MASINT

Measurement & Signature Intelligence

A PRIMER BY THE NATIONAL MASINT OFFICE

MASINT

A surface level look into a misunderstood intelligence discipline

What is MASINT?

MASINT, or Measurement and Signature Intelligence, is an intelligence discipline built on capturing and measuring the intrinsic characteristics and components of an object or activity. These characteristics allow the object or activity to be detected, identified, or characterized every time it is encountered. If the 'target' vibrates, makes a sound, leaves a trace, or gets hot or cold, it could have an exploitable signature. MASINT measures the way things are and how they actually perform. Due to the highly technical and scientific means used to develop MASINT signatures, it became known as the "INT' of science.

Why is MASINT important?

MASINT information advances our understanding of the object or activity and allows us to assess the uses and capabilities that the object or activity provides to a potential adversary. This vital information allows us to develop or adapt our abilities to defend against, defeat, or otherwise overcome any use of the object or activity that is harmful to the interests of our nation, allies, and partners.

What are MASINT strengths?

MASINT's focus on scientific measurement of the quantitative and qualitative information inherent to the object or activity makes MASINT difficult to deceive. MASINT processing methods often can enhance data collected through other disciplines providing additional insights and understanding.

Measurement:

In MASINT, a measurement measures the intrinsic characteristics of the object or activity to better describe it using features such as an object's motion, speed, direction, and location.

Signature:

A unique set of characteristics that differentiate one item or event from another.

Example: Although all DNA is composed of the same nitrogen-based molecules, each organism's DNA is unique - producing an exceedingly exclusive signature that allows identification between organisms (a human or animal).

Some factors to "Measure" a signature

Street Bike V. Beach Cruiser

If these objects are new to you, how would you tell them apart? Simple observation might indicate they are the same thing... both have a frame and two wheels forming a mode of conveyance. But when their intrinsic characteristics (noise, weight, speed, heat) are measured, they start to become different with potentially different uses!

- Cruising vs Racing/commuting
- Rough terrain vs. smooth streets

Vs

What's Unique?

1. Noise: - The beach cruiser has wider wheels & no gears, resulting in more contact on the pavement while moving, this makes a "humming" noise when passing by.
   - The street bike has thin wheels and many gears giving off a clicking noise when passing by.

2. Speed: - The large build of the beach cruiser is designed to "cruise" around, making their design slower than street bikes
   - The gears and light weight of the street bike give the bike an ability to move more quickly

3. Weight: - Beach cruisers are designed to ride on sand, requiring wider wheels and an overall bigger design, thus weighing more.
   - Street bikes were designed to be ergonomically efficient; fitting in tighter spaces and light enough to carry around, usually making them lighter than beach cruisers.

4. Heat: - The wheels of each bike have different diameters, and therefore have different revolutions per minute and exert different amounts of heat while going the same speed.

What are MASINT Sub-Disciplines?

A structure to organize the broad range of MASINT capabilities that stretch across the full range of scientific disciplines.

Electro-Optical (EO)

The collection of reflected or emitted energy across the optical portion (ultraviolet, visible, near-infrared, and infrared) of the electromagnetic spectrum.

Materials

The collection of air, water, or solid material from or near a target location. The samples are analyzed for isotopic, chemical, or biological Signatures.

Nuclear Radiation

The detection, identification, & characterization of nuclear sources and events. Space-based nuclear sensors monitor X-rays, gamma rays, & neutrons. Ground-based nuclear sensors monitor the movement of materials by tracing the radiation emissions.

Geophysical

The collection of physical phenomena of the Earth; energy and disturbances that affect the ionosphere, atmosphere, oceans, solid surface, crust and even regions deep beneath the Earth's crust.

Radar

The active or passive collection of electromagnetic energy reflected from a target. Radar data collection provides information on radar cross sections- tracking, precise measurements of components' size, shape, & motion characteristics for targets & objects.

Radio Frequency

The measuring of electromagnetic radiation across frequencies (not including infrared). These targets are usually unintentional byproducts of an event such as unintentional radiation from engines, weapon systems, & electronics.

ELECTRO-OPTICAL (EO) MASINT

These sensors collect data derived from reflected or emitted energy across the optical portion (ultraviolet, visible, near-infrared, and infrared) of the electromagnetic spectrum. Data is collected by a variety of optically sensitive devices, such as radiometers, spectrometers, non-imaging systems, lasers, and fiber optics.

Three main categories of EO Sensors: **Spectral**, **Infrared (IR)**, and **Laser.**

Spectral sensors measure the frequency/ wavelengths of radiation associated with specific targets or events. This collection is based upon interactions of radiant energy through processes of scattering, absorption, reflection and emission.

IR sensors measure the changes in light waves and convert them into electromagnetic signals. These sensors can be used to track and characterize reentry vehicles flown on ballistic missile flight tests and Nuclear Detonations (NUDETs).

Laser collection is a form of technical intelligence defined as the interception, processing and analysis of optical radiation to evaluate the technical characteristics and performance of the laser and its associated systems.

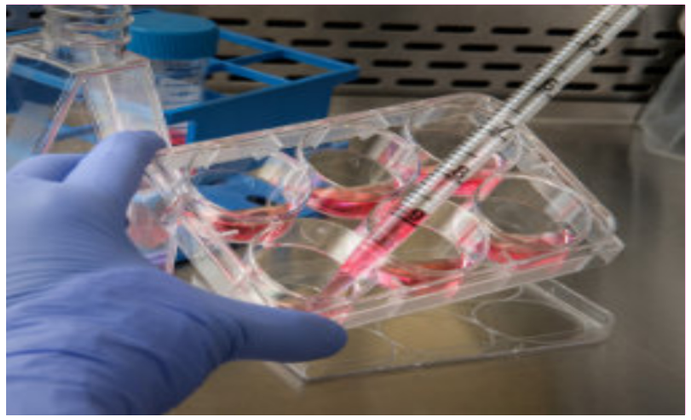
MATERIALS MASINT

The physical collection, processing, & scientific analysis of gas, liquid, or solid samples

COLLECTION

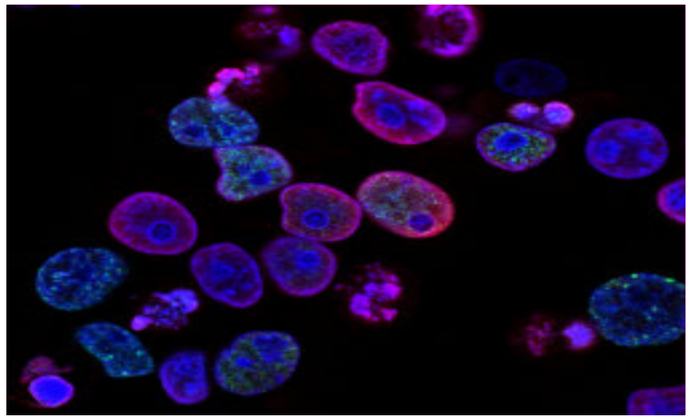
Collected samples include air, water, or solid material from a target location. These samples are analyzed for isotopic, chemical or biological signatures.

PROCESSING



Samples are processed to determine isotopic, chemical or biological signatures. For advanced materials, this sub-discipline explores ceramics, composites, organics, metallic materials, smart materials, and special materials for armor, weapon, and vehicle applications.

ANALYSIS



Samples are analyzed for potential energy, clinical or biomedical applications. Material agents pose unique challenges for confirmatory analysis and conclusive attribution to their point of origin when found in the environment.

MATERIALS MASINT COLLECTION AND ANALYSIS IS ESSENTIAL.

Although nuclear materials are difficult to obtain, chemical and biological materials are inexpensive to produce and easy to hide and disseminate. Both state and non-state entities pose a threat. A single attack could cause heavy physical, psychological, and economic damage to the United States and its interests.

NUCLEAR MASINT

The active or passive detection, collection, and measurement of gamma rays, neutrons, x-rays, or other radiation phenomena from nuclear sources.

Sensors that detect nuclear radiation include devices onboard overhead satellites, hand-held radiation sensors used by customs agents at our borders, and the emplaced sensors attempting to detect and identify the transfer of nuclear materials or weapons.

The detonation of the Soviet Union's first atomic bomb in 1949 highlighted the need for the United States to develop a method to detect nuclear weapons tests worldwide.

Target materials for collection include uranium and plutonium isotopes used in nuclear weapons. Additionally, radioactive material such as gamma rays are emitted and can be measured. Some targeted materials have industrial or medical applications.

Nuclear weapons are developed to cause massive destruction with overpressure and radiation. Although lethal and destructive, the main effects of these weapons are panic, and the economic impact of quarantine and clean-up.

The closest near-real-time method of detection, location, and characterization depends on where the event took place, and what medium the event occurs in. Detection of the optical flash associated with a nuclear detonation can also be accomplished from space.

GEOPHYSICAL

THE COLLECTION, PROCESSING, AND EXPLOITATION OF DISTURBANCES THAT AFFECT THE IONOSPHERE, OCEANS AND FIRMAMENT OF THE EARTH.

MASINT LOOKS FOR...

-PRESSURE WAVES
-VIBRATIONS
-MAGNETIC FIELDS
-ELECTRIC FIELDS
-IONOSPHERIC DISTURBANCES
-GRAVITATIONAL PERTURBATIONS

WHICH COULD BE AN...

-EARTHQUAKE
-EXPLOSION
-VEHICLE
-SHIP
-SUBMARINE
-AIRCRAFT
-UNDERGROUND FACILITIES CONSTRUCTION ACTIVITY

HOW CAN YOU TELL THE DIFFERENCE BETWEEN NATURAL VIBRATIONS & EVENTS?

GEOPHYSICS! IT IS ABLE TO DISTINGUISH TARGETS OF INTEREST THAT ARE BURIED IN THE BACKGROUND BROADCAST OF THE EARTH.

MASINT

THIS FORM OF MASINT HELPS US UNDERSTAND VITAL INFORMATION AND DETAILED SIGNATURES OF THREAT SUBMARINE PLATFORMS, SIGNATURES FROM OPERATION OF SUBMARINE-LAUNCHED BALLISTIC MISSILE SYSTEMS, AND OTHER SEA-LAUNCHED WEAPONS. WHEN USED OPERATIONALLY GEOPHYSICAL MASINT AIDS THE DETECTION, CLASSIFICATION, AND SURVEILLANCE OF MISSILES, SUBMARINES, SURFACE SHIPS, GROUND VEHICLES, AND AIRCRAFT. GEOPHYSICS CAN ALSO BE USEFUL IN THE ASSESSMENT OF THREATS. FOR EXAMPLE, GEOPHYSICAL SENSORS CAN PROVIDE INDICATIONS AND WARNING OF TROOP AND VEHICLE MOVEMENTS OR NUCLEAR EXPLOSIONS.

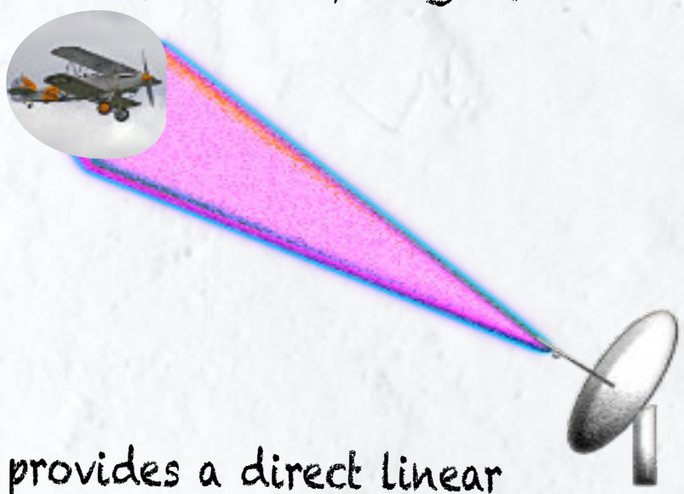
Radar MASINT

A system for detecting the direction, distance, and speed of an object by sending out pulses of high frequency waves that are reflected off the object and back to the source. RADAR systems can be used to determine missile threats and protect our troops from attacks. RADAR measurements can be made using direct, over the horizon, or indirect energy data reflections.

1.

Direct-

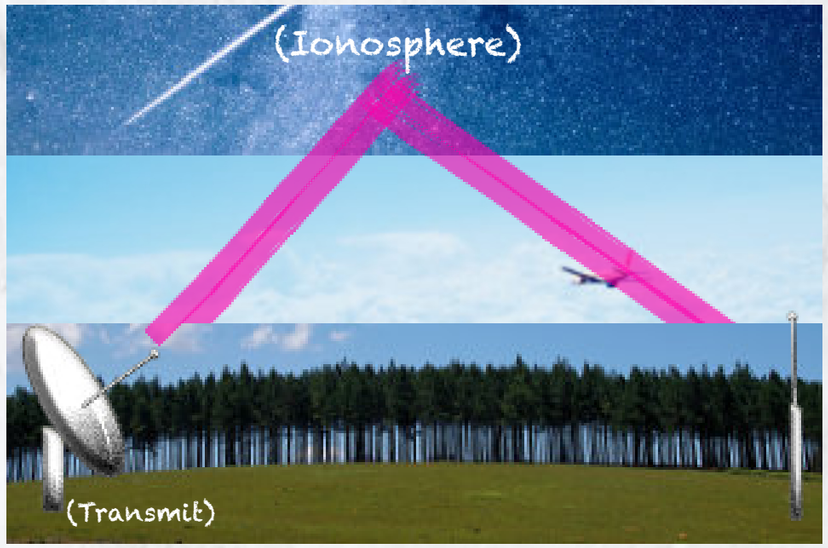
(Line of Sight)



provides a direct linear view to the target

2.

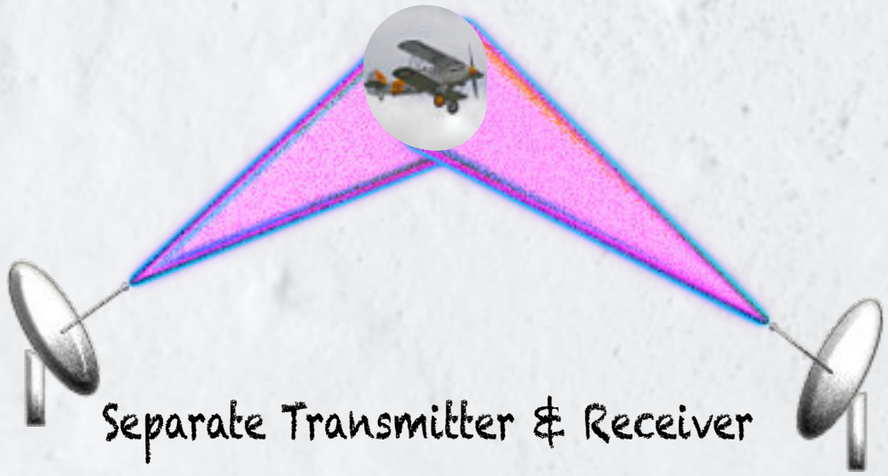
Over-the-Horizon Radar



3.

Indirect-

(Bistatic)



Separate Transmitter & Receiver

RADIO FREQUENCY MASINT

The collection, processing, and exploitation of electromagnetic radiation at frequencies from nearly zero up through TeraHertz (THz)

RF MASINT sources include nuclear and simulated nuclear electromagnetic pulse (EMP), intentionally radiated and collateral signals from Radio Frequency Weapons (RFW), and Unintentionally Radiated Emissions (URE) from diverse mechanical and electronic sources.

Radio frequency weapons (RFW) systems use electromagnetic energy to disable electronic systems. RFW produce short, intense, directed pulses of electromagnetic energy that upset or damage targeted electronics. RFW can target a wide variety of electronic components, including those found in: aircraft, munitions satellites, air defense systems, or command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) electronics.

RF MASINT can be used to detect, locate, identify, characterize, and target threats. A primary objective of RF MASINT collection is to diagnose the technical parameters of a target device for the purposes of determining its power levels, operating characteristics, and signatures. MASINT exploitation results of RF Weapon Systems can enable development of countermeasures and provide assessments of adversary developments in advanced weapon technologies.

PROCESSING FOR PURPOSE

Energy is the most critical requirement for the body. So critical that we won't survive a minute without it.

When we eat, our body processes food into Adenosine Triphosphate (ATP), commonly known as the "energy" molecule. It is produced by biological oxidation of food in the presence of oxygen. Once food is converted into ATP, our body delivers it to the essential systems to be processed for their unique functions.

This process is very similar to how energy sources are used for different intelligence disciplines.

ENERGY & INTELLIGENCE APPLICATIONS

GEOINT & MASINT

GEOINT, or Geospatial Intelligence, is intelligence derived from energy such as Synthetic Aperture Radar (SAR). When processed through GEOINT methods, the energy is used to create imagery intelligence. When processed through MASINT methods, the energy is used to produce signatures. Energy sources are the same, but the outcome is different.

SIGINT & MASINT

SIGINT, or Signals Intelligence, is intelligence derived from energy such as Radio Frequency (RF) related to communications systems. When processed through SIGINT methods the energy is used to produce communications. When this energy is processed through MASINT methods, it is used to understand RF signatures related to weapons systems. Again, energy sources are the same, but the outcome is different.

MASINT AND NATIONAL DEFENSE

MASINT provides information to a variety of customers to: support military operations, provide decision makers with knowledge to make informed judgments, verify treaties, defeat terrorism, prevent the spread of *Weapons of Mass Destruction* (WMD), and counter threats worldwide. MASINT provides critical support to military, national, and civil users.

The precise threat characteristics and performance information collected and produced by MASINT are essential to policymakers, warfighters, and homeland security analysts. MASINT supports the planning, development, and application of weapons systems, countermeasures, tactics, targeting, and battle damage assessments. Policy makers depend upon precise information to assess the impacts of proliferating WMD technologies to confidently monitor treaties and arms control agreements, to protect our homeland, and to thwart acts of terrorism.

MASINT & THE WARFIGHTER

MASINT systems provide the warfighter with unique information on objects or targets that are not available from other sources. All objects inherently possess or produce observable, detectable and measurable characteristics; such as material composition, heat, sound, vibration, radiation and radar reflective strength. These characteristics can be exploited to identify information about the target. Some capabilities, like airborne and underwater acoustic systems, have been in operational use since before World War II. Ground acoustic systems can locate enemy fire. Unattended acoustic, magnetic, and seismic ground sensors can identify enemy vehicle movements. RF ground sensors can detect vehicle types. Biological and chemical sensors can detect the presence of Biological Weapon(BW) and Chemical Weapon (CW) agents. Radar can provide information concerning missile launches. WMD sensors provide the the warfighter the ability to respond to and prevent WMD related catastrophes.