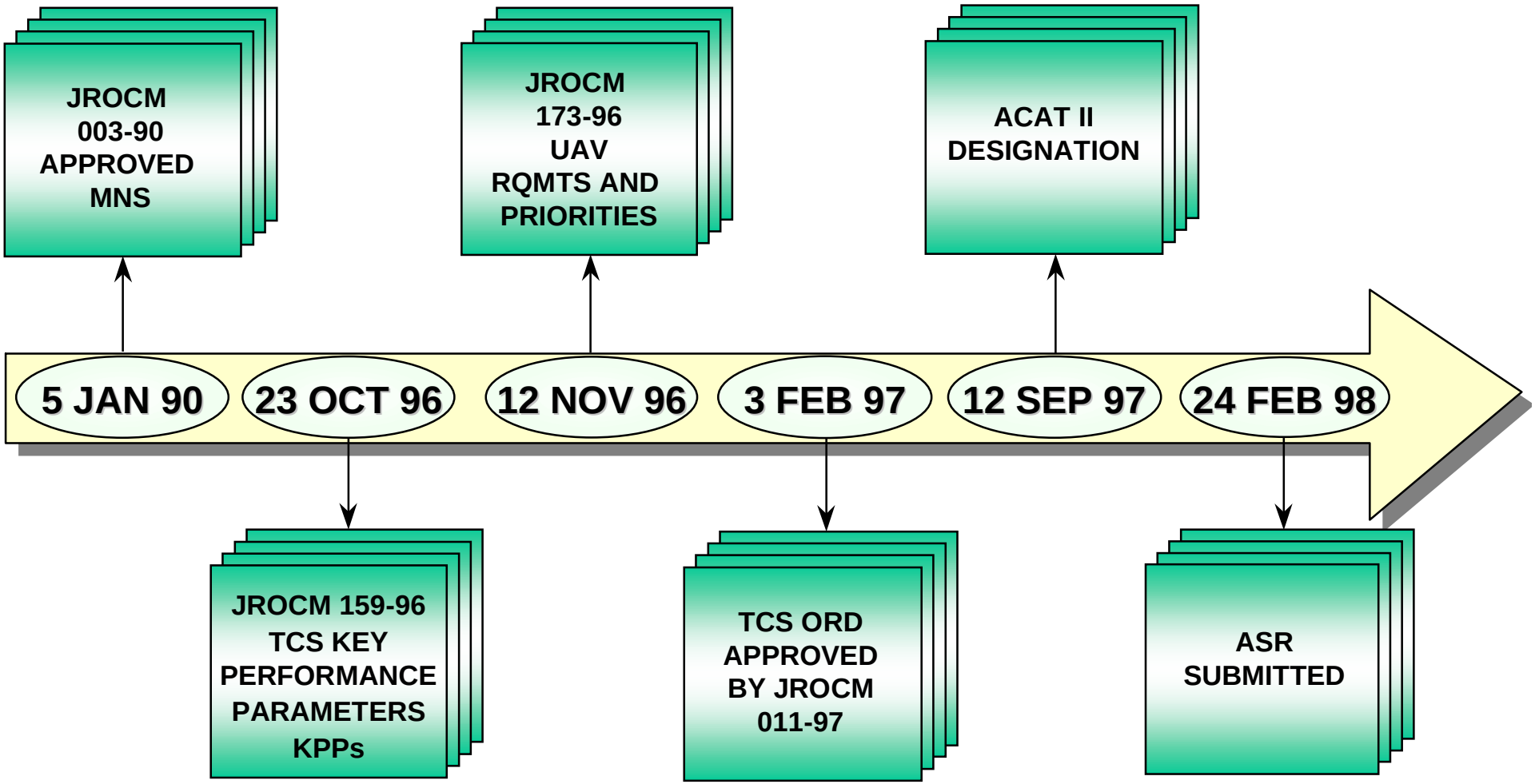
INDUSTRY BRIEF
AAA
LISA COLUZZI
7 APRIL 1998

AGENDA

- DIRECTION & REQUIREMENTS
- SYSTEM OVERVIEW
- DEMONSTRATIONS COMPLETED/PLANNED
- ACQUISITION STRATEGY
- SCHEDULE/FUNDING
- ACTIVE ARRAY ANTENNA (AAA)

PROGRAM DIRECTION



UAV TCS KEY PERFORMANCE PARAMETERS

THRESHOLD	OBJECTIVE
• MUST BE CAPABLE OF SUPPORTING MISSION PLANNING, MISSION EXECUTION, AND DATA DISSEMINATION FOR TUAV AND MAE UAV SYSTEMS.	• AND SUPPORT DATA COLLECTION FROM HAE UAV • ENSURE INTEROPERABILITY WITH OTHER UAVs AND COLLECTION SYSTEMS
• MUST BE INTEROPERABLE WITH SELECT C4I SYSTEMS IN COMPLIANCE WITH ASD (C3I) JOINT TECHNICAL ARCHITECTURE.	• SAME
• MUST BE CAPABLE OF BEING INTEROPERABLE WITH DIFFERENT TYPES OF UAVs AND UAV PAYLOADS ACROSS THE FIVE LEVELS OF UAV INTERACTION	• CAPABLE TO BE INTEGRATED AND OPERATED FROM TACTICAL COMMAND & CONTROL AIRCRAFT AND SUBMARINES
• MUST ALLOW OPERATORS TO HAVE SIMULTANEOUS FLIGHT AND PAYLOAD CONTROL OF AT LEAST TWO AIR VEHICLES, BEYOND LINE OF SIGHT, USING ONE TCS.	• AND MULTIPLE PLATFORMS/PAYLOADS SIMULTANEOUSLY • LOS LINK COMPLY WITH CDL STANDARDS • SIMULTANEOUS LOS AND BLOS

APPROVED 23 OCT 96

ORD DEFINED LEVELS OF UAV COMMAND AND CONTROL

LEVEL I

- Secondary Product

LEVEL II

- Direct Data Receipt

LEVEL III

- Payload Control
- Direct Data Receipt

LEVEL IV

- Flight Control
- Payload Control
- Direct Data Receipt

LEVEL V

- Launch & Recovery
- Flight Control
- Payload Control
- Direct Data Receipt

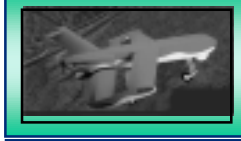
DEMOS: OPERATIONAL TOMAHAWK LAUNCH 203, TASK FORCE XXI, JWID 97, USS TARAWA FLEETEX, OUTRIDER/HONDO, TX

PREDATOR WAYPOINT AND PAYLOAD PLANNING (LAB)

TACTICAL CONTROL SYSTEM

HAE

Predator



Outrider

Pioneer

Hunter

VTOL/
Future UAV

Other
Platforms

PROVIDE AN INTEROPERABLE AND SCALEABLE COMMAND, CONTROL, COMMUNICATIONS AND DATA DISSEMINATION SYSTEM FOR THE FAMILY OF TACTICAL, MAE, AND FUTURE UAVS

(RECEIVE
ONLY)

TCS

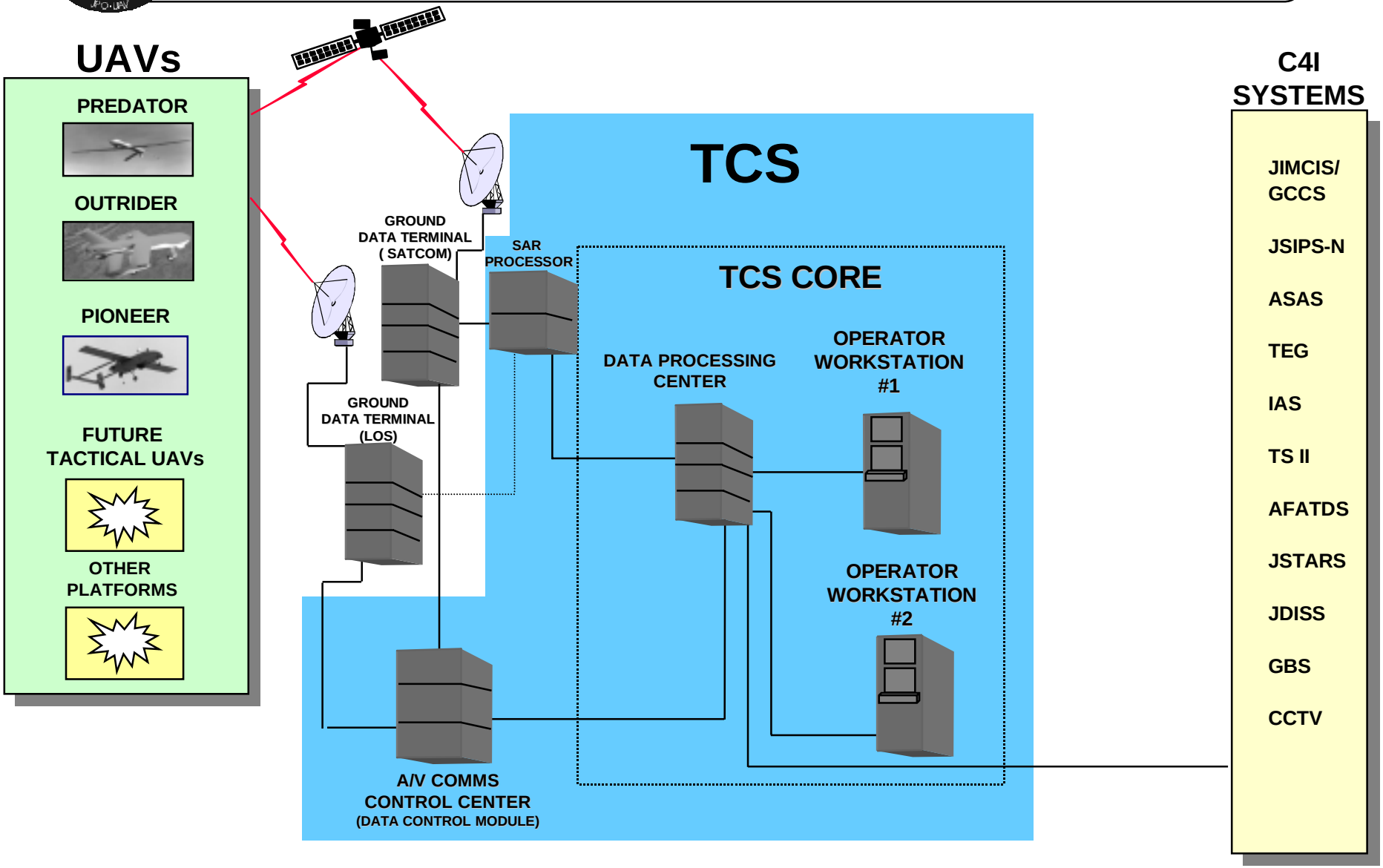
MULTIPLE TYPE UAV & PAYLOAD CONTROL	C4I INTERFACES FOR IMAGERY & DATA

- TCS
- ASAS
- JSTARS GCS
- AFATDS
- MIES
- IAS
- ATHS
- ADOCS
- ATWCS
- TROJAN SPIRIT II
- COMPASS
- GUARDRAIL ACS/IPF
- JDISS
- JSIPS-N
- TEG
- JSIPS
- JMCIS
- TBMCS
- CCTV
- ETRAC
- CARS
- MISSION PLANNERS

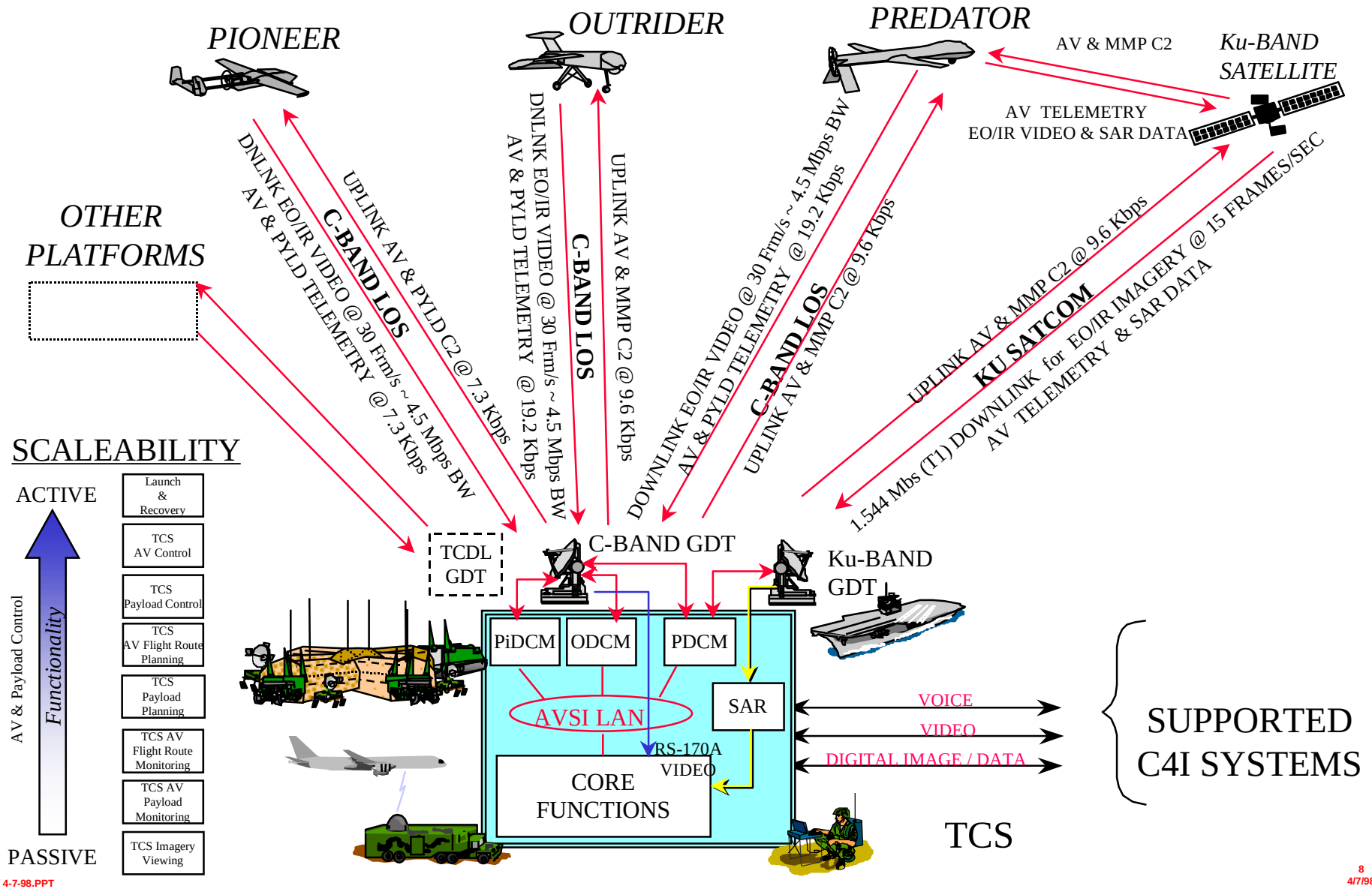
FUNDED EFFORT

UNDER CONSIDERATION

TACTICAL CONTROL SYSTEM



TCS SYSTEM OPERATIONAL ARCHITECTURE



TCS IOC CAPABILITIES

C^2: Multi-Air Vehicle Level 5 (manual L/R)

- **1 Outrider (LOS)**
- **1 Pioneer (LOS)**
- **1 Predator (LOS or BLOS)**
- **2 Predator (BLOS)**

Payloads: EO, IR, SAR

C4I: AFATDS, ASAS, CCTV, JDISS, JMCIS, JSIPS-N, JSTARS, TEG, IAS, TSII

Antenna Requirements: 1 LOS, 1 BLOS

Navy

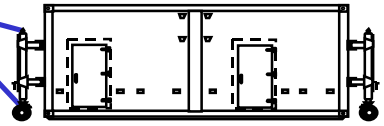
L-Class/LPD

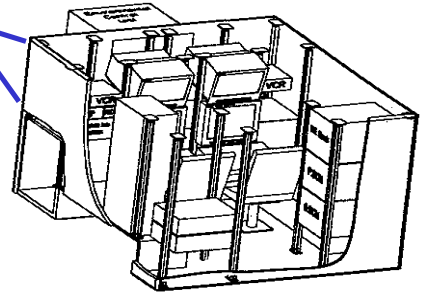
Air Force

Predator Shelter

Army/Marine Corps

HMMWV Based:
SICPS Based Shelter





TCS MULTI-UAV
DEMO RESULTS TO DATE

PREDATOR

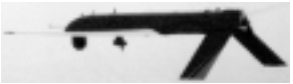
- 3 FLIGHTS
- 6 HOURS
- LEVEL II EO RECEIPT
- EL MIRAGE, CA
- JWID-97 (MUSE)

PIONEER

- 2 FLIGHTS
- 2.3 HOURS
- LEVEL II EO RECEIPT
- FLEETEX & SOCCERT

OUTRIDER

- 2 FLIGHTS
- 3 HOURS
- LEVEL II EO RECEIPT
- HONDO, TX

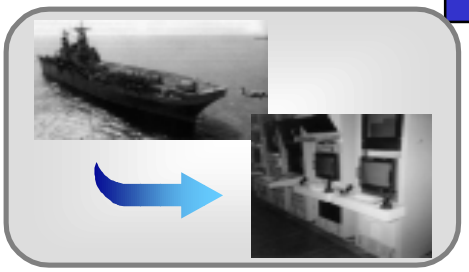


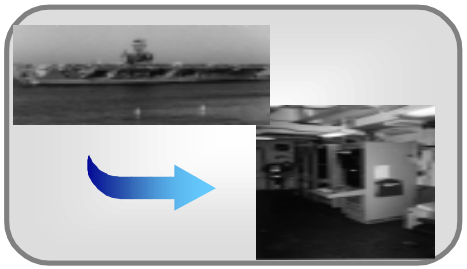
GNAT 750
(PREDATOR SURROGATE)

- 11 FLIGHTS
- 78 HOURS
- LEVEL II EO RECEIPT
- FLEETEX & TFXXI

HUNTER
(TUAV SURROGATE)

- 50 FLIGHTS
- 250 HOURS
- LEVEL II EO RECEIPT
- TFXXI





C4I CONNECTIVITY

ASAS
AFATDS
CCTV
JMCIS
JSIPS-N/PTW
JDISS
JSTARS AICGS
ADOCS
NWCS

TCS PHASE I UAV CONTROL CAPABILITIES

DEMONSTRATION MILESTONES

GOAL: PROVIDE INTEROPERABLE C2 (LEVEL I - V) AND DATA DISSEMINATION FOR TACTICAL AND MAE UAV'S

3/97
PREDATOR EO/IR
LOS RECEIPT
LEVEL I/II

4/97
PREDATOR SAR
LOS RECEIPT
LEVEL I/II (LAB)

5/97
HAE EO
LOS RECEIPT
LEVEL I/II (LAB)

9/97
OUTRIDER EO
LOS RECEIPT
LEVEL I/II (LAB)

2/98
OUTRIDER EO
LOS RECEIPT
LEVEL I/II (FIELD)

PREDATOR (FIELD)
OUTRIDER (LAB)
WAYPOINT & PAYLOAD
CONTROL LEVEL III/IV

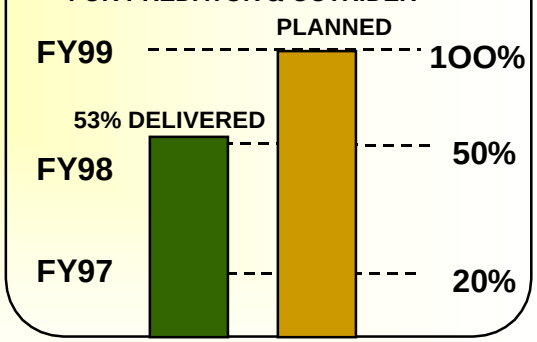
OUTRIDER (FIELD)
WAYPOINT
CONTROL LEVEL III/IV

PREDATOR / OUTRIDER
MULTI-UAV CONTROL
LEVEL IV/V

MAR 97 | MAY 97 | JUL 97 | SEP 97 | MAR 98 | APR 98 | JUN 98 | AUG 98

MEASURING SUCCESS

METRIC: LEVEL V CAPABILITY
FOR PREDATOR & OUTRIDER



TCS UPCOMING EVENTS

APR 98	SI CONTRACT RFP RELEASE (IN REVIEW ASN(R,D&A))
APR 13-24 98	PREDATOR 2A/2B WAYPOINT & PAYLOAD CONTROL - NAS FALLON, NV
MAY 98	PREDATOR 1A SAR DEMO - EL MIRAGE, CA - NSWCDD DAHLGREN, VA
MAY 98	OUTRIDER 2A LAB DEMO - SIL OR HONDO,TX
MAY 13 98	SI CONTRACT PROPOSALS DUE
JUN 98	CRITICAL DESIGN REVIEW (CDR)
JUL 98	OUTRIDER 2A/2B DEMO WAYPOINT & PAYLOAD CONTROL - HONDO, TX
AUG 98	MULTI-UAV CONTROL, DEMO 2C - NAS FALLON, NV
AUG 98	PREDATOR LAUNCH & RECOVERY DEMO 2C - NAS FALLON, NV
AUG 98	NATO TCS/SEAMOS DEMO
AUG-SEP 98	OUTRIDER LAUNCH & RECOVERY DEMO 2C - HONDO, TX
SEP 15 98	MILESTONE II PROGRAM DECISION MEETING (PDM)
SEP 18 98	MS II ACQUISITION DECISION MEMORANDUM (ADM)
SEP 30 98	SI CONTRACT AWARD

NATO

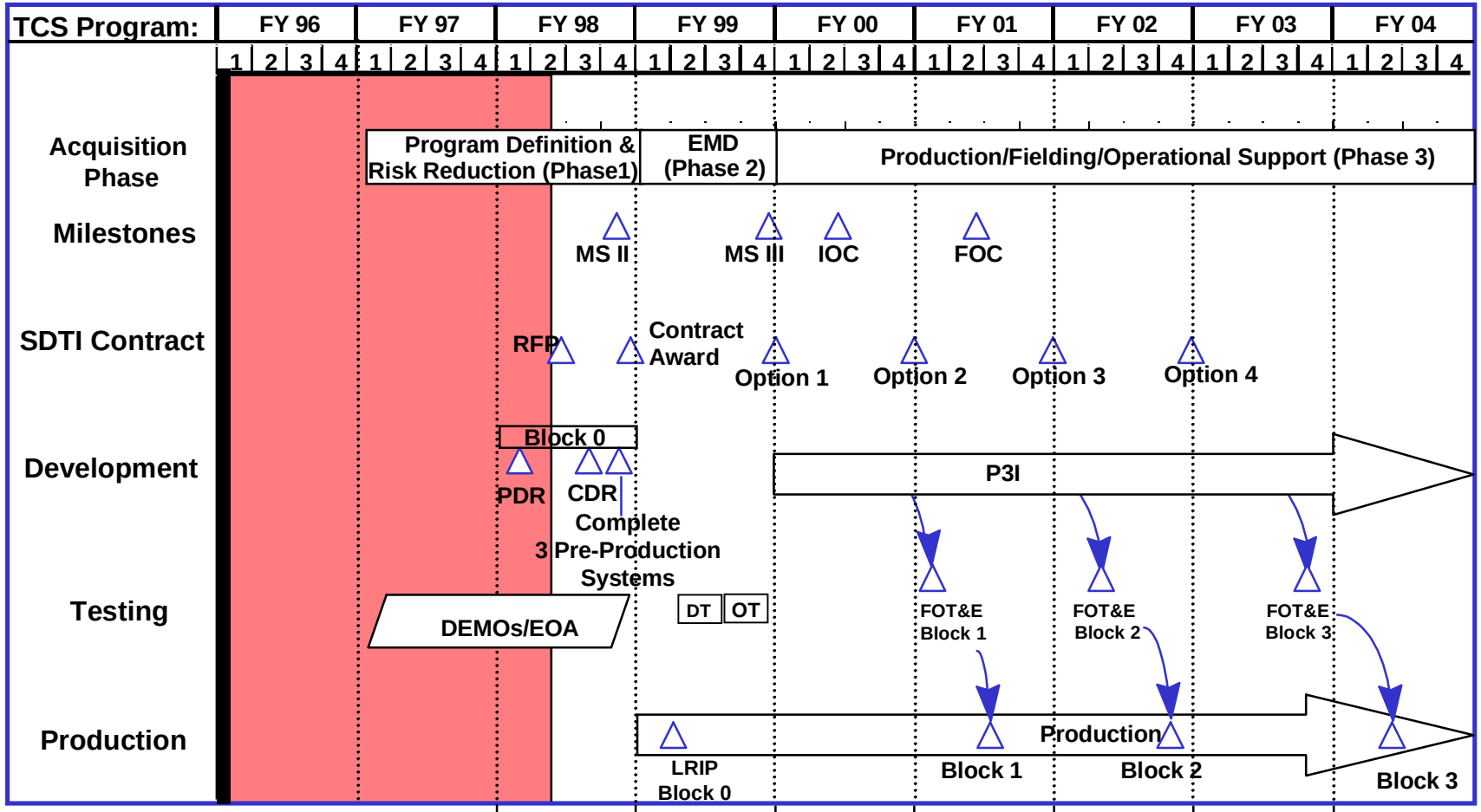
- <u>GERMAN/US</u> TACTICAL REQUIREMENTS DATA PACKAGE (TRDP) PROJECT AGREEMENT SIGNED 18 JULY - ASN (RDA) AND GERMAN MOD
  - VTOL UAV LAND BASED FLIGHT TESTING INTEGRATED WITH TCS (DEMO WITH SEAMOS VTOL UAV DEC 97 - SEPT 98)

- <u>UK/US</u> INTERNATIONAL R & D AGREEMENT - DRAFT AT LEGAL IPO FOR REVIEW
  - UAV DIGITAL DATALINK INTEROPERABILITY TEST BED PROJECT (MOU)

- CANADA/US FMS CASE FOR TCS/MOU

- NATO ARMAMENTS GROUP PG/35 CONTINUING NATO UAV INTEROPERABILITY EFFORTS

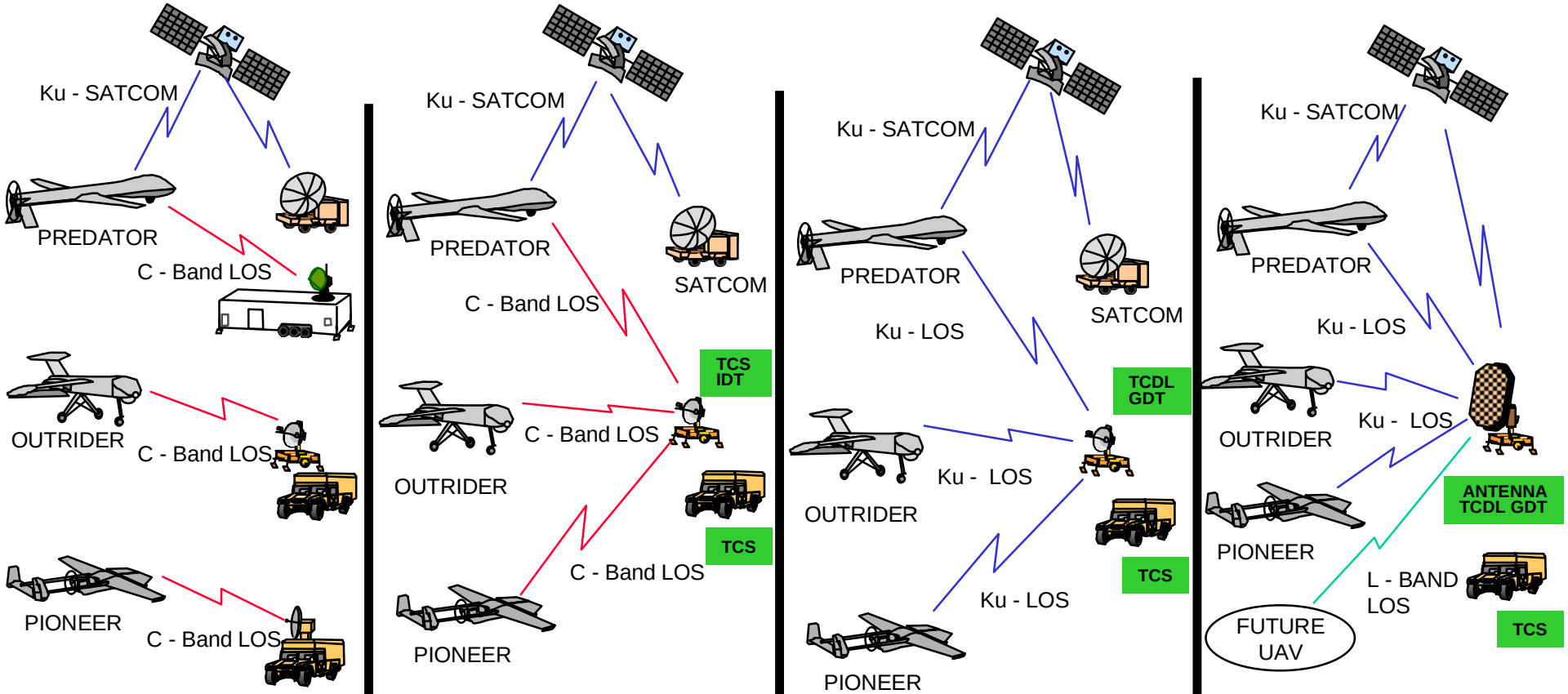
TCS SCHEDULE & FUNDING



FY 99 PRESIDENT'S BUDGET BASELINE (RDT&E)	40.5	42.5	32.1	24.9	15.9	9.6	9.6	----
POM 00 SUBMIT (RDT&E)				+6.0	+20.55	+13.5	+14.9	+22.5

NOTE: PROCUREMENT/O&S FUNDING CURRENTLY IN TUAV/PREDATOR LINES; FY00 AND BEYOND SUBJECT OF SERVICE POM SUBMITTALS

ANTENNA EVOLUTION



TODAY

- Each A/V Requires Separate Antenna
- Analog Datalink

FY99

- *1 Antenna Multiple A/V Types (Sequentially)*
- Analog Datalink

TCDL

- 1 Antenna Multiple A/V Types (Sequentially)
- *Digital Datalink*

FUTURE

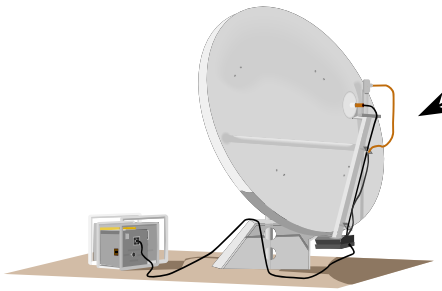
- *1 Antenna Multiple A/V Types (Simultaneous)*
- Digital Datalink

REQUIREMENTS/NEEDS

- DEMONSTRATION PROGRAM TO MEET DOD TECHNOLOGY OBJECTIVE*:
  - DEVELOP METHODOLOGIES, COMPONENTS, AND MANUFACTURING CAPABILITIES NECESSARY TO MAKE EFFECTIVE USE OF INTERCONNECTED MICROWAVE AND DIGITAL COMPONENTS TO PRODUCE SMALLER AND MORE COST EFFECTIVE ADVANCED RF SYSTEMS
  - POTENTIAL APPLICATIONS:
    - TACTICAL CONTROL SYSTEM (TCS)
    - PREDATOR MAE UAV (RELIEF ON STATION)
    - BATTLEFIELD AWARENESS AND DATA DISSEMINATION (BADD)
    - LIGHT AIRBORNE MULTIPURPOSE SYSTEM (LAMPS)
    - JOINT MARITIME COMMUNICATIONS STRATEGY (JMCOMS)

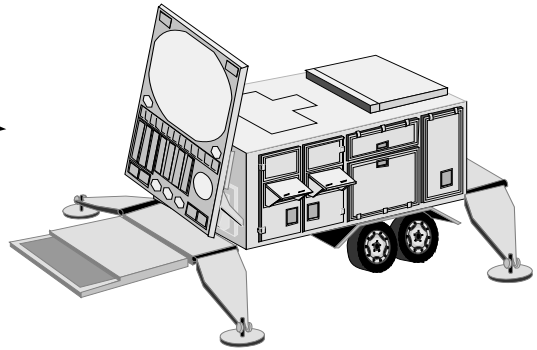
*1995 DETAILED AREA TECHNOLOGY PLAN (ELECTRONICS)

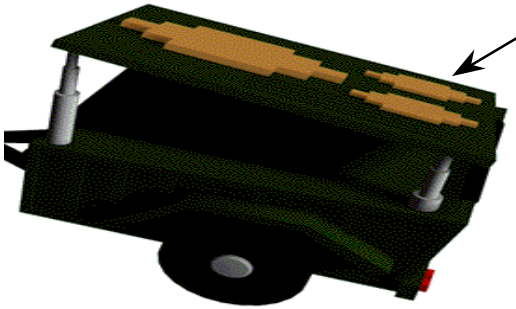
ACTIVE ARRAY ANTENNA (AAA)



Parabolic Dishes:
- Large Footprint
- Single Beam
- Mechanical Movement
- Multiple single failure points

Typical Phased Arrays:
- Single and/or Fixed Beam
- Electronic rapid beam steering
    - RADAR Oriented
- Electronic beam stabilization
- Multiple single failure points
- Hand touch manufacturing





Active Array Antennas:
- True Flat Plate: Conformal,Low profile
    - Size, Weight Improvement
- Multiple independent beams
- Electronic rapid beam Steering
- Graceful degradation,
- Automated Production

ARTIST CONCEPTION OF DISH vs. AAA

EXISTING DISH TECHNOLOGY

Typical Shipboard SATCOM Antenna

Size 14.2 ft (Dia.) x 13.5 ft (Ht.) (2,646 ft^3) (each)

Weight 1,840 lbs (each) Two antennas: 3,680 lbs

Typical Shipboard LOS Antenna

Size 7ft (Dia.) x 7ft (Ht.) (343ft^3 1 beam); 686 ft^3 multiple (2)LOS

Weight 600 lbs (1 beam); 1200 lbs (multiple (2) LOS beams)

AAA TECHNOLOGY

AAA SATCOM and LOS Active Array Antenna

Size 6.9 ft (Dia.) x .5 ft (Thickness) (18.7 ft^3)

Weight 750 lbs

AAA LOS Only Active Array Antenna (2 Beams)

Size 5 ft (Dia.) x .5 ft (Thickness) (10 ft^3)

Weight 400 lbs

Typical Combined Shipboard Multiple LOS/SATCOM Antenna (2 SATCOM*, 2 LOS)

Size 5,978 ft^3

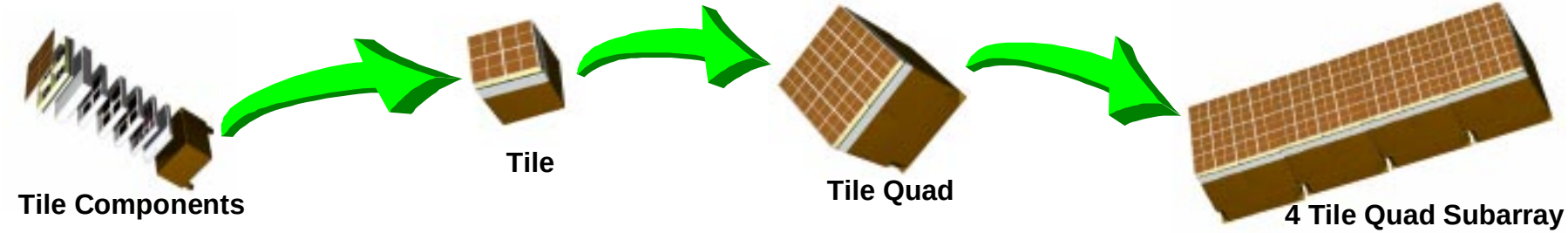
Weight 4,880 lbs * to preclude ship masking

AAA Combined SATCOM / LOS Active Array Antenna (4 arrays)

Size 4 x 18.7 ft^3 = 74.8 ft^3

Weight 4 x 750 lbs = 3,000 lbs

TECHNICAL ACCOMPLISHMENTS



FY 96				FY 97			
1	2	3	4	1	2	3	4

- Kick-Off

- Multiple Layer LTCC Via Hole Connections Demonstrated

- Multiple LTCC Frames Flowed Together

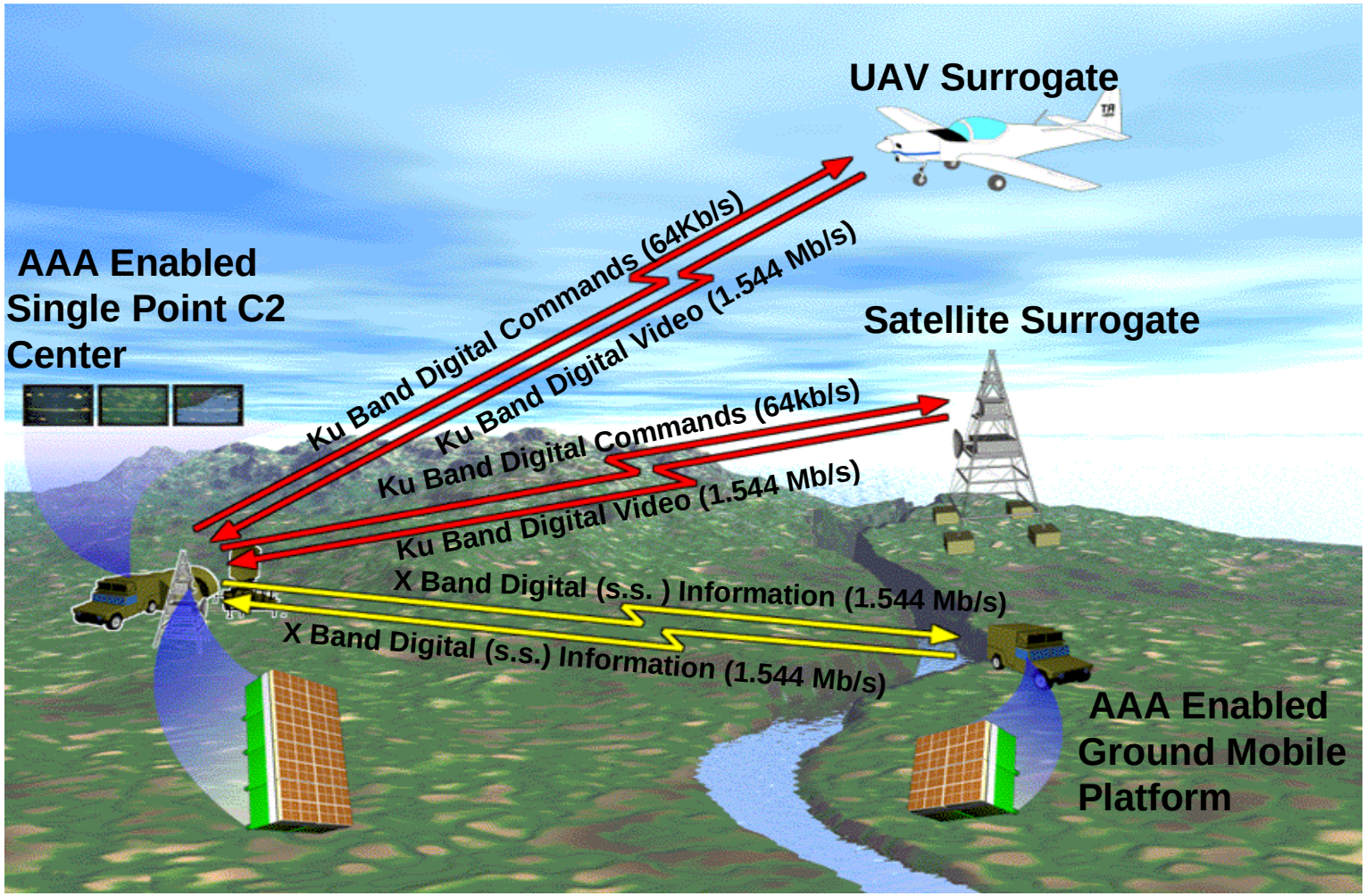
- First Iteration MMIC Chips Embedded in LTCC Frames
- Half Frequency Radiating Elements Tested

- Demonstrated Full-Duplex SATCOM channels in a Prototype Tile module with embedded MMICS

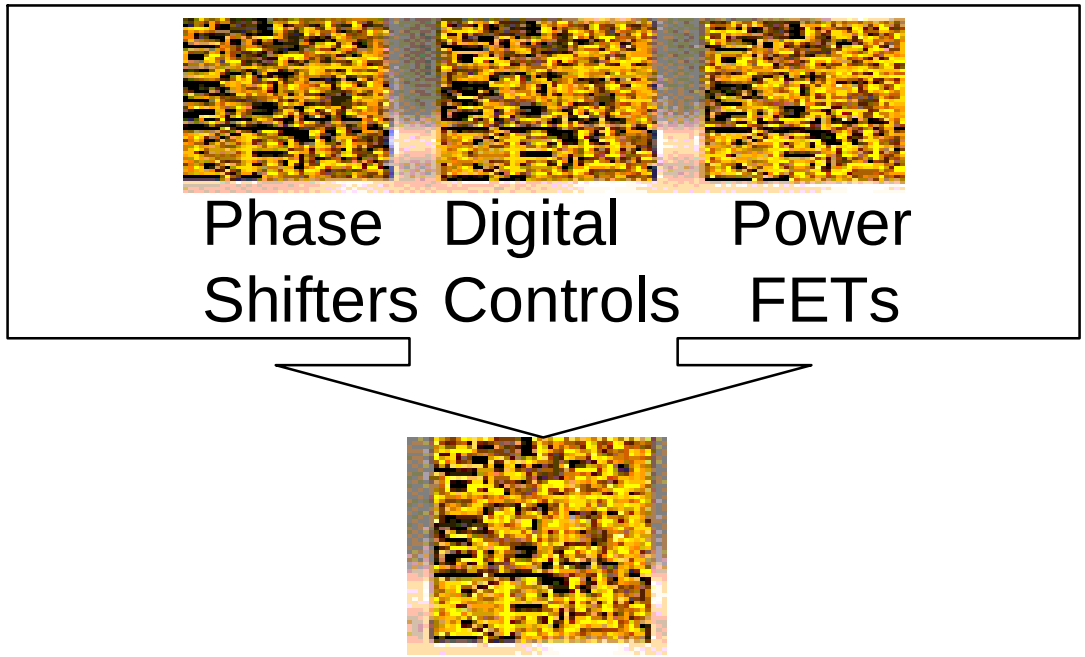
- Demonstrated Full Function Radiating Tile

- Four Tile Quad Subarray (16 Tiles) Demonstrated:
  - Full Duplex Ku band
  - Simultaneous X Band Capability
  - Beam Forming/ Scanning
  - Dynamic Linear Polarization
- 70% of each Tile built on automated assembly line

CURRENT DESIGN(PROOF OF CONCEPT) DEMONSTRATION SCENARIO



MMIC CAPABILITY



MMIC CHIP

- Multiple Circuitry on Single Chip
- RF and Digital Capability on Single Chip
- Proven Capability in L,C,X & Ku Bands
- Recently Broken mmwave Barrier (>36 Ghz)