ATCA for space domain awareness: aspirations vs. reality - addressing the operational gaps

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Space Domain Awareness: Three Core Challenges

1. WHERE - Position & Trajectory

Orbit determination - Tracking 47,000+ objects

Collision prediction - Managing conjunction assessments

Catalogue maintenance - Correlating observations with known objects

2. WHAT - Function & Intent

Capability assessment - Detecting non-Keplerian manoeuvrers

Status monitoring - Distinguishing controlled vs. unplanned changes

Anomaly detection - Identifying proximity operations

3. CONTEXT - Space Environment

Space weather - Solar activity causing orbit prediction errors

Radiation effects - Single event upsets (SEUs) mimicking intentional behaviour

EM environment - RF interference affecting tracking and operations

SDA Data Availability

	KNOWN	UNKNOWN
	Things we know we know	**Things we know we don't know**
KNOWN	• Catalogued object positions (WHERE) • Declared satellite capabilities (WHAT) • Historical space weather (CONTEXT) Data: Abundant & structured	• Small debris positions (WHERE) • Unlicensed/undeclared satellite capabilities (WHAT) • Properties of upcoming solar events (CONTEXT) Data: Insufficient and sparse
	Things we don't know we know	**Things we don't know we don't know**
UNKNOWN	• Uncorrelated tracks (WHERE) • Undocumented behaviours (WHAT) • Unrecognised patterns (CONTEXT) Data: Siloed & underutilised	• Undetected objects (WHERE) • Novel capabilities/intentions (WHAT) • Unpredicted phenomena (CONTEXT) Data: None - requires discovery

The SDA Data Paradox: Drowning in Data, Starving for Knowledge

Known Unknowns: A Fundamental Data Gap

Data is often sparse, unreliable, and insufficient for operational decisions

Limited collection capabilities rather than just integration challenges

Unknown Knowns: The Overlooked Intelligence

Data collected but not properly associated or utilised

Patterns visible in data but not recognised as significant

Unknown Unknowns: The Critical Blind Spot

No detection capability for certain object sizes/orbits/ behaviour/ capability

Unpredicted environmental phenomena lack monitoring systems

ATCA's Unique Technical Advantages

1. Finding What Others Miss

High spatial resolution and high sensitivity improves **Known Unknowns** specially in higher orbits and beyond GEO

2. Seeing What Others Can't See

1.1-105 GHz spectral range with wide band digital receivers exposes **Unknown Unknowns** through RF signature detection across multiple bands

3. Processing Power at the Edge

On-premise, programmable GPU backend enables **Unknown Knowns** extraction through custom signal processing algorithms

ATCA: Extraordinary Power, Limited Accessibility (for SDA)

ATCA **CAN** detect what others miss

ATCA **CAN** see what others can't see

ATCA **CAN** perform specialised signal processing at the edge

But SDA Operators Need:

AVAILABILITY: On-demand access when needs emerge

RELIABILITY: Consistent service for time-critical decisions

ACCESSIBILITY: Fully automated SERVICE from request to insight!

ATCA: Research Tool or Operational Asset?

- **Research Path**
  - **Status Quo Works**
  - Project scheduling
  - Manual processing
  - Publication-driven

- **Commercial Path**
  - **Requires Investment**
  - On-demand access
  - Automated pipeline
  - API integration

Decision Point

Research: Continue as-is with grant funding

Commercial: Invest now for future revenue streams

The Choice: Accept limitations or transform capabilities

Thank you

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