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NATIONAL RECONNAISSANCE OFFICE

NRO Systems Overview

Module 2: Orbital Mechanics

This module is classified

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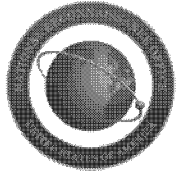
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DECL ON: 25X1, 20660101
DRV FM: INCG 1.0, 13 February 2012

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(U) Course Agenda

(U) Module 1: **Course Introduction**

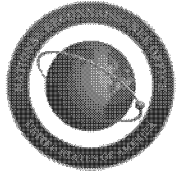
▶ (U) Module 2: **Orbital Mechanics**

(U) Module 3: **NRO Signals Intelligence Systems**

(U) Module 4: **NRO Geospatial Intelligence Systems**

(U) Module 5: **Other NRO Products and Services**

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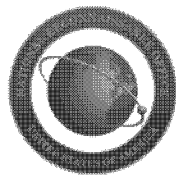


(U) Module 2 Agenda

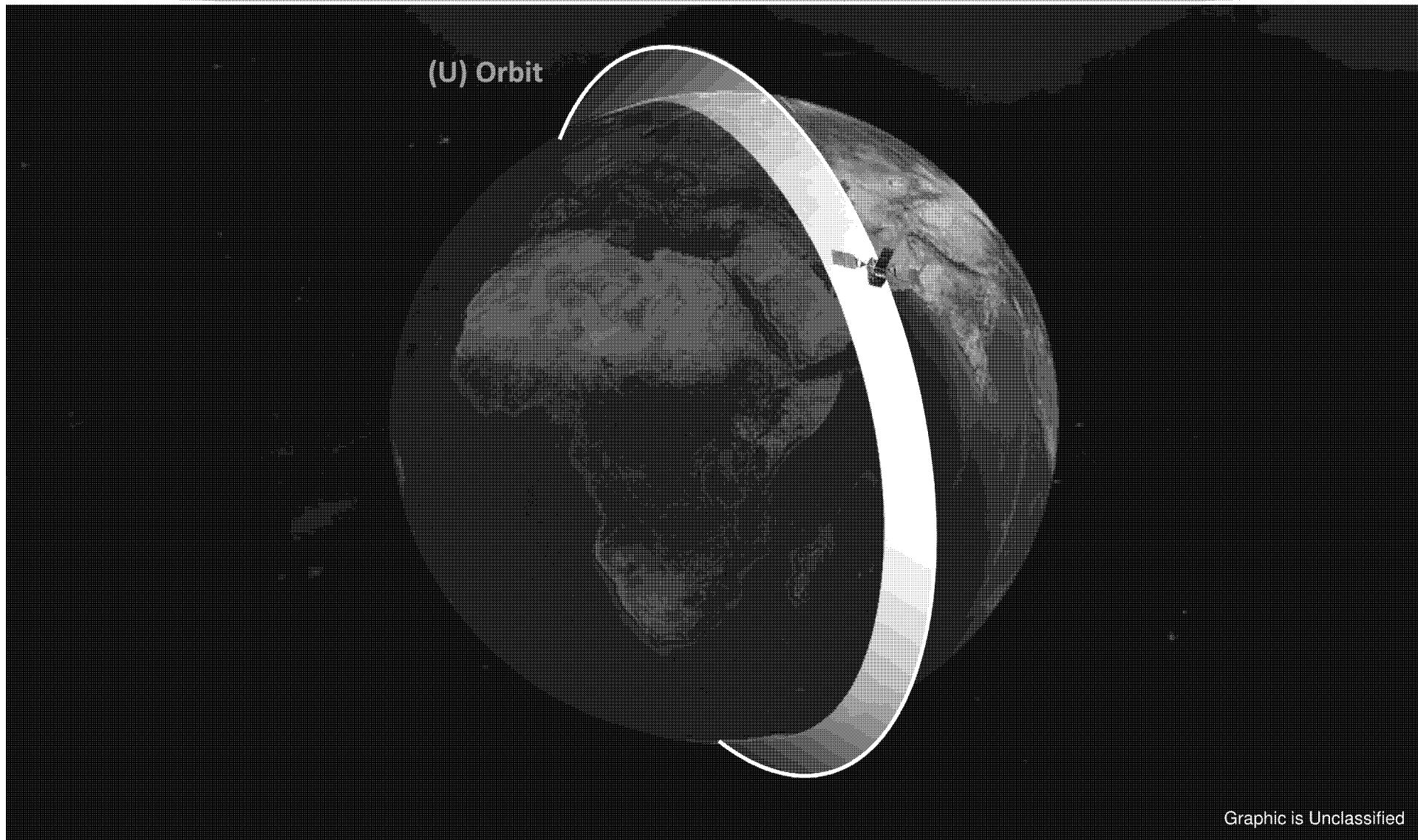
(U) Orbital Mechanics

- (U) Orbital Terminology
- (U) Orbits
- (U) Satellite vs. Mission
- (U) Introduction to NRO's Constellation

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(U) Orbit

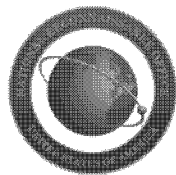


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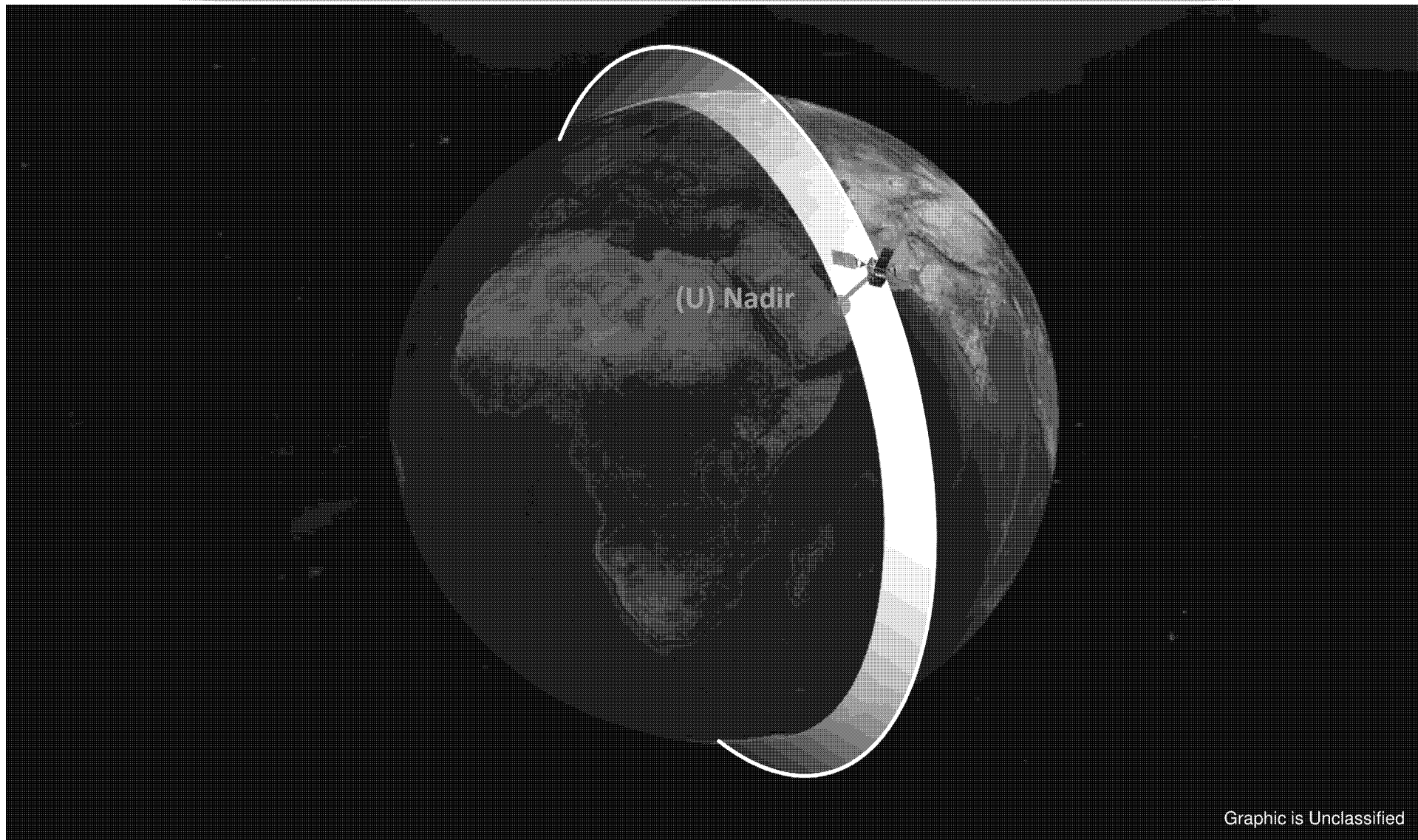
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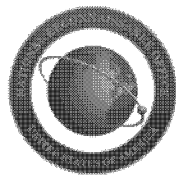


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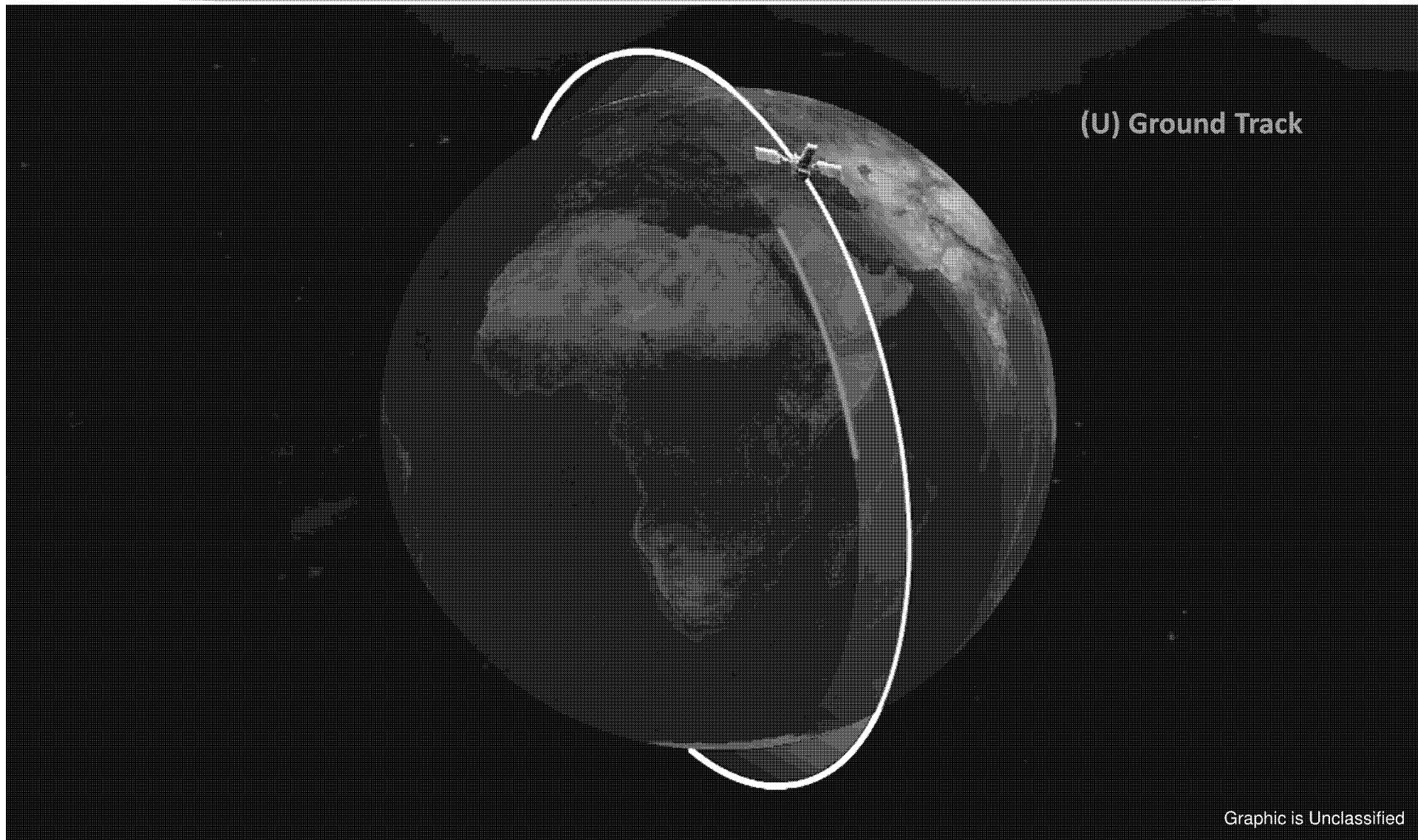
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(U) Ground Track

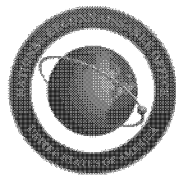


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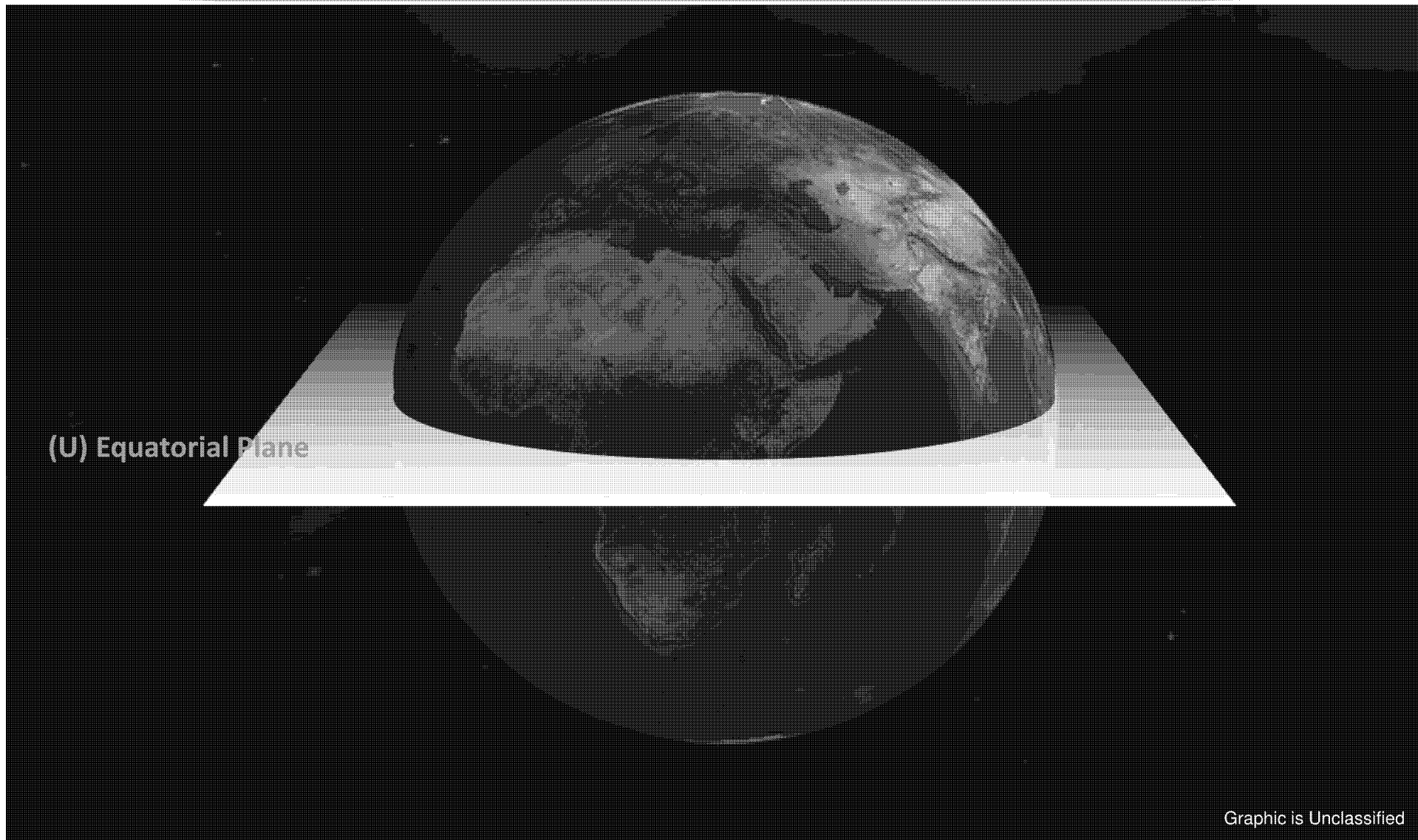
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(U) Equatorial Plane

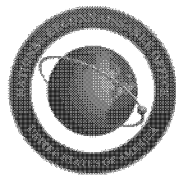


(U) Equatorial Plane

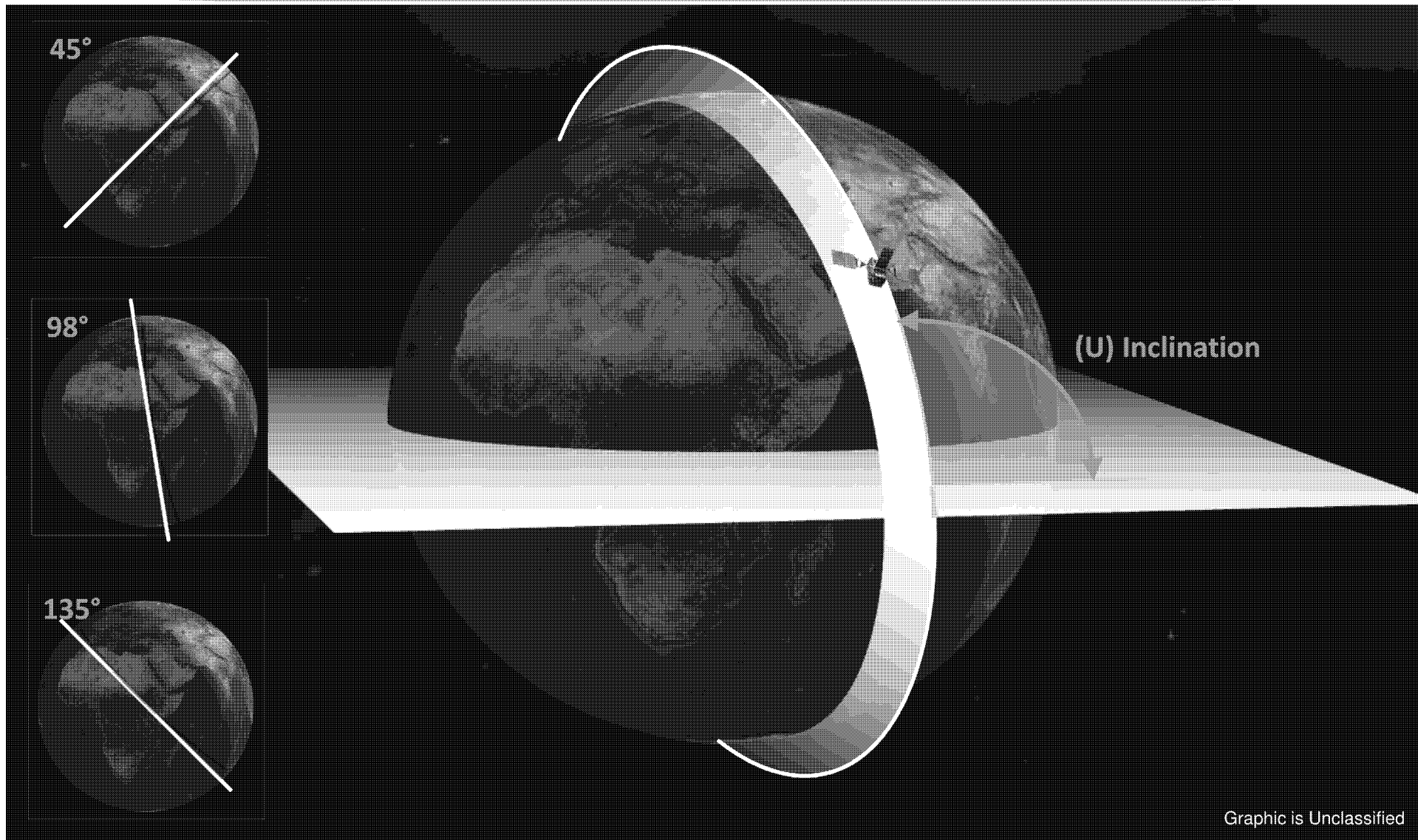
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(U) Inclination

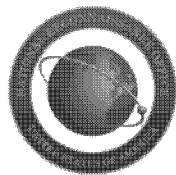


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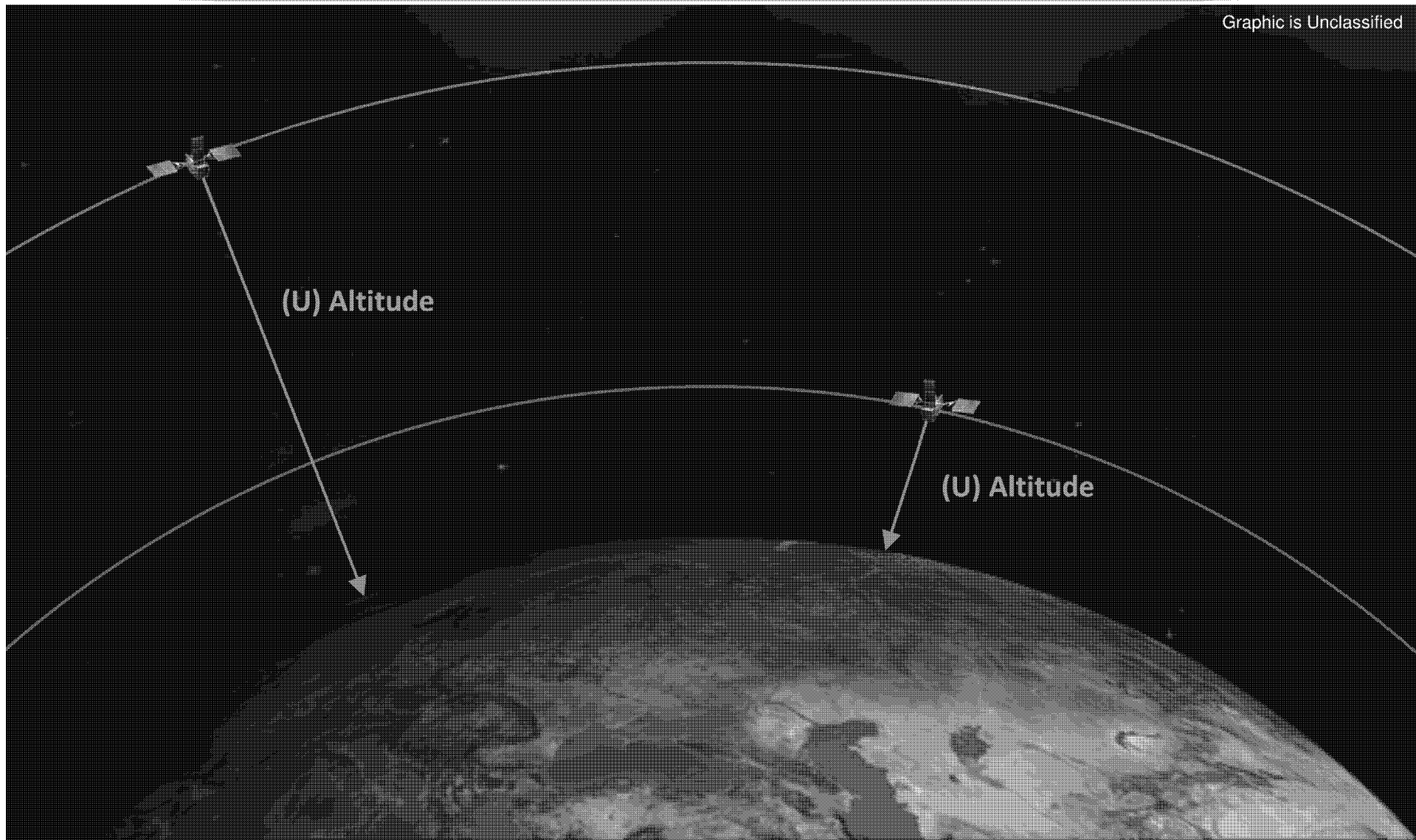
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(U) Altitude

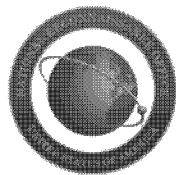
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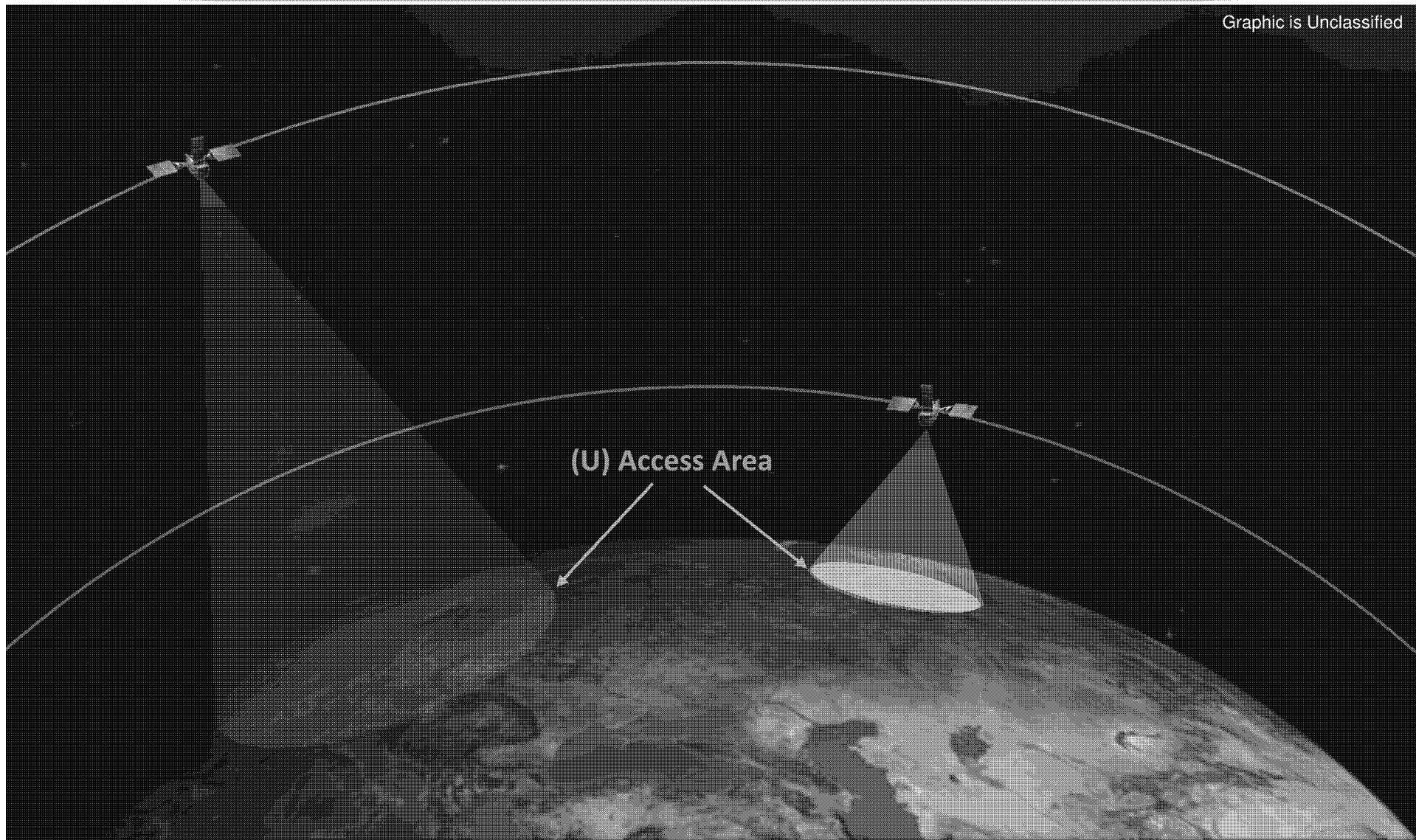
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(U) Access Area

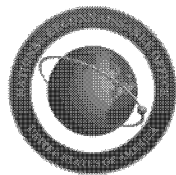
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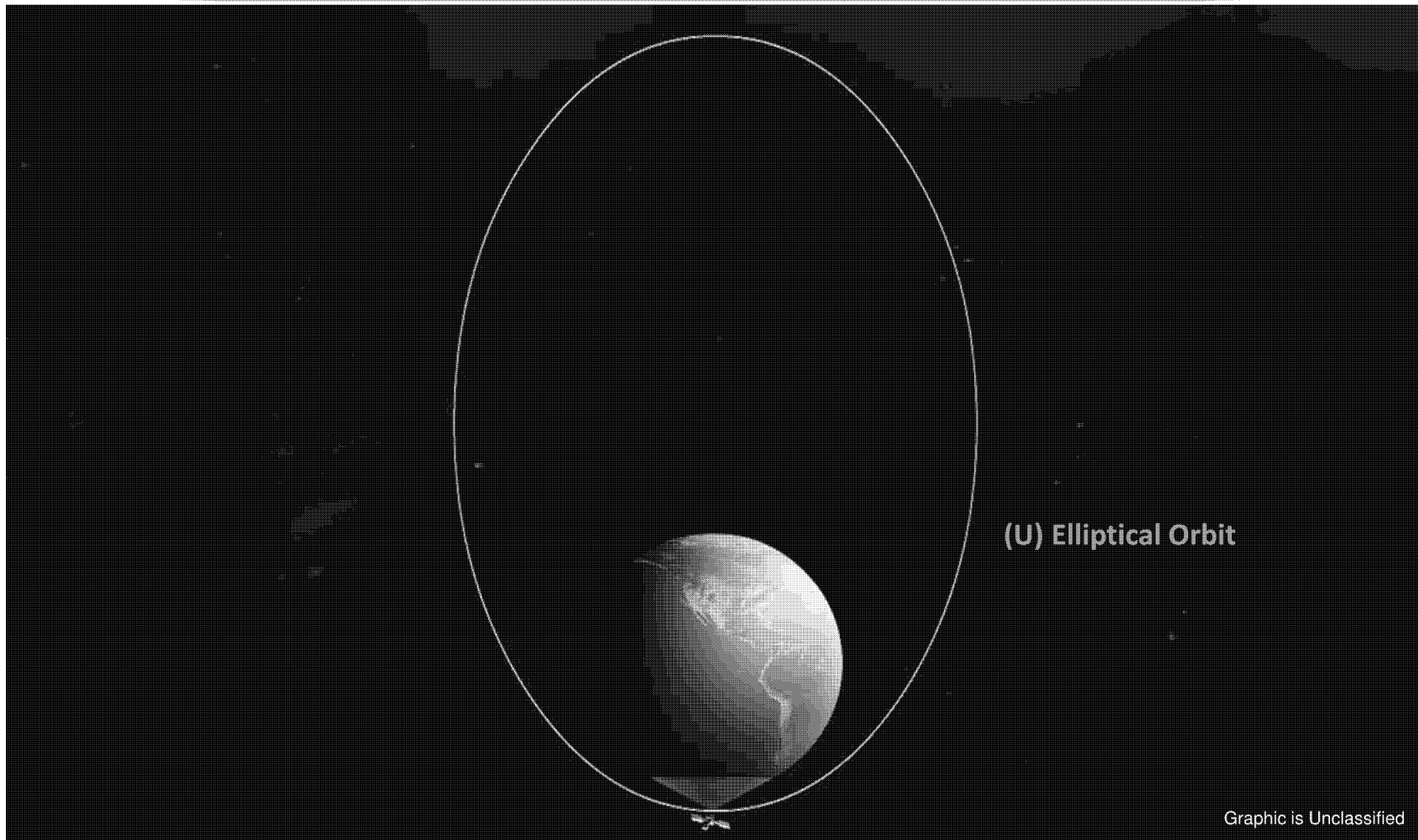
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(U) Elliptical Orbit



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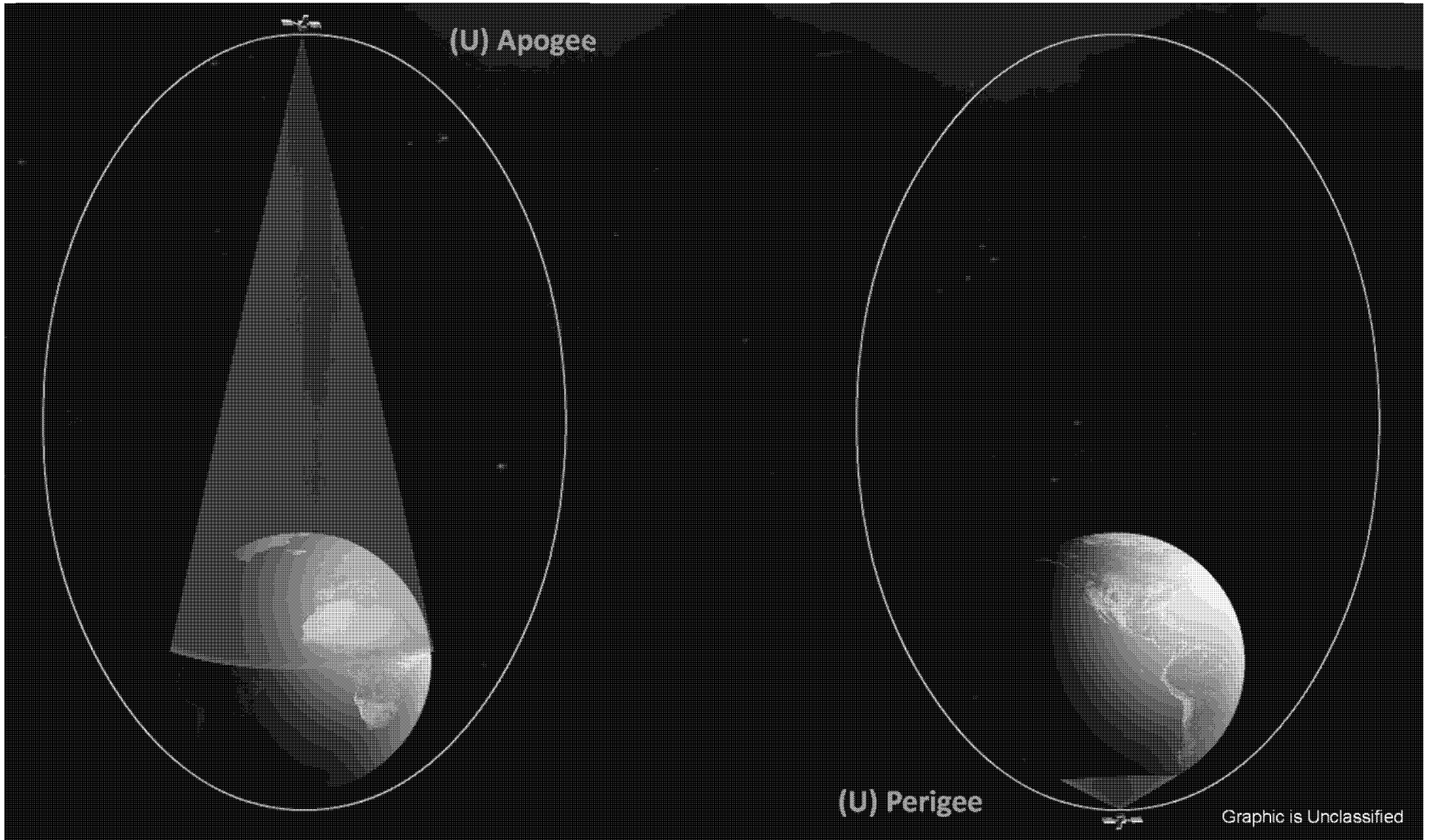
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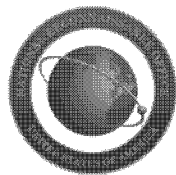


(U) Apogee and Perigee



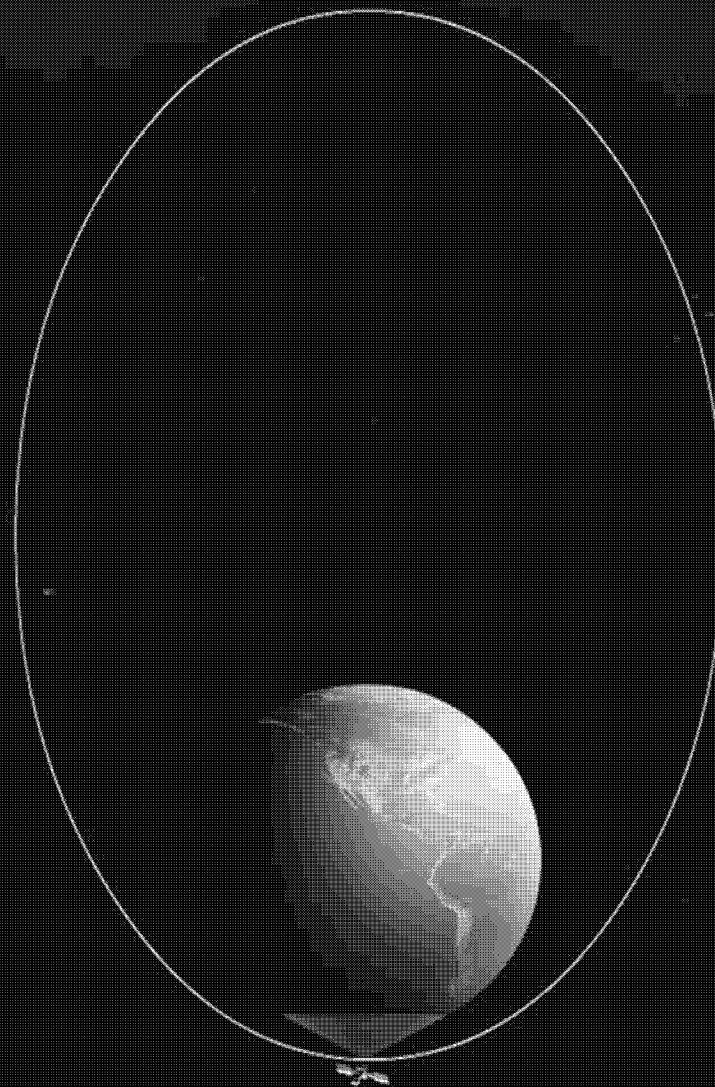
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(U) Orbital Period

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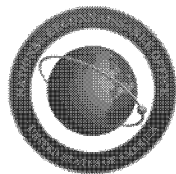


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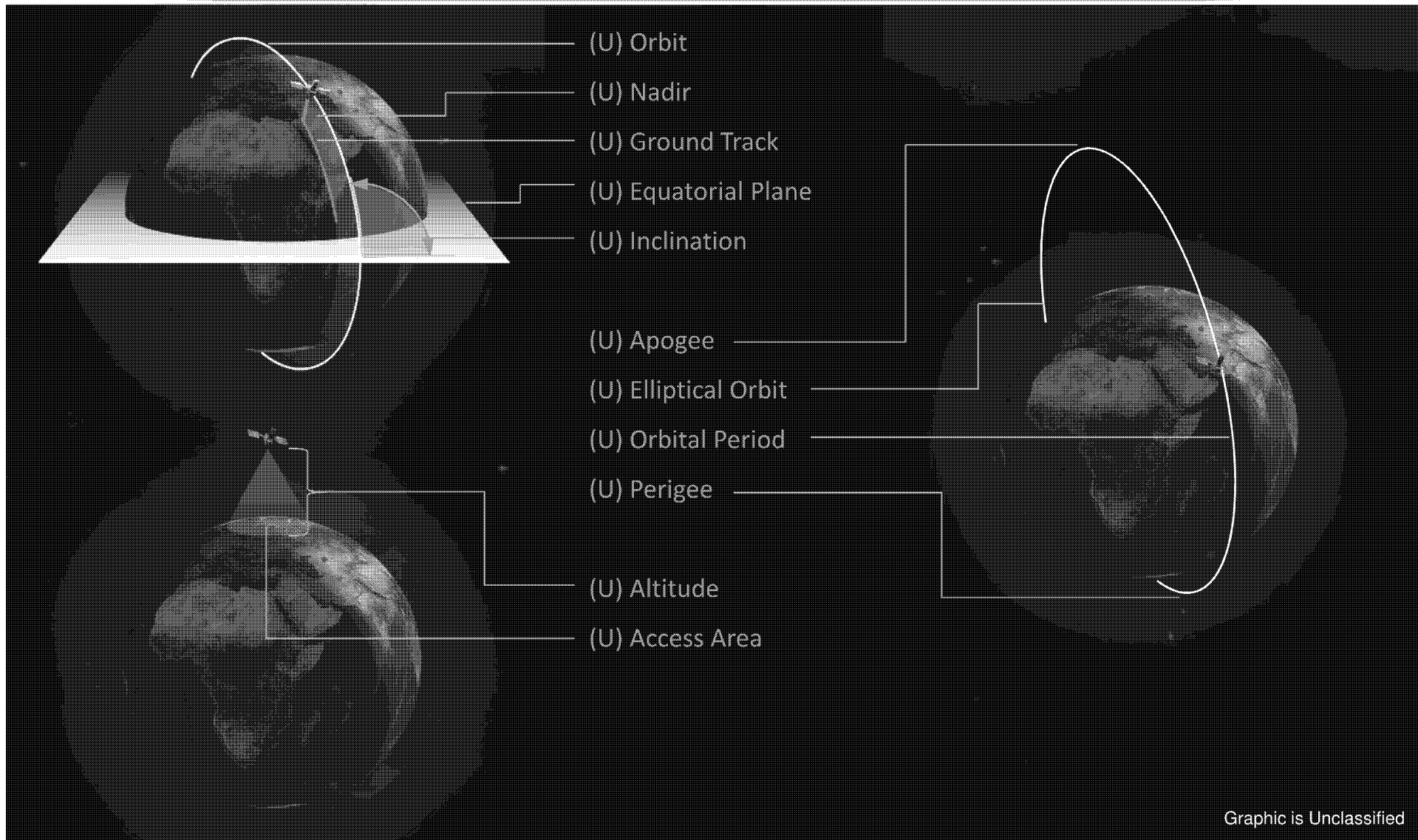
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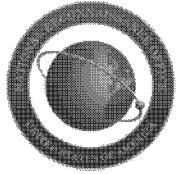
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(U) Orbital Terminology



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(U) Module 2 Agenda

(U) Orbital Mechanics

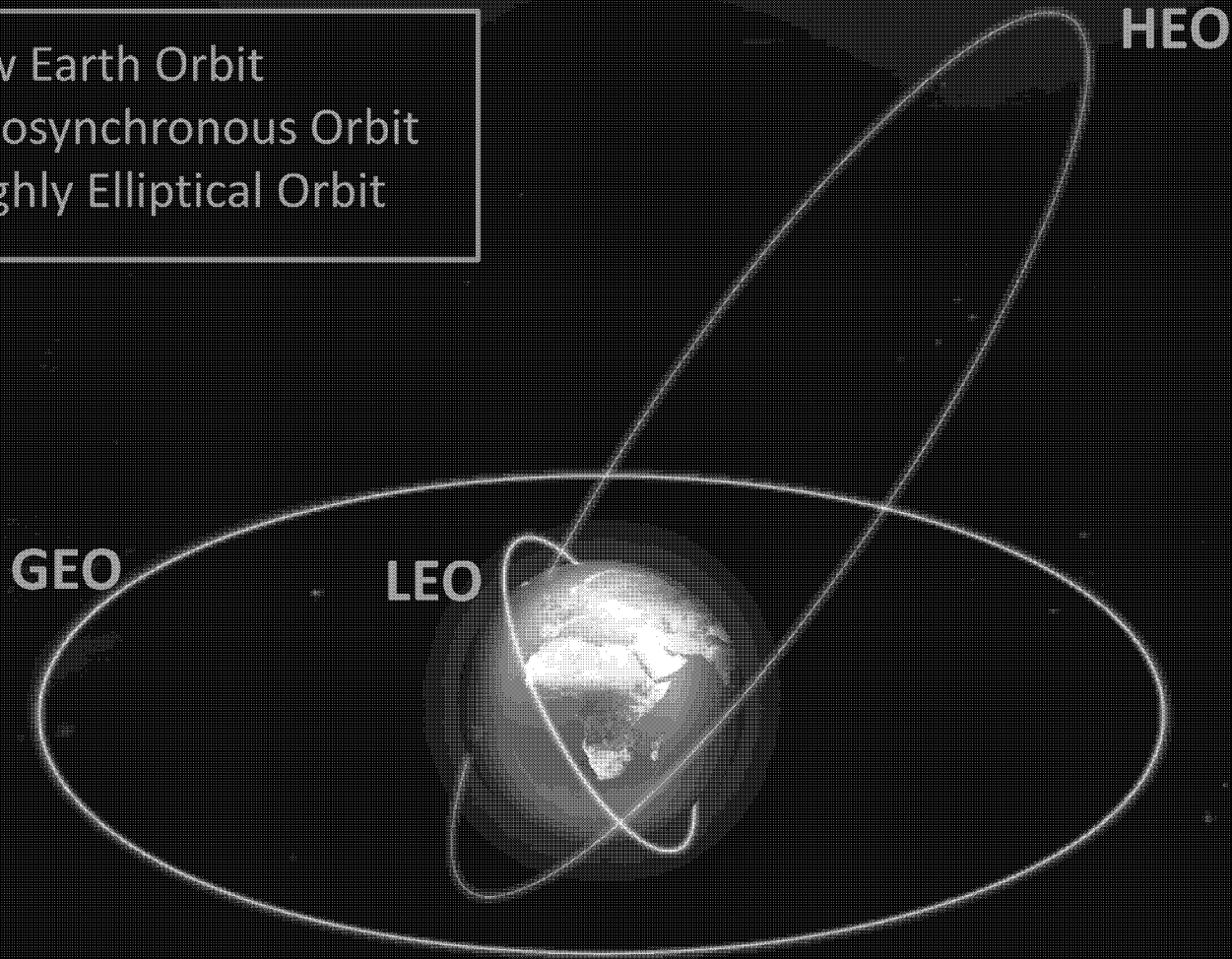
- ✓ (U) Orbital Terminology
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(U) Orbits

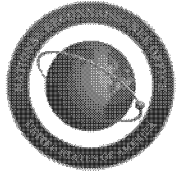
- (U) LEO = Low Earth Orbit
- (U) GEO = Geosynchronous Orbit
- (U) HEO = Highly Elliptical Orbit



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(U) Low Earth Orbit (LEO)

Global Access



Graphic is Unclassified

Specifications

- Inclination ~50-98 degrees
- Altitude 86 to 863 NM
- Access ~2M to ~15M SQNM
- Dwell ~4 to ~20 mins

Text is Unclassified

Pros

- Frequent Periodic Revisit
- Worldwide Access
- Sensors have best resolution / reception
- Lowest cost to launch

Cons

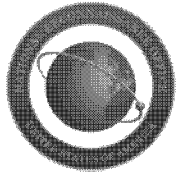
- Short dwell time
- Small Access Area

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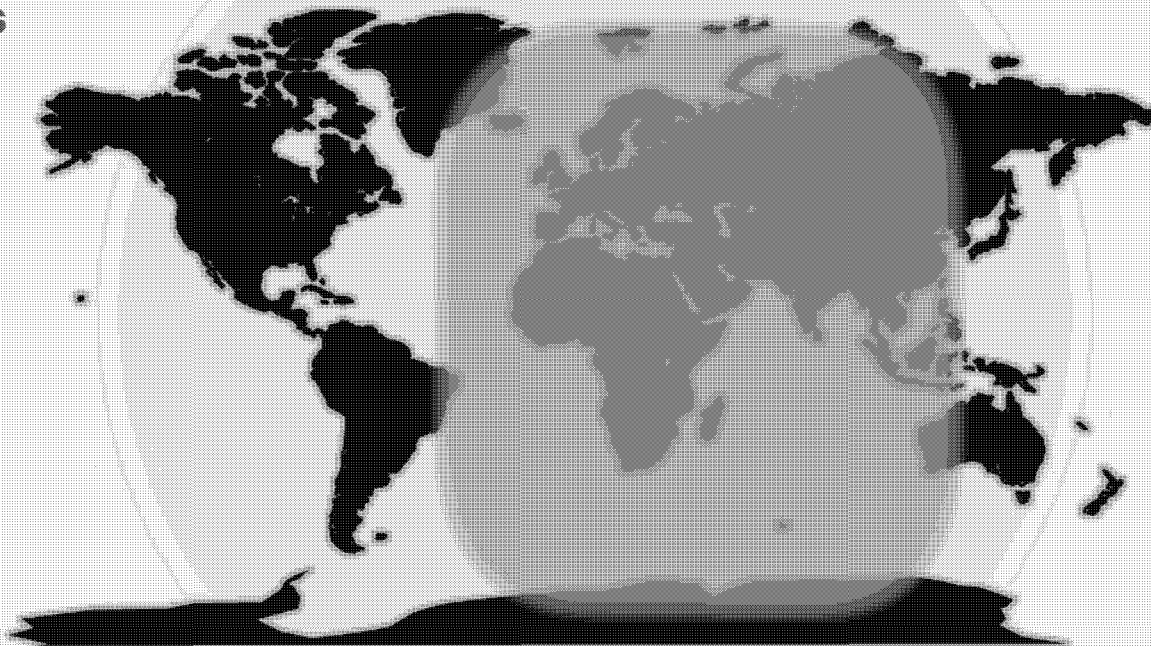
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(U) Geosynchronous Orbit (GEO)

Global Access



Graphic is Unclassified

Specifications

- Inclination 0 to 30 degrees
- Altitude ~19,300NM
- Access ~57M SQNM
- Dwell ~24 Hrs

Pros

- Wide Area Access
- Continuous Coverage Area

Cons

- No Polar Coverage
- Minimal Relative Motion
- Most Expensive to Launch

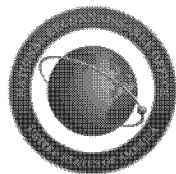
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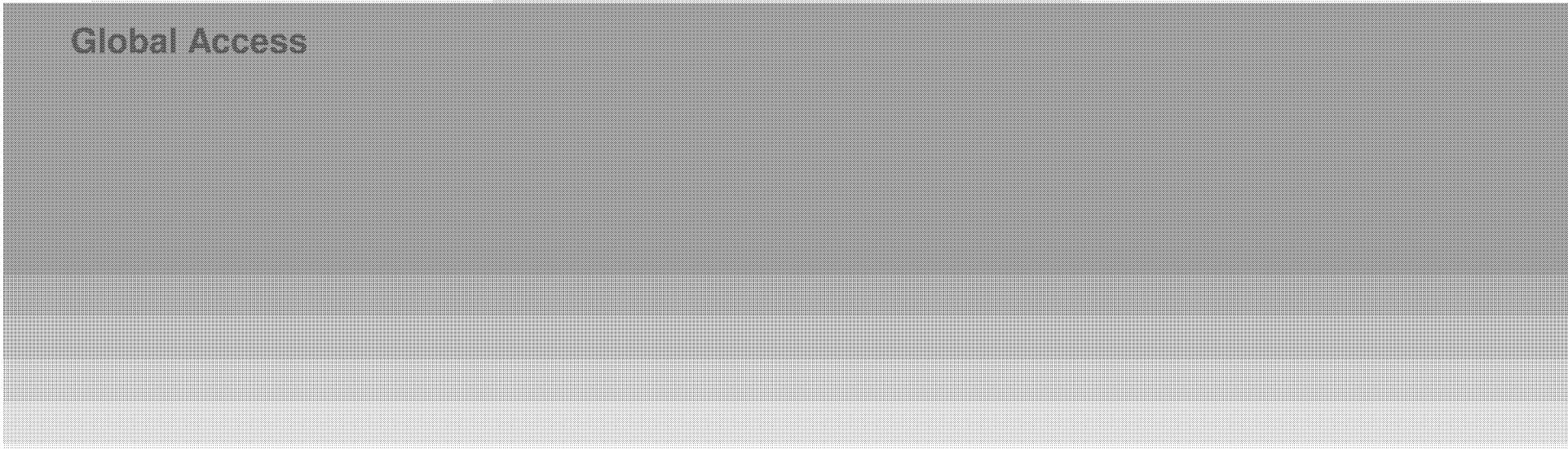
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(U) Highly Elliptical Orbit (HEO)

Global Access



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Graphic is Unclassified

Specifications

- Inclination 63.4 degrees
- Altitude 174NM to 20,680NM
- Access ~3M to ~57M SQNM
- Dwell ~30Min to ~10Hrs

Pros

- Over Northern Hemisphere:
 - Long Dwell
 - Large Access Area
- North Pole Access

Cons

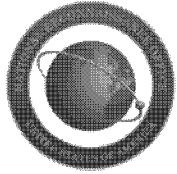
- Over Southern Hemisphere:
 - Short Dwell
 - Small Access Area
- No South Pole Access

Text is Unclassified

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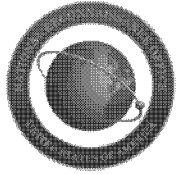


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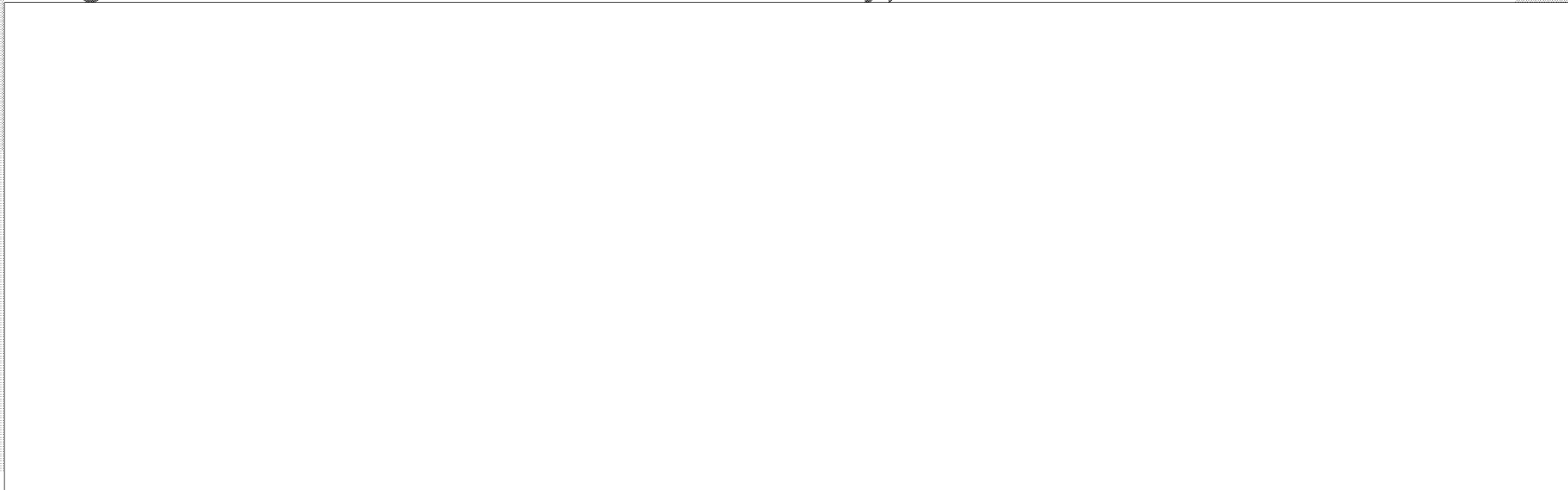


(U) Satellite vs. Mission

(U) Satellite: An artificial body placed in orbit around the earth to collect information or for communication.



(U) Mission: operational capability (i.e. imagery collection, signals collection, communications relay)



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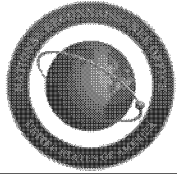


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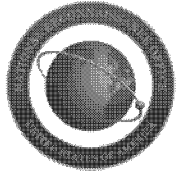


(U) NRO SIGINT Constellation

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(U) NRO GEOINT Constellation

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(U) NRO Communication Relay Constellation

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(U) NRO Reconnaissance Constellation

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(U) Module 2 Summary

(U) Orbital Mechanics

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