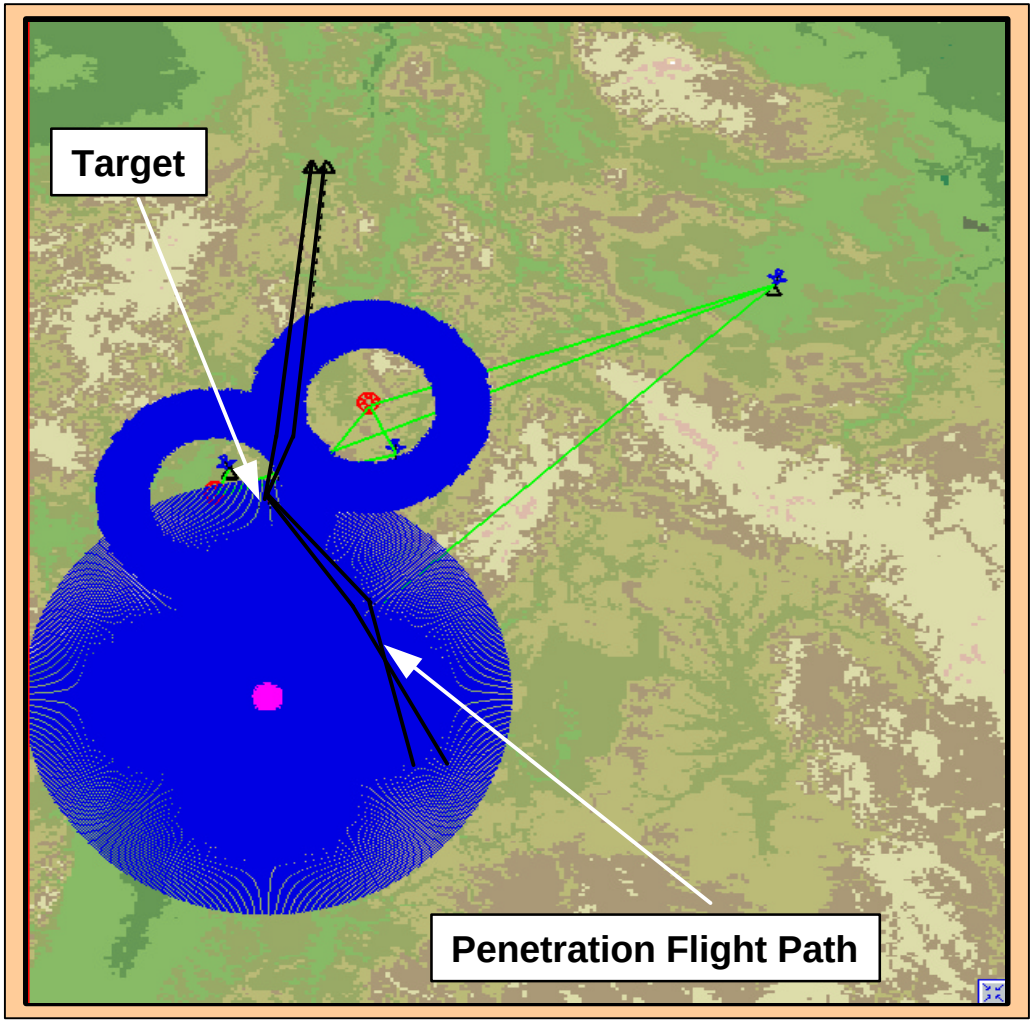
(Attack Aircraft RCS = B dBsm)



Target SAM (Acq / Track) Early Warning

Attack A/C Standoff Jammer Stand-in Jammer Close-In Jammer

EADSim Results
(Intervisibility Plot Coverage for Attack A/C RCS = B dBsm)

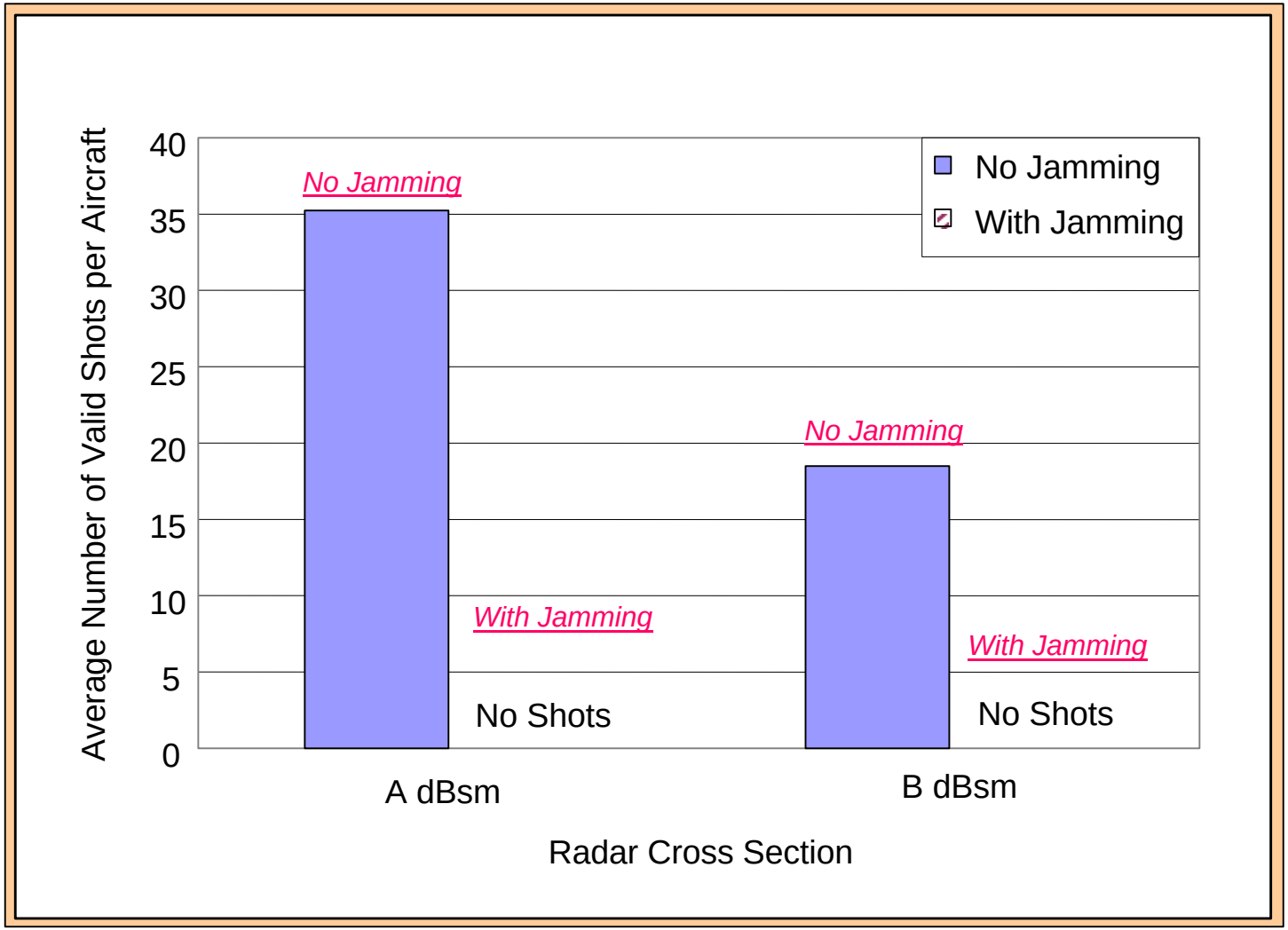


Detectability Region

- No Jamming
- Jamming

Reduced ingressor RCS combined with EA assets ensure complete overflight of IADS threats

EADSim Results
Impact of Realigned Assets and Lower RCS on Attack Aircraft



Summary

- **NC-EA Evaluation Methodology Can Support:**
  - **Development of system requirements for EA system development**
  - **Pre-mission planning**
  - **Real-Time jammer assets tradeoff, re-alignment and reaction**
- **Lessons Learned from NC-EA and EADSim Modeling:**
  - **Close-In Jammers Can Be a Significant Factor but Need Dynamic and Accurate Control**
  - **Stand-in Jammers Need to Be Accurately Located or Use High ERP for Network Centric Electronic Attack (NC-EA) Operation**