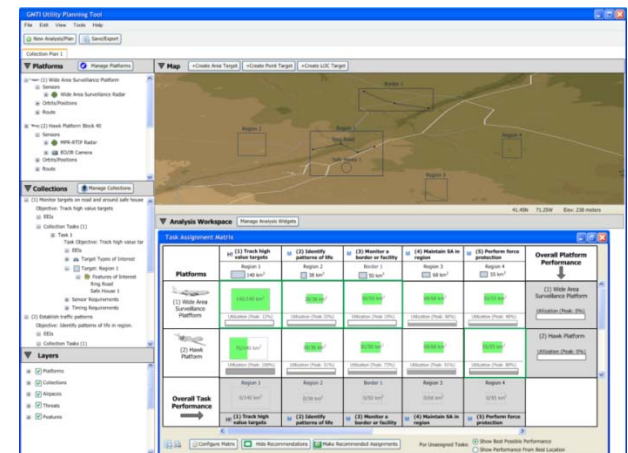


Ground Moving Target Indicator (GMTI) Utility Analysis for Airborne Assets

A mission-based framework for requesting and planning GMTI support

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Outline

- Introduction to GMTI and Planning Challenges
- Mission-Based Approach to GMTI Planning
- Moving Target Indicator Interpretability Rating Scale (MTIIRS):
Assessing required GMTI data fidelity to support the mission
- Decision Support Applications
 - PRISM Input Tool[®] (PIT): Requesting GMTI support
 - GMTI Planning Tool[®] (GPT): Planning GMTI collections

Mission-Based GMTI Request

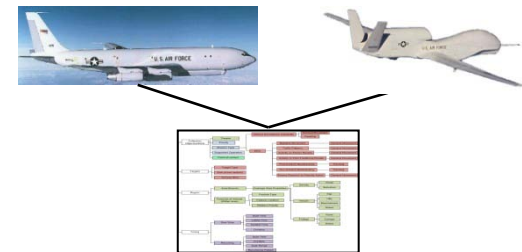


MTIIRS Level

MTIIRS Level	Surveillance Capability	Endowment	Target Type
1	General Movement	Rural or Suburban	Vehicular
2	General Movement	Rural or Suburban	Vehicular & Congregations
3	Tracking	Rural	Vehicles
4	Tracking	Suburban	Vehicles
5	Tracking	Rural	Dismounts
6	Tracking	Suburban	Dismounts

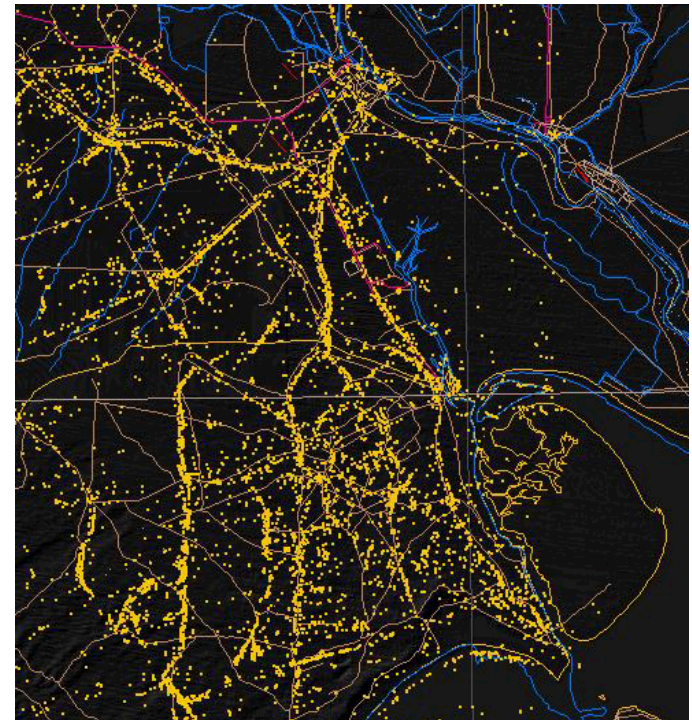


Sensor Tasking



Introduction – What is GMTI?

- GMTI = Ground Moving Target Indicator
 - An INT type that detects and tracks moving surface objects in an area of interest
 - Detections can be associated to form tracks, or used for situational awareness
 - Traditionally radar-based, but can be from other sources such as video and SIGINT
- Typical uses of GMTI
 - Discover and characterize lines of communication
 - Monitor borders
 - Track high value targets

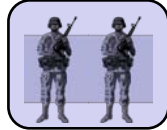


GMTI Planning Challenges

- GMTI data collection is complex and multi-dimensional, involving detection across time and space
- GMTI planning today is based on **implicit assumptions** about the effectiveness of GMTI sensing strategies in meeting operational objectives.
- Collaboration and planning suffers from **inconsistencies** in these assumptions between humans and machines, as well as between humans in different echelons, locations, and organizations. [Hence lots of chat.]
- **Standardized mission types and model-driven mission planning tools** are needed to provide potential sensing strategies spanning multiple GMTI sensors/platforms that satisfy end-user operational objectives.

Mission-Based GMTI Planning Process

GMTI Requesters

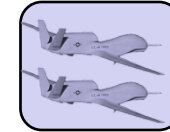


Current Process

“I need a JSTARS with a 10 second revisit rate.” Lack tools to structure requests in mission-centric terms.



GMTI Planners



“Hands tied” to requested revisit rates. Requests often lack needed information.

Lack systems to evaluate mission satisfaction and plan multi-platform collects.

Mission: “I need to identify traffic patterns along a road.”



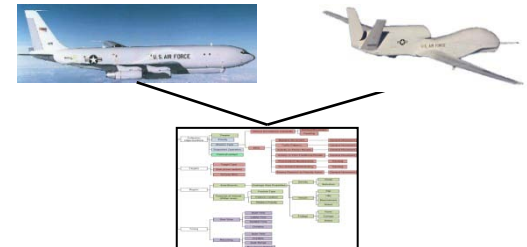
Improved Process

Mission-Based GMTI Request



MTIIRS Level

MTIIRS Level	Surveillance Capability	Endowment	Target Type
1	General Movement	Rural or Suburban	Vehicular
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PRISM Input Tool[©]

GMTI Planning Tool[©]



GMTI Mission Types and Essential Elements of Information (EEl)s

■ Mission Types:

- Track high value targets
- Monitor a border, facility, or other area of interest
- Perform force protection or convoy over-watch
- Maintain situation awareness in a region
- Identify patterns of activity in a region

■ EEl)s

- Characterize baseline movement
- Establish traffic patterns
- Identify activity on established routes
- Identify activity on non-traditional routes
- Perform incident backtracking (forensics)
- Identify enemy reactions to friendly actions
- Identify milling activity

MTIIRS Level	Target/Interest	Environment	Target Type
1	General Movement	Based on Suburban	Vehicle & Congestion
2	General Movement	Based on Suburban	Vehicle & Congestion
3	Tracking	Based on Suburban	Vehicle & Congestion
4	Tracking	Based on Suburban	Vehicle & Congestion
5	Tracking	Based on Suburban	Vehicle & Congestion
6	Tracking	Based on Suburban	Vehicle & Congestion

The Moving Target Indicator Interpretability Rating Scale (MTIIRS)

- Previous efforts to define GMTI fidelity based on the analogy to imagery: National Imagery Intelligence Interpretability Rating Scale (NIIRS)
 - Imperfect analogy: GMTI data is not imagery
 - **GMTI data fidelity is the degree to which targets are unambiguously distinguished**
- Current approach: “GMTI Units” based on area scanned per hour is insufficient as it does not consider update rate
- MTIIRS Approach:
 - Characterize required GMTI data fidelity given mission requirements
 - Enable collection planners to bin requests by difficulty
 - Characterize fidelity of previously collected GMTI data
- MTIIRS is currently is linear scale comprised of 6 levels in increasing order of fidelity
- MTIIRS levels are derived from the triad of mission type, target types of interest, and area characteristics

Current MTIIRS Levels

MTIIRS Level	Surveillance Capability	Environment	Target Type
1	General Movement	Rural or Suburban	Vehicular
2	General Movement	Rural or Suburban	Vehicular & Congregations
3	Tracking	Rural	Vehicles
4	Tracking	Suburban	Vehicles
5	Tracking	Rural	Dismounts
6	Tracking	Suburban	Dismounts

MTIIRS Levels	Rural	Suburban	Rural	Suburban
	Vehicles	Vehicles	Dismounts	Dismounts
Wide Area Surveillance / Situation Awareness	1	1	2	2
Tracking	3	4	5	6



PRISM Input Tool[©]

Structuring GMTI Requests

■ Goal: Develop a software tool to:

- Assist in requesting GMTI support in mission-centric terms
 - Old Way: “I need a JSTARS with a 30 second revisit rate”
 - New Way: “I need to identify traffic patterns along a road”
- Add structure to the GMTI request process
- Be “Turbo Tax” easy-to-use
- Compute an MTIIRS level based on request
- Export requests as formatted text and XML to PRISM

■ Needs Addressed:

- GMTI requests are currently poorly structured and not reproducible
- GMTI is not a well understood INT type by end-users
- Structuring requests will:
 - Standardize the process and avoid confusion
 - Help requesters understand GMTI a
 - Help planners better manage and utilize GMTI assets

PIT: Specifying Mission Type and EEIs

PRISM Input Tool

UNCLASSIFIED//FOUO

Creating New Request From Template

Point of Contact ☒ EEIs ☒ Targets ☒ Region & Features ☒ Timing ☒ Review Request ☒

Specify the request name, theater, collection objective, and EEIs.

Enter a name for the request (up to 75 characters):
 [Show Summary](#)

Select the theater:

Select the collection objective:

Maintain surveillance over the location of forces or a convoy and monitor for threat activity.

Select one or more EEIs. You may also add notes to each EEI you select. Select one or more *Other EEIs* if you do not find a suitable EEI. Hover over an EEI for a description:

- ☐ Baseline Movement
[Add Notes](#)
- ☒ Traffic Patterns
[Add Notes](#)
- ☒ Activity on Established Routes
[Add Notes](#)
- ☐ Activity on Non-Traditional Routes
[Add Notes](#)

[Select All](#)
[Unselect All](#)

[Help](#) [< Back](#) [Next >](#) [Save](#) [Home](#)

Help

Request name: The name to use for the request. The request will be saved for later retrieval using this name.

Theater: The theater the request takes place in (OEF or OIF).

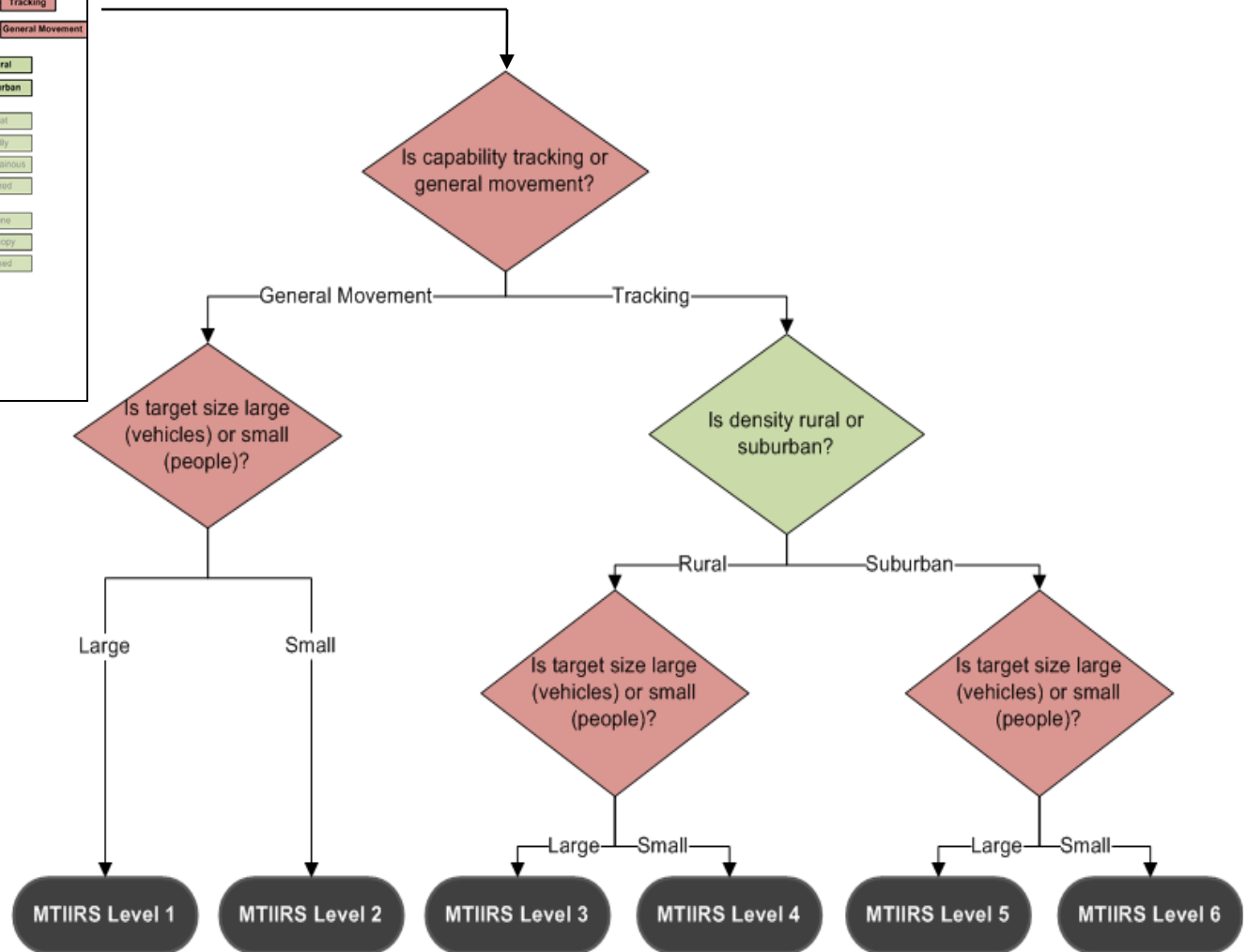
Collection Objective: The type of objective/mission the request will support. Collection objectives include:

- **Track high value targets:** A mission to track high value targets for possible engagement. An example is tracking vehicles suspected of planting IEDs along a road.
- **Monitor a border or facility:** A mission to monitor a border or facility for activity. An example is monitoring a border for vehicle crossings, or monitoring a facility for vehicles that come within a certain distance of it.
- **Perform force protection/convoy watch:** A mission to monitor for targets that come within a certain distance of a troop or convoy location.
- **Maintain situation awareness in a region:** A mission to monitor target activity in a region. An example is monitoring an area for any vehicle movement.
- **Identify patterns of activity in a region:** A mission to identify common patterns of target movement in a region. An example would be monitoring a road to establish traffic patterns, or monitoring a facility to establish when vehicles typically come and go.

EEIs enabled for selection are specific to the mission type

Context-sensitive help

MTIIRS Calculation



PIT: Request Summary

The screenshot shows the 'PRISM Input Tool' window with the 'UNCLASSIFIED' status. The 'Review Request' tab is active, showing a summary of the request. The summary is formatted as a paragraph and includes the following information:

- Request Name:** Scenario 1
- Submitter Name:** Craig Bonaceto
- Submitter Email:** cbonaceto@mitre.org
- 1 Point-of-Contact is:** Tom Thomas
 - Unit: MITRE
 - Email: tnthomas@mitre.org
 - Phone Number: 703 983 8912
 - Call Sign: Straight Leg
 - Chat System: mlRC
- 2 Perform Collection:** Identify patterns of life in a region
 - In Theater: OEF
 - Collect EEIs:
 - Baseline Movement
 - Traffic Patterns
- 3 On Targets:**
 - All Ground Vehicles (Convoy Size: Any)
 - Small Boats
 - All People and Animals
- 4 In Region:** DSA 2
 - Coordinates:

Below the summary, there is a text area for 'Enter any additional instructions or notes about this request here:' and a 'Close' button. At the bottom right, there are 'Export' and 'Save' buttons.

Formatted
summary
paragraph
of request

“Save” when inputs
are complete

“Export” provides a
text file that
can be copied to
PRISM



GMTI Planning Tool[©]

GMTI Platform Planning and Optimization

■ **Goal: Develop a decision support capability to:**

- Provide a structure to allow a non-expert to determine radar tasking requirements based on mission needs, target type and area conditions
- Evaluate which and how many GMTI platforms are required to satisfy requests
- Determine placement and orbit of platforms to maximize collection effectiveness
- Predict and visualize performance based on platform placement and orbits

■ **Needs Addressed:**

- Current systems for tasking GMTI collections do not provide adequate feed back as to whether they satisfy mission needs
- No systems exist to plan multi-platform GMTI missions
- Improve GMTI platform utilization (reduce/eliminate incorrect tasking)

GPT: Overall Tool Layout

The interactive map shows areas requiring GMTI coverage.

The platforms browser enables planners to add, edit, and remove GMTI platforms.

The collections browser allows planners to add, edit, and remove GMTI collections.

GMTI Utility Planning Tool

File Edit View Tools Help

New Analysis/Plan Save/Export

Collection Plan 1

Platforms Manage Platforms

- (1) Wide Area Surveillance Platform
 - Sensors
 - Wide Area Surveillance Radar
 - Orbits/Positions
 - Route
- (2) UAV Surveillance Platform
 - Sensors
 - MPR-RTIP Radar
 - EO/IR Camera
 - Orbits/Positions
 - Route

Collections Manage Collections

- (1) Monitor targets on road and around safe house
 - Objective: Track high value targets
 - EEIs
 - Collection Tasks (1)
 - Task 1
 - Task Objective: Track high value tar
 - EEIs
 - Target Types of Interest
 - Target: Region 1
 - Features of Interest
 - Ring Road
 - Safe House 1
 - Sensor Requirements
 - Timing Requirements
- (2) Establish traffic patterns
 - Objective: Identify patterns of life in region.
 - EEIs
 - Collection Tasks (1)

Layers

- ☒ Platforms
- ☒ Collections
- ☒ Airspaces
- ☒ Threats
- ☒ Features

Map +Create Area Target +Create Point Target +Create LOC Target

Border 1
Ring Road
Safe House 1
Region 2
Region 3
Region 4

41.45N 71.25W Elev: 238 meters

Analysis Workspace Manage Analysis Widgets

Task Assignment Matrix

	H: (1) Track high value targets	M: (2) Identify patterns of life	M: (3) Monitor a border or facility	M: (4) Maintain SA in region	M: (5) Perform force protection	Overall Platform Performance
Platforms	Region 1 140 km ²	Region 2 38 km ²	Border 1 50 km ²	Region 3 68 km ²	Region 4 55 km ²	
(1) Wide Area Surveillance Platform	140/140 km ² Utilization (Peak: 55%)	38/38 km ² Utilization (Peak: 33%)	50/50 km ² Utilization (Peak: 10%)	68/68 km ² Utilization (Peak: 60%)	55/55 km ² Utilization (Peak: 48%)	(1) Wide Area Surveillance Platform Utilization (Peak: 0%)
(2) UAV Surveillance Platform	70/140 km ² Utilization (Peak: 100%)	38/38 km ² Utilization (Peak: 51%)	50/50 km ² Utilization (Peak: 73%)	68/68 km ² Utilization (Peak: 91%)	55/55 km ² Utilization (Peak: 80%)	(2) UAV Surveillance Platform Utilization (Peak: 0%)
Overall Task Performance	Region 1 0/140 km ²	Region 2 0/38 km ²	Border 1 0/50 km ²	Region 3 0/68 km ²	Region 4 0/55 km ²	
	H: (1) Track high value targets	M: (2) Identify patterns of life	M: (3) Monitor a border or facility	M: (4) Maintain SA in region	M: (5) Perform force protection	

Configure Matrix Hide Recommendations Make Recommended Assignments

For Unassigned Tasks: ☒ Show Best Possible Performance ☐ Show Performance From Best Location

The analysis area contains an interactive assignment matrix that shows the expected performance of each platform against each collection.

Summary and Future Directions

- Our aim is to standardize the process of requesting GMTI support and tasking GMTI platforms with a mission-based framework
- We demonstrated a framework for requesting support based on mission needs, a new MTIIRS metric to assess required fidelity, and a planning tool to relate requests to platform tasking
- We intend to next investigate extending this methodology by understanding how GMTI can be combined with other INT types
- We also intend to validate our utility models using theater GMTI data collects

Mission-Based
GMTI Request



MTIIRS Level

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Sensor Tasking

