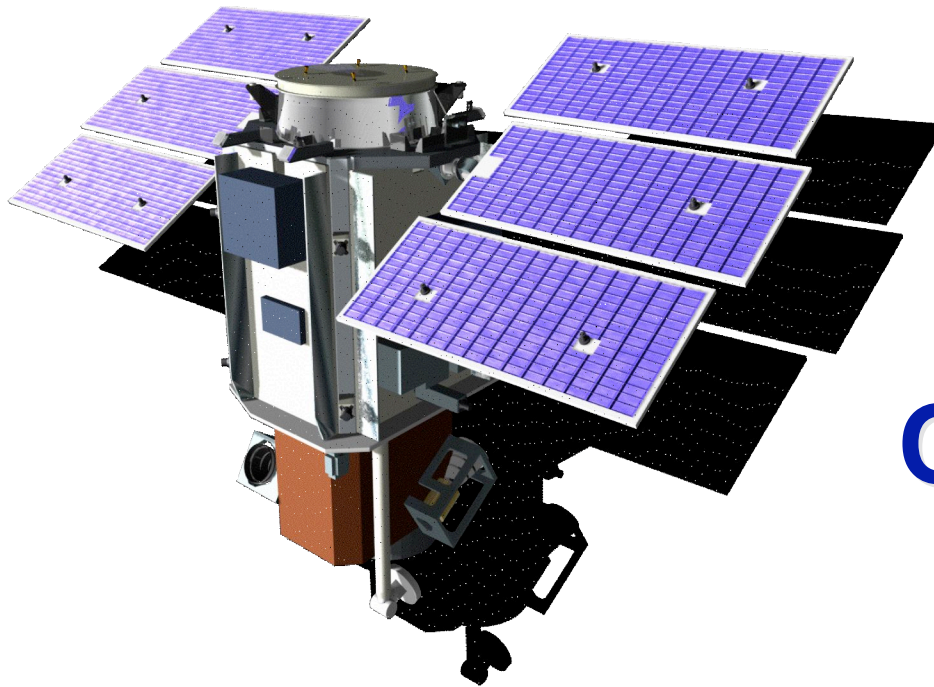


The Use of Oracle Spatial at DigitalGlobe

DigitalGlobe operates
the world's highest resolution
commercial imaging satellite



QuickBird !

Satellite Resolution Comparison



**10 Meter
1985**



**1 Meter
1998**



**QuickBird
.6 Meter
2002**

QuickBird Specifications

- Launched Oct. 2001; Fully Operational Apr. 2002
- 60 centimeter panchromatic resolution (at nadir)
 - 450-900 nm (grayscale)
- 2.44 meter multispectral resolution (at nadir)
 - 450-520 nm (blue)
 - 520-600 nm (green)
 - 630-690 nm (red)
 - 760-900 nm (near IR)
- 60 centimeter color imagery (natural or near-IR)
- Collection capacity: 16 orbits/day; ~57 scenes/orbit; = ~70 million km² per year
- 16.5 x 16.5 km (10.3 x 10.3 mi) scene/footprint
 - Area equal to 99 aerial photos at 1"=1200' scale
- 11 bit dynamic range



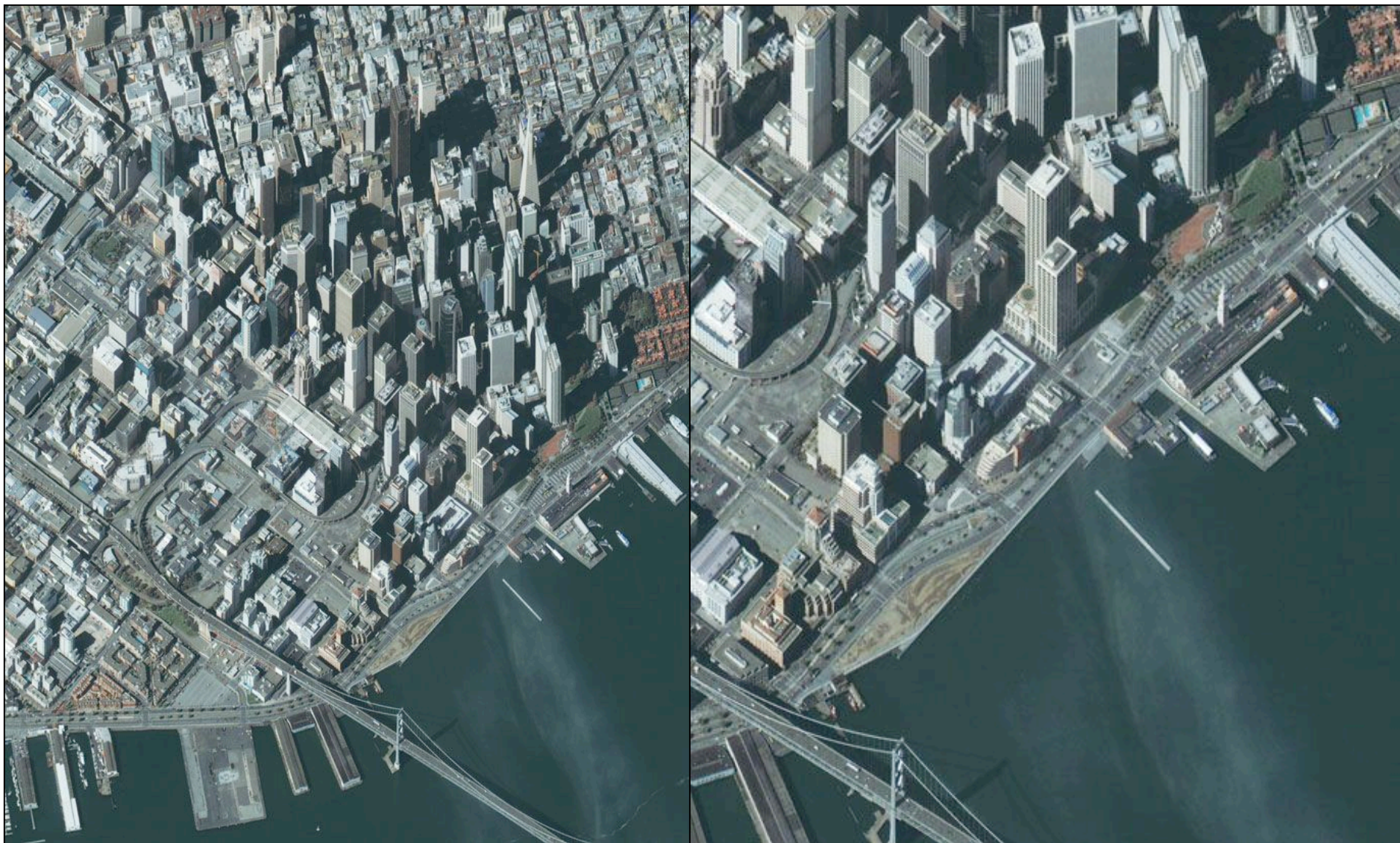
Revisit Time in Days		
Latitude	0° to 15°	0° to 25°
0	11	6
10	11	6
20	9	5
30	9	5
40	8	5
50	7	4
60	7	4
70	5	3
80	3	2



Examples of QuickBird Imagery

San Francisco, CA

72-cm Natural Color Pan-sharpened

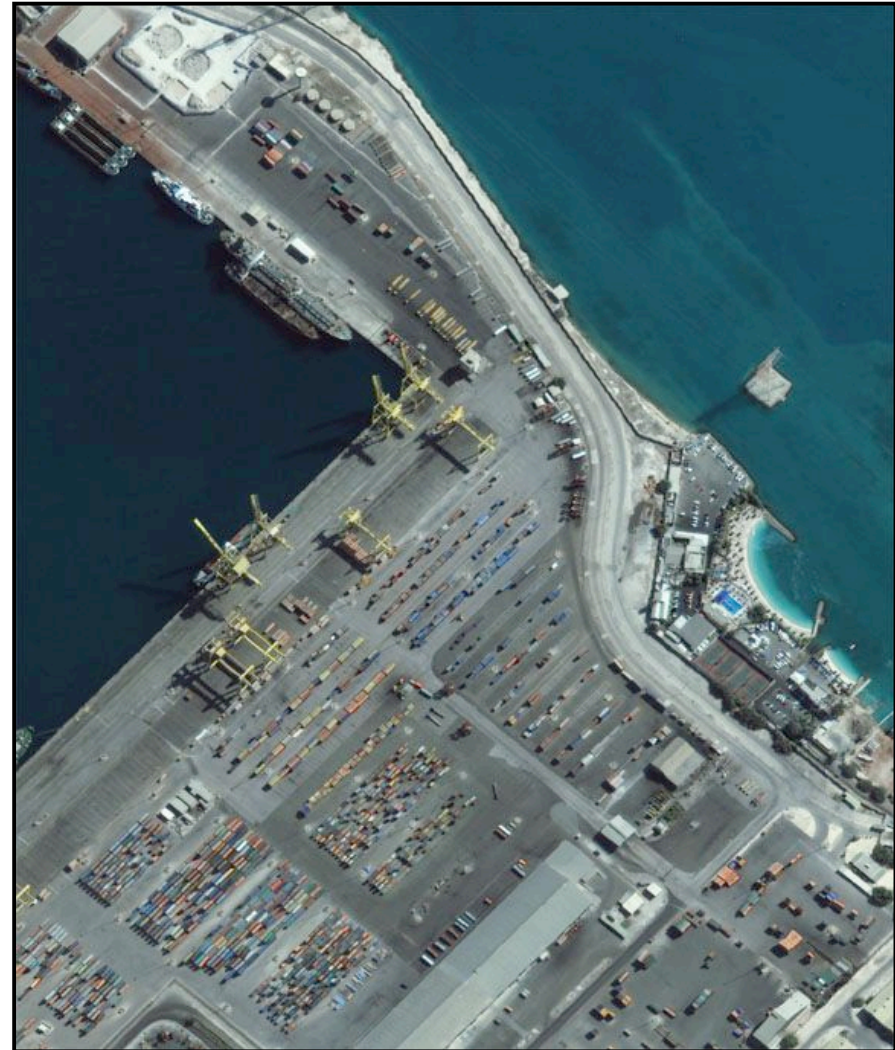


3-Band True Color Product Option



QuickBird 3-Band Color Imagery

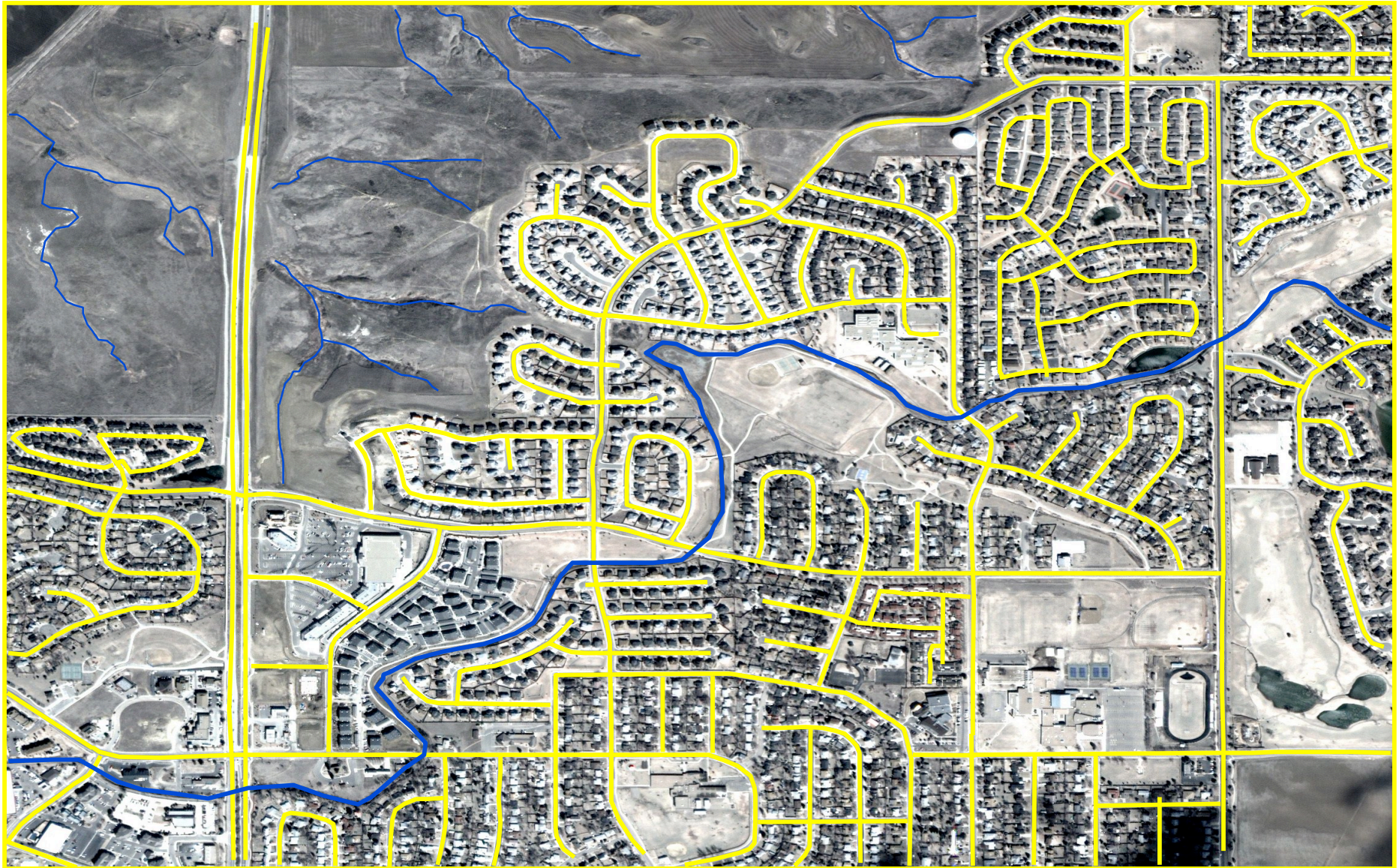
- 60 cm GSD
 - Standard Imagery
 - Orthorectified Imagery
- 11-bit dynamic range
- Natural Color
 - Blue
 - Green
 - Red



Abu Dhabi, UAE

Transportation Network Update

QuickBird Imagery - 2002



Homeland Security Applications

- **Crisis Response/Transportation Routes**

- Need for Up-to-Date Information
 - Rapid, Repeatable Access
- Need for Change Detection

QuickBird imagery can be used to update imagery layers in Geographic Information Systems.

The ability to image large areas (e.g., entire metro areas) on a regular and “as-needed” (crisis) basis can greatly assist decision-makers and emergency response personnel in effectively responding to an emergency while working with accurate and up-to-date information.



August 31, 2005
Hurricane Katrina
New Orleans, Louisiana

Sites to see ...



DigitalGlobe provides high resolution data to Google, visible at these sites:

- <http://earth.google.com/>
- <http://maps.google.com/>

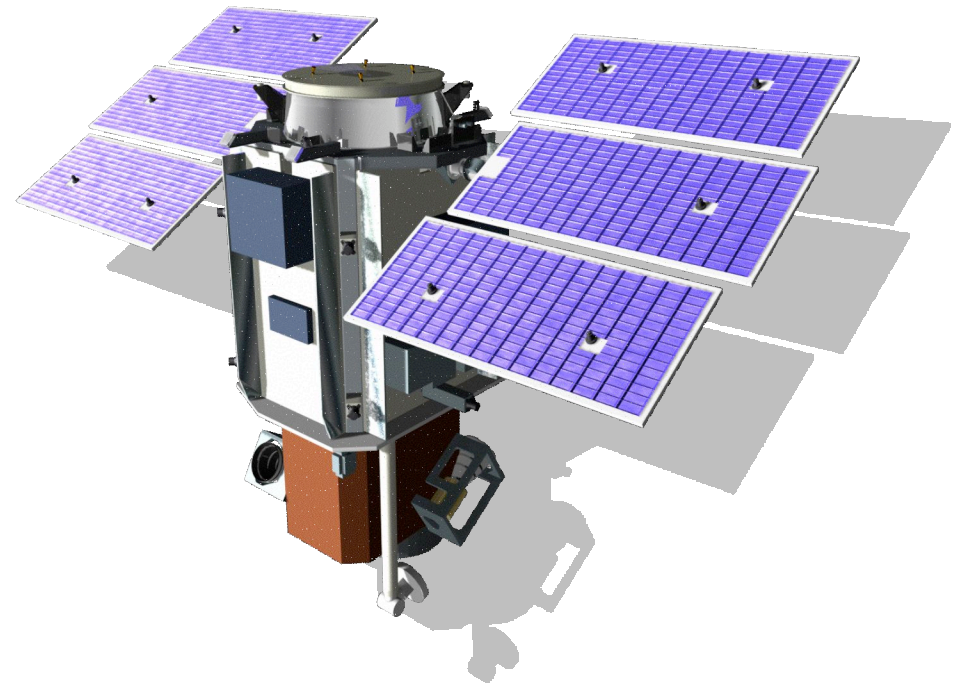
Additional imagery and information available at:

- <http://www.digitalglobe.com/>

QuickBird .vs. WorldView Imaging



- Regarding the video:
 - Animation depicts how our satellite acquires imagery
 - Three concentric circles represent 15, 25 and 30 degrees off nadir
 - Blue line is the ground track
 - Red wedge sweeps the area that can be imaged
 - Blue tiles are images acquired
 - Red tiles are images missed
 - Our current QuickBird satellite is compared with our planned WorldView satellite.



Why Oracle Spatial?



- The Earth is round – Aristotle knew it more than 2000 years ago, observing the round shape of the earth's shadow on the moon during an eclipse of the moon.
- Oracle Spatial supports a round earth with geodetic coordinate systems, unlike certain other vendors that still use a flat earth model.
- DG's QuickBird satellite circles the earth every 90 minutes, so DG needs a spatial system that readily crosses the poles, the equator, and the prime meridian.
- DG stores (most) of its spatial data in WGS84 (SRID 8307).
- Oracle Spatial is well integrated with the rest of Oracle's DBMS.

How we use Oracle Spatial at DG

Basic Business Process



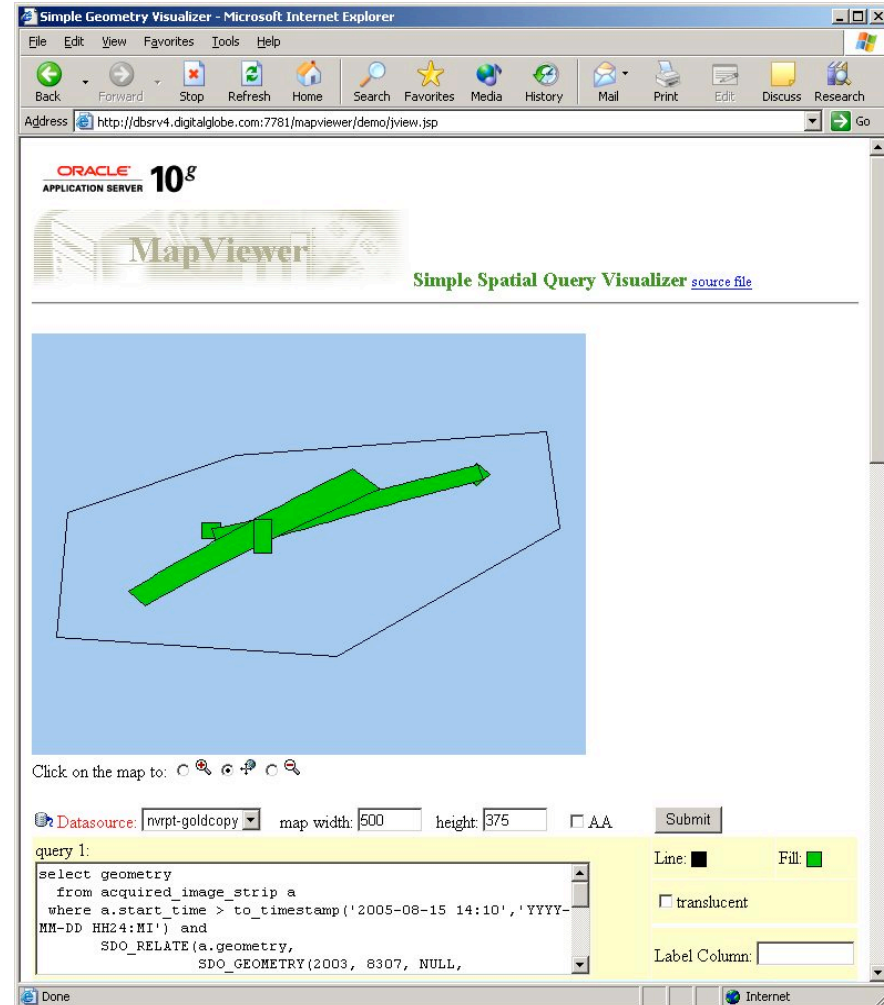
1. Customer places an order.
2. DG fills the order from our image archive if possible.
 - or -
 - DG tasks our satellite to acquire the image as needed.
3. DG processes and delivers the image to customer specification.

The following slides will focus on steps two and three.

Archive Check for Existing Imagery

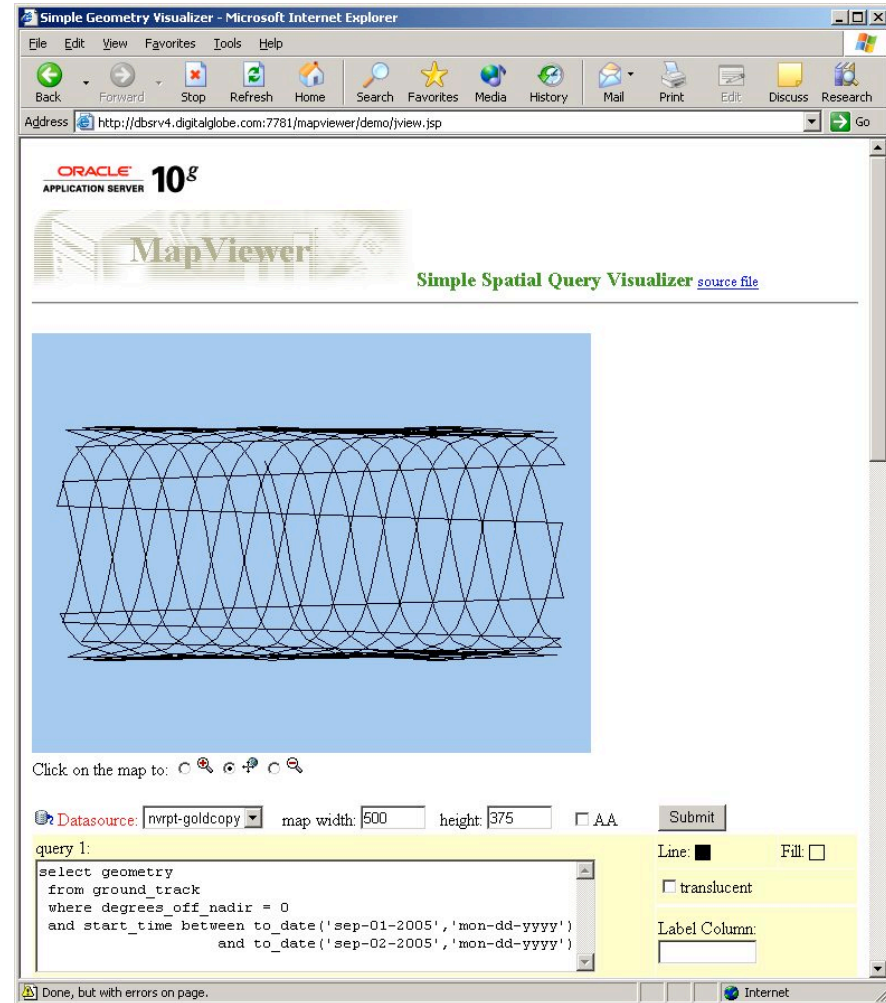


- Customer places an order, we check archive to determine if we can fulfill their request with existing imagery.
 - sdo_relate - anyInteract. Compare Order Line Item geometry with Acquired Image Strip geometry. Most relationships are of interest.
 - sdo_intersection - examine area of intersection between customer area of interest and available imagery.
 - sdo_area - determine % cloud cover in customer area of interest.
- If available image meets spec, we process it according to order processing parameters, then deliver as requested.

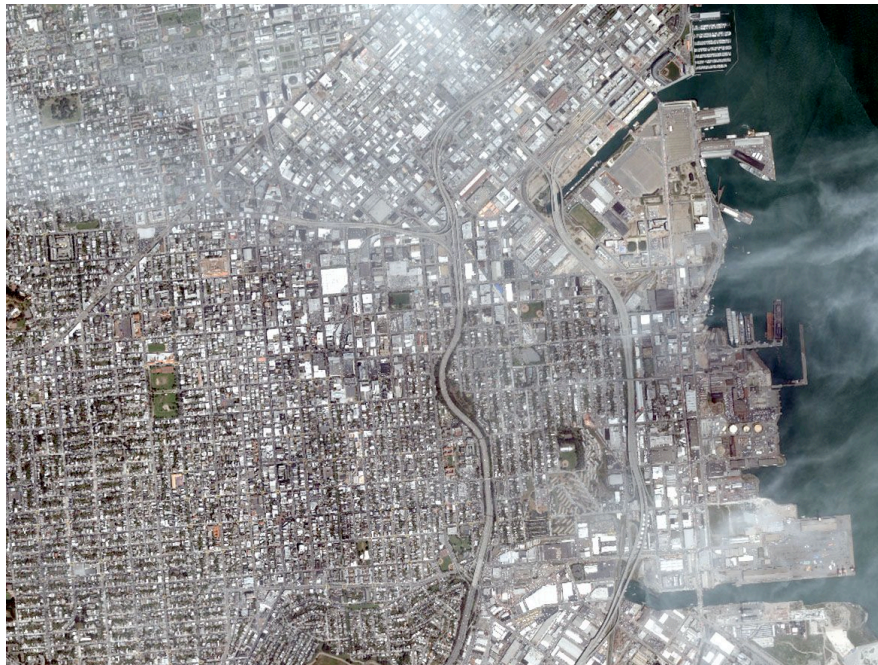


Satellite Ground Track

- If customer request can't be met from archive, we task the satellite to take the imagery.
- As you might expect, this is a complex process. We know when the satellite will be in a certain position in it's orbit. Position is described in earth centered/earth fixed (ECEF) coordinates Units are meters, relative to center of the earth. These ECEF coordinates are not stored in Oracle Spatial, but can be translated to a ground track, which is stored spatially. One day's ground track is plotted at right.
- Knowing where the satellite is at a point in time is just a matter of doing the math on the received telemetry. Taking a cloud free image is the trick.



Cloudy or Clear?



Cloud Cover



- **Historical Cloud Cover**

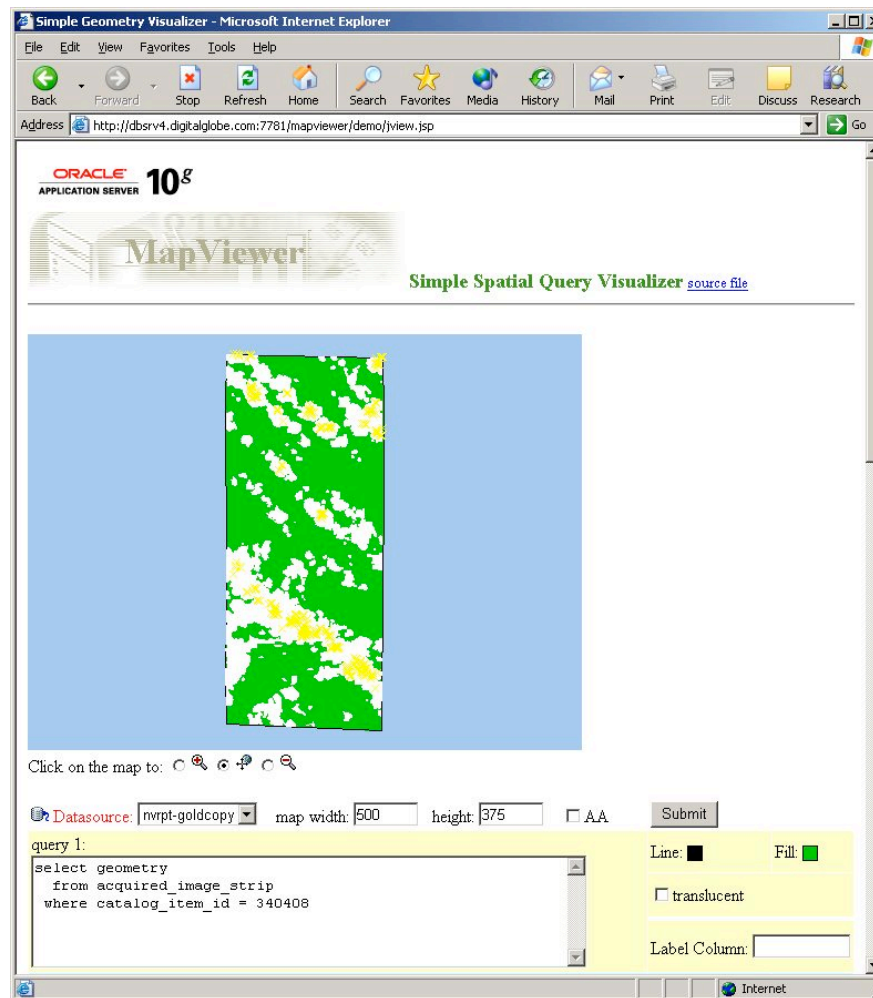
- For long term planning we use historical cloud cover as determined by the USAF.
- Roughly 97k nodes, data stored as point geometry with a 273 element Varray describing cloud cover percentages by month.
- Sdo_nn – returns cloud cover of node nearest a point of interest.
- Sdo_relate – returns cloud cover in an area of interest

- **Current Cloud Cover Forecast**

- For final planning, we use current cloud cover forecasts.
- Given the real time nature of the data, the single required method of access, and time constraints to be met, we don't store this data with Oracle Spatial.
- Instead, we map longitudes and latitudes into an x-y grid and perform operations in memory.

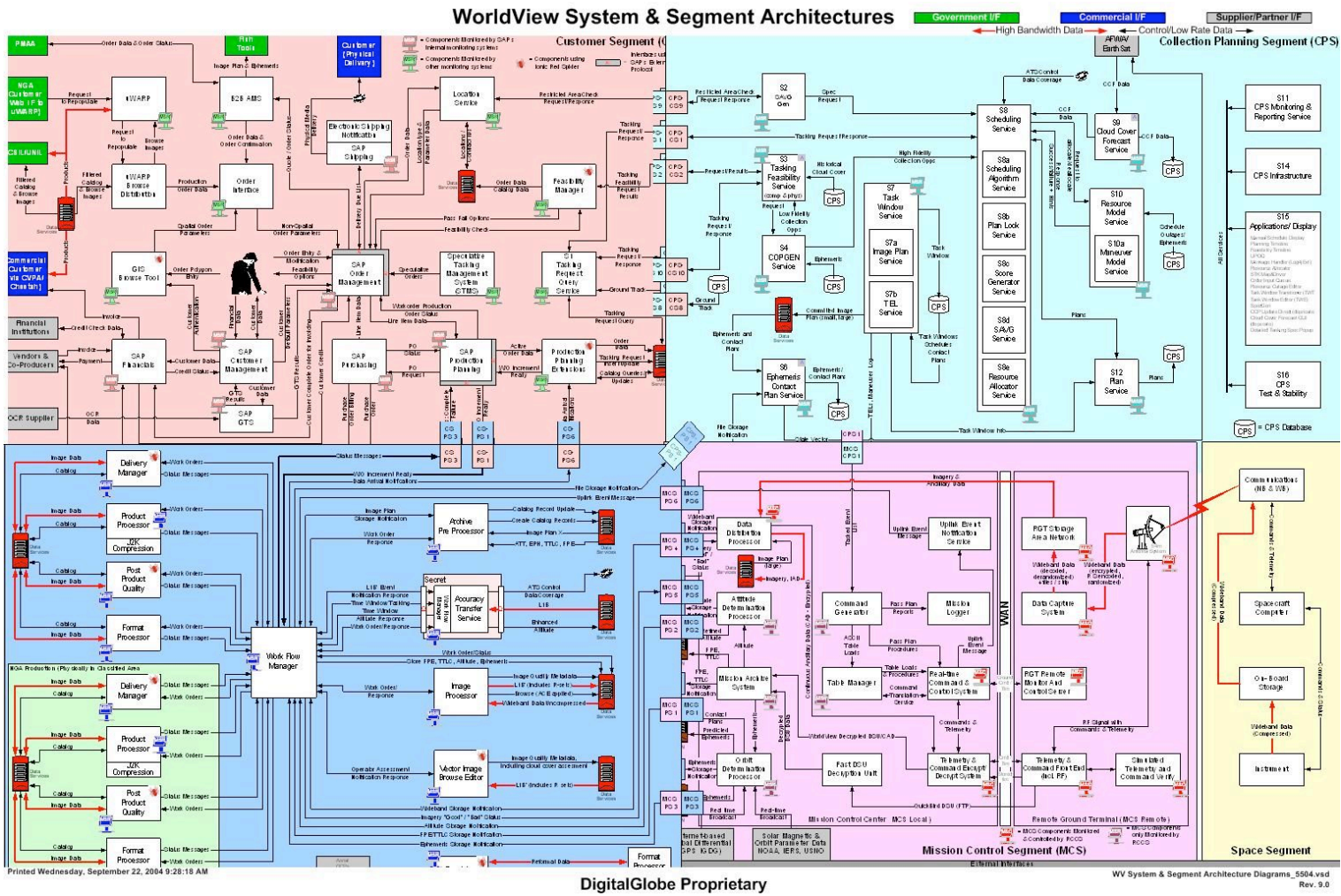
Cloud Cover and Flare Anomalies

- After images are acquired, they are processed to determine anomalies (like flares, in yellow) and covers (clouds, in white).
- Anomalies are stored as points, covers as polygons.
- 38M anomalies are described in current archive. They usually overlap cloud cover.
- Cloud cover is stored for each image.
- These attributes are part of what is assessed to determine if an image meets customer spec.



Other Oracle Technologies in use at DG

DG Systems – A Complex Environment



DG Environment Overview



- Oracle Grid Control
- Oracle Database 10G
- Oracle Application Server 10G
- Customer Segment
 - SAP R/3 hosted by separate Oracle Instance
 - Database interface via updateable views
- Collection Planning Segment
 - Oracle Application Server cluster/RedHat Linux
- Mission Control Segment
 - Oracle RAC DB/RedHat Linux
 - Handles Satellite Command/Control and Telemetry archive
- Production Segment
 - Ionic Red Spider hosted on OAS
 - WFS, WMS, Display Basemap and Browse Imagery

Oracle Enterprise Manager (SYSMAN) - Oracle Enterprise Manager Console Homepage - Microsoft Internet Explorer

Address: http://dbsrv5.digitalglobe.com:7778/em/console/home

ORACLE Enterprise Manager 10g
Grid Control

Page Refreshed Sep 1, 2005 8:48:48 PM

View: All Targets

Status
Total Monitored Targets: 246
Groups: 3

All Targets Availability

78% Up (192)
18% Down (44)
4% Unknown (9)
0% Under Blackout (1)

All Targets Alerts
Critical: 3629
Warning: 379
Errors: 84

All Targets Jobs
Problem Executions (last 7 days): 0
Suspended Executions (last 7 days): 0

Target Search
Search: All Targets

Critical Patch Advisories
Patch Advisories: 8
Affected Oracle Homes: 27

Deployments Summary
View: Database Installations

Targets without software inventory: 1 of 11
Collection Errors: 6

Database Installations	Targets	Installations	Interim Patches Applied
Oracle Database 10g 10.1.0.2.0	1	1	No
Oracle Database 10g 10.1.0.3.0	9	6	Yes
Oracle9i 9.2.0.4.0	0	1	No

Resource Center
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[Release Notes](#)
[Support](#)
[Oracle Technology Network](#)

Home | Targets | Deployments | Alerts | Jobs | Management System | Setup | Preferences | Help | Logout
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