Radar Data Generator (RDG)
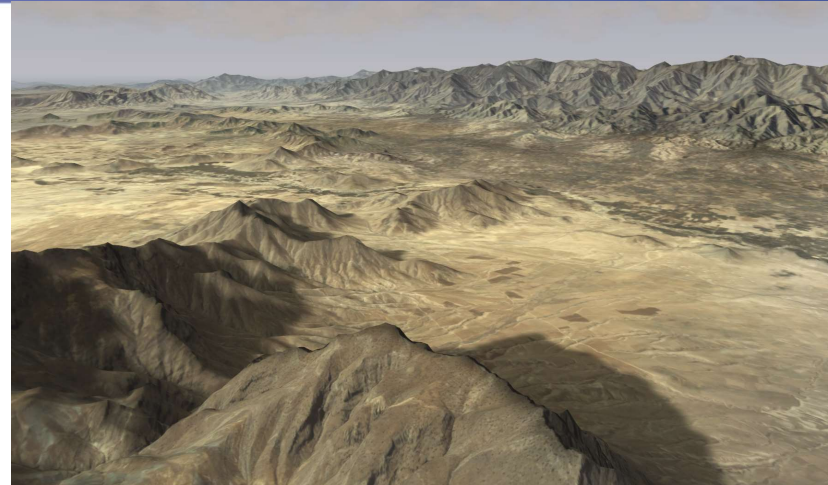
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Technology :: Terrain 3D Elevation Resolution

Relative Size & Bandwidth	Year	Feet between 3D posts	Initial Program
x1	1998	300	USMC AV8B
x10	2001	90	MV-22
x90	2004	30	USN MH-60S
x360	2006	15	USMC Afghanistan
x2250	2013	6	
>x10,000	2014	<3	

The Big Data effect has become a non-linear effect that places Aechelon Technology at a unique intersection of Big Data, Real Time and Production Capacity.
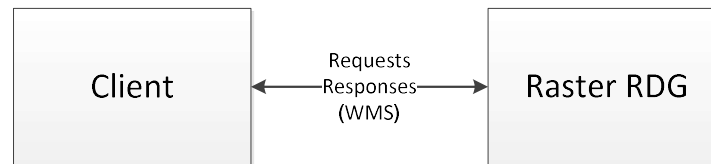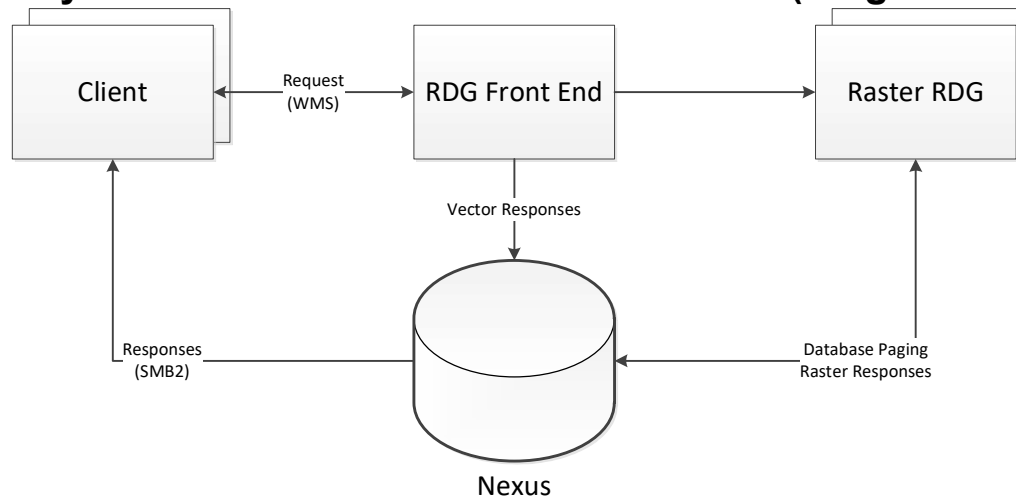

VS

Synchronous RDG Architecture

```
┌──────────┐      Requests      ┌──────────┐
│          │←──Responses───────→│          │
│  Client  │      (WMS)         │ Raster RDG│
│          │                    │          │
└──────────┘                    └──────────┘
```

Asynchronous Cluster RDG Architecture (Large Scale)

```
┌──────────┐   Request   ┌──────────────┐            ┌──────────┐
│  Client  │←──(WMS)────→│ RDG Front End │───────────→│ Raster RDG│
└──────────┘             └──────────────┘            └──────────┘
     ↑                          │                          ↑
     │                  Vector Responses                   │
     │                          ↓                          │
     │                      ╭────────╮                      │
  Responses                 │        │       Database Paging
   (SMB2)   ────────────────│ Nexus  │←──── Raster Responses
                            ╰────────╯
```

Nexus

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Radar Data Generator (RDR) :: Correlated Radar
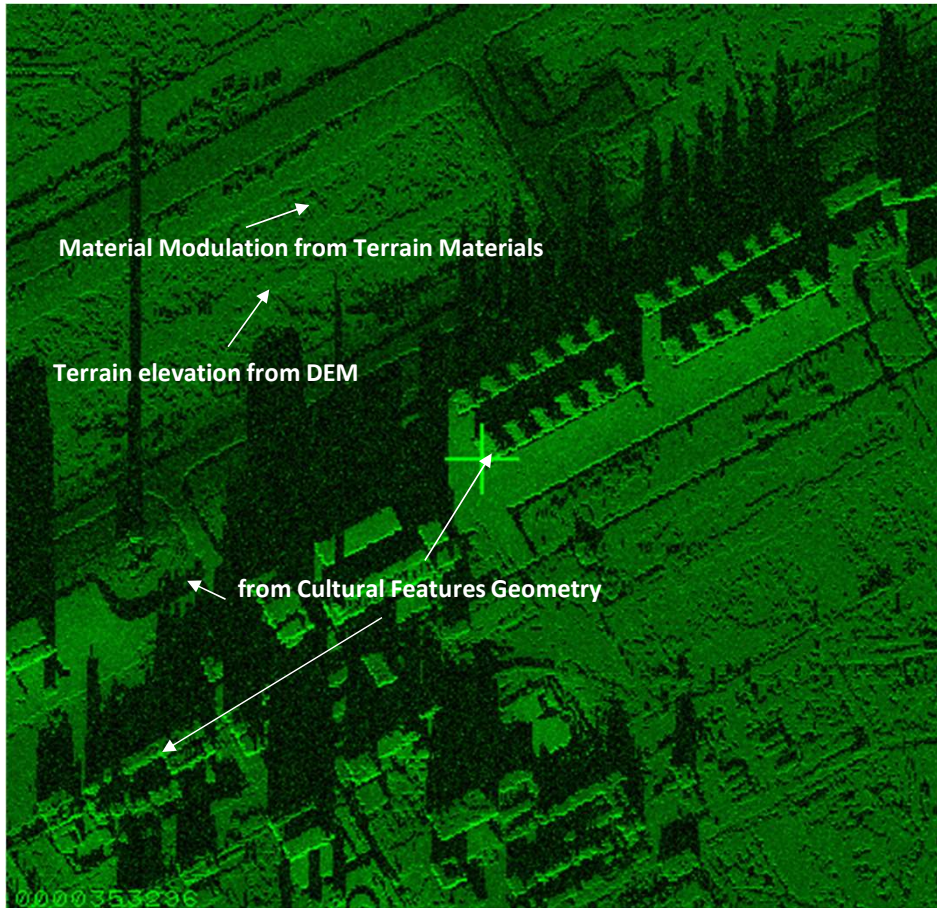

Kadena (UNCLASSIFIED Boeing MMRS Image)

Scales to Big SAR swaths of Millions x Millions

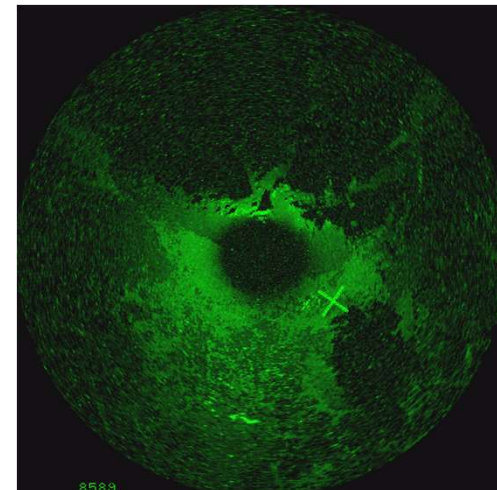**Scales to classified resolutions**

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Data Generators :: Radar Data Generator (RDG)

Material Modulation from Terrain Materials

Terrain elevation from DEM

from Cultural Features Geometry

**SAR/DBS 1m
(Camber RTK)
Circa 1999…
precursor of RDGs!**

Land Mass Modes

Client Radar Simulation Session :: TCP Messaging

- A messaging control protocol was preferred over the rigid API/DLL approach used in the past

- Messaging controls free RSS and future testing from the OS and compiler dependent Windows DLLs

- Aechelon has selected modern open standard WMS (**Web Map Service protocol), WCS & WFS** implemented over TCP with a very flexible architecture

- The WMS/WCS/WFS standards provides both a simple but yet scalable control interface that maps well from "small" radars to large scale radar designs

- The system works great for multi-computer applications enabling clusterization of **RSS** (i.e. RDG farms feeding RSS clusters) and correlated **CGF/TACTICAL ENVIRONMENT** (i.e. road networks, terrain) and **IOS** Stations (i.e. 1:1 IOS maps of roads, terrain, feature footprints …)

◆ **Messaging (Control ICD)**

- WMS (Web Map Services) used as basis for requests
- Two modes:
    - synchronous (small radars – first programs)
    - asynchronous (very large scale radars)

◆ **File format export IDD (asynchronous)**

- A per pixel type to separate terrain, features, sides and corners is included
- View independent top and side normal buffers supported
- Simplified OpenFlight files format for cultural features (if you want)
- Vector information attribution derived from NPSI (shape files)

◆ **Storage (file system) management (Asynchronous)**

- Directory structure returned for each request
- Instanced model library returned at initialization, (openFlight files returned in response to a capabilities request)

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Data Generators :: Radar Data Generator (RDG)

◆ **We produce on-the-fly using combinations of GPU/CPU streams of data layers**

◆ Deployed for the largest classified Big SAR ISR system

◆ Also in integration on "smaller" attack and TFR radars
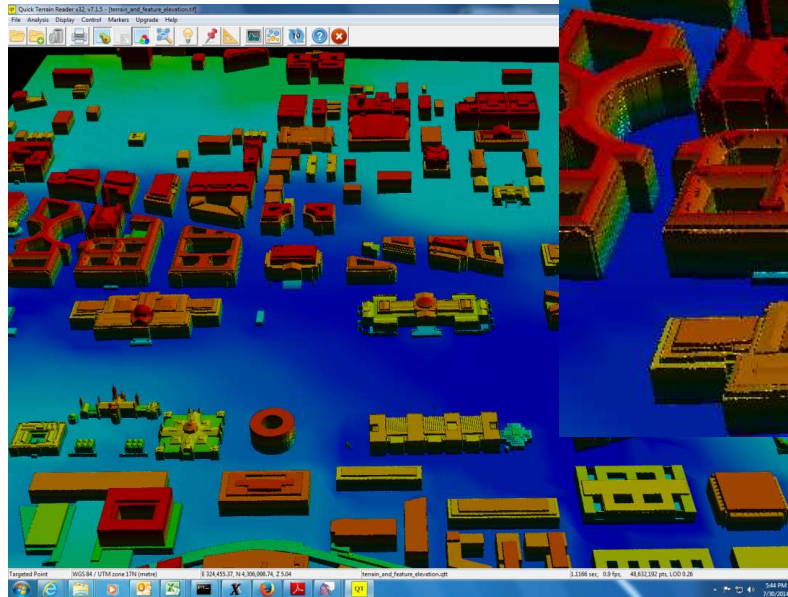
Client Radar Simulation (RSS) Session :: ICD

- ◆ **Web Map Service (WMS) protocol**
  - ▪ **http://opengeospatial.org/standards/wms**
- ◆ **WMS is an open HTTP 1.0-based protocol for requesting excerpts from a map server based on a bounding box**
  - ▪ **All requests can be performed using HTTP GET**
  - ▪ **TCP Protocol is robust**
- ◆ **One or more layers may be requested simultaneously**
- ◆ **Data formats are negotiated between client and server using mimetype enumerations**
  - ▪ **We will use *text/xml* to point to locations on the Nexus.**
- ◆ **WMS protocol supports request queueing**

◆ **GetCapabilities**

- ▪ **E.g. http://RDG:8080/rdg?**
  - **service=wms**
  - **&request=GetCapabilities**
- ▪ **Returns information about each layer, coordinate systems, etc. as an XML document.**
- ▪ **This information should be static.**

◆ **GetMap**

- ▪ **E.g. http://RDG:8080/rdg?**

  service=wms

  &request=GetMap

  &layers=elevation,material,intensity,normal

  &srs=EPSG%3A4326

  &bbox=-117.1626,32.7149,-117.1624,32.7151

  &width=4096

  &height=4096

  &format=text/xml

  &queue=true

◆ **Returns an XML file pointing to the location of the requested files, updated as they are generated.**

◆ **Queue argument is part of asynchronous query extension.**

◆**Example XML Response**

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Aechelon Radar Data Generator Response-->
<RDG_RESPONSE version="1.0">
  <requestID>1234</requestID>
  <request>service=wms
  &request=GetMap
  &layers=elevation,material,intensity,normal
  &srs=EPSG%3A4326
  &bbox=-117.1626,32.7149,-117.1624,32.7151
  &width=4096
  &height=4096
  &format=text/xml
  &queue=true</request>
  <requestDir>file:////nexusnas/radar/request1234/</requestDir>
  <elevationFile>file:////nexusnas/radar/request1234/elevation.tif</elevationFile>
  <materialFile>file:////nexusnas/radar/request1234/material.tif</materialFile>
  <intensityFile>file:////nexusnas/radar/request1234/intensity.tif</intensityFile>
  <normalFile>file:////nexusnas/radar/request1234/normal.tif</normalFile>
</RDG_RESPONSE>
```

Client RSS Session :: *Asynchronous Mode*

- ◆ **Asynchronous GetMap Extension**
  - ▪ Asynchronous requests will enable increased performance through pipelining
  - ▪ A single queue for the RDG cluster will permit elimination of duplicate requests and a single point of contact for issuing and managing requests.
- ◆ **Requests are queued when the *queue=true* option is specified.**
- ◆ **The server will close the TCP connection as soon as the request is queued.**
- ◆ **Request status may be queried with the GetStatus operation.**
- ◆ **Requests may be cancelled or retired with the RetireRequest operation.**

RSS Session :: ICD – Asynchronous Mode

- ◆ **GetStatus**
  - ▪ **E.g. http://RDG:8080/rdg?**
  - **service=wms**
  - **&request=GetStatus**
  - **&requestID=1234**

- ◆ **RequestID may be a specific request or "all"**

- ◆ **Returns an XML document with the status of the desired request(s)**

- ◆ **Example XML Response**

<?xml version="1.0" encoding="UTF-8"?>

<!--Aechelon Radar Data Generator Response-->

<RDG_STATUS version="1.0">

<requestStatus requestID="1234">QUEUED</requestStatus>

</RDG_STATUS>

- ◆ **Status is one of QUEUED, PROCESSING, COMPLETE, UNKNOWN.**

- ◆ **Retired requests will report UNKNOWN.**

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RSS Session :: *ICD – Asynchronous Mode*

- ◆ **RetireRequest**
  - ▪ **E.g. http://RDG:8080/rdg?**
  - **service=wms**
  - **&request=RetireRequest**
  - **&requestID=1234**

- ◆ **RequestID may be a specific request or "all"**

- ◆ **Cancels queued/pending request**

- ◆ **Deletes all files pertaining to request from Nexus**

- ◆ **Example XML Response**

  <?xml version="1.0" encoding="UTF-8"?>

  <!--Aechelon Radar Data Generator Response-->

  <RDG_RETIREMENT version="1.0">

  <requestStatus requestID="1234">RETIRED</requestStatus>

  </RDG_RETIREMENT>

- ◆ **Status is one of CANCELLED, RETIRED, or UNKNOWN.**

Radar Data Generator (RDG) :: Not just raster

◆ **RDGs produce on-the-fly database streams**

terrain_and_feature_top_normal	terrain_elevation
terrain_and_feature_fic_shape_code	terrain_material
terrain_and_feature_variance	terrain_intensity
areal_vegetation_canopies	terrain_variance
terrain_and_feature_elevation	terrain_color
areal_building_footprints	point_vegetation
terrain_and_feature_material	feature_elevation
lineal_power_lines	lineal_railroads
terrain_and_feature_intensity	lineal_walls
Point_vegetation_canopies	feature_material
Point_planted_vegatation	lineal_coastlines
feature_side_normal	lineal_roads
feature_intensity	point_features