

Building the SRTM Production Management System Interface With ArcIMS

By Sridhar Katragadda and Nathan Sretching

A Production Management System (PMS) was designed for the National Imagery and Mapping Agency (NIMA) to schedule and monitor the processing of Shuttle Radar Topography Mission (SRTM) data into finished products. ESRI's ArcIMS and SQL Server 2000 were used to build the PMS. This paper presents the design, development and implementation of the PMS that is currently accessed by NIMA through the contractor's website. The paper details the programming of ArcIMS to interface with the database and display the SRTM input data, generate and display the required progress, statistical reports and monitor other aspects of the production process in near real-time using a map.

Introduction

On February 11, 2000, the Space Shuttle Endeavour payload bay was outfitted with two radar antennas. During the mission, one antenna was in the cargo bay and the other was outside the shuttle at the end of the 60-meter and gathered topographic data over approximately 80% of the land surfaces of the Earth, creating the first-ever near-global data set of medium resolution land elevations. The NASA Jet Propulsion Laboratory (JPL) delivered the data to NIMA in one degree of latitude by one degree of longitude cells for processing.

System Overview

The Shuttle Radar Topography Mission's (SRTM) Production Management System (PMS) works within a Virtual Private Network (VPN). Multiple production sites process the data at different locations and use independent databases called Production Management Databases (PMDs). The production sites are designed to process the SRTM cells independently with no interruption if one production site is shut down due to technical problems.

Design

The SRTM main PMS is a tool designed to provide statistics and reports on the production status of SRTM cells from all production sites. The main PMS shows the aggregate information of the production sites. The PMS uses a web-based Graphical User Interface (GUI) that provides the framework for viewing cell status information and can be accessed using a remote web browser on a client machine accessed directly by NIMA staff. The client machine requires Internet Explorer 5.5, Microsoft Office 2000 and an Internet connection. The client machines are required to connect to the Virtual Private Network (VPN) that was implemented for the SRTM Project.

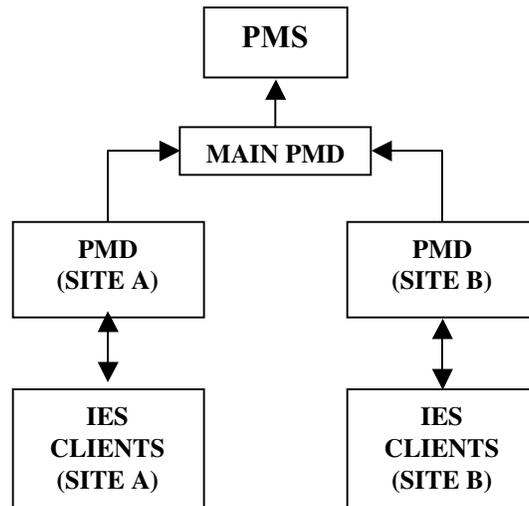


Figure 1. Site Layout.

Boeing Space and Intelligence Systems Washington Operations, the heritage Autometric group, supplies the interactive editing system interface (IES) and digital elevation model editing tools that are used to process the SRTM cells. The processing information is reported to the PMD at each site. All the required information for statistics and reports from the production PMDs is aggregated in the main PMD. The PMS interface provides access to the statistics and reports. The site layout is shown in figure 1.

PMS Component

PMS consists of three components: Web, Map and Database. Software used for each component is shown as below. The web component consists of the Internet Information Server, Microsoft's Web server that runs on Windows 2000 Server operating system, Internet Explorer 5.0 or greater and Microsoft Office 2000. The map component consists of tomcat, jdk and ArcIMS. The database component consists of Microsoft's SQL Server 2000. PMS Components are shown in Figure 2.

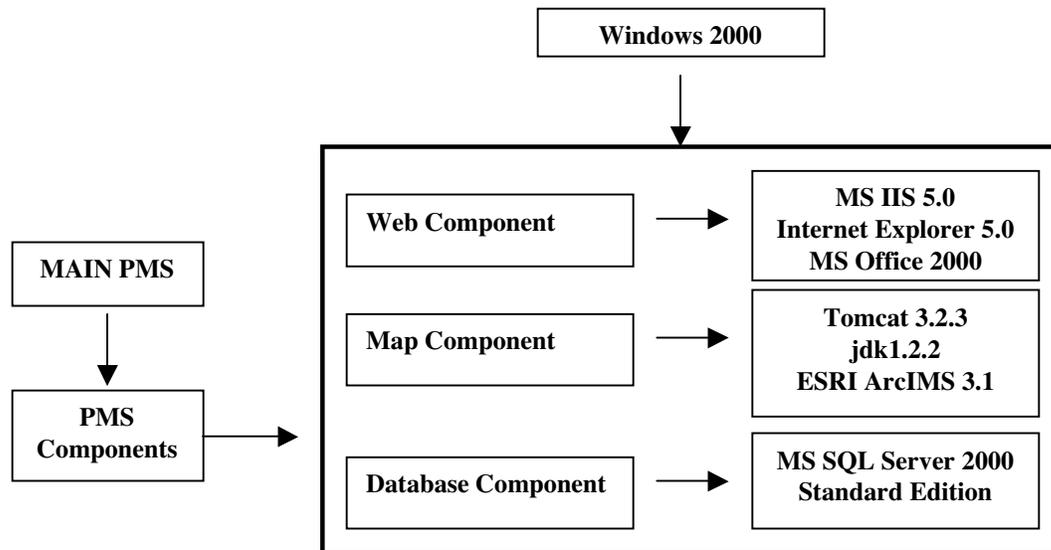


Figure 2. PMS Components.

Web Component

The web component was designed to share resources within a distributed environment from different locations. Boeing designed and implemented the VPN. NIMA managers can access the PMS using a secure login.

Map Component

The map component was designed using ESRI's ArcIMS that provides the foundation for distributing high-end geographic information systems (GIS) and mapping services via the Internet. The map component was designed to deliver map information, search capabilities, reporting the current status of SRTM data processing using maps. The map consists of a vector layer of the one-degree by one-degree cells covering the land areas of the world and a raster layer of Worldsat satellite imagery as the background. The vector layer was created using ESRI's ArcInfo, ArcView 3.2 and Microsoft Access 2000. The raster layer was obtained from the ESRI Data & Maps CD.

The x,y pairs for latitude and longitude line features were created using an Excel spreadsheet. An Arc Macro Language (AML) file was created for the x,y pairs. ArcInfo was used to generate the line features from the AML scripts. Clean and build in ArcInfo was used to create the SRTM cells as polygons for the whole world. The attribute information for all SRTM cells was created as a separate table in MS Access 2000. The attributes follow the convention provided by NIMA. TILENAME is the name of attribute column in the coverage. The attribute table was then joined to the cell polygons using ArcInfo to complete the coverage. The coverage was converted into a layer in ArcView's shapefile format. The attributes have a 1:1 relationship to the cellnames field in the database component that follows the same convention.

The cell naming convention is as follows:

Longitude: W or E followed by XXX (Three Digits)

Latitude: N or S followed by XX (Two Digits)

Example: W095N16

Database Component

The database component was designed to capture information of SRTM cell processing from the production sites and aggregated into the master database for access by clients in several locations. SQL Server 2000 Standard Edition was used as the database.

Production clients process the SRTM cells in automated and semi-automated techniques. Each SRTM cell passes through several phases of production processing. The cell state indicates the completion of processing as the cell moves from one phase to another. The cell state changes are updated in the cell table in the production databases. The change in the state of the cell is used by the main PMS to provide the statistics and reports on the production status.

The cell statistics and report information are generated as xml files by the production software. The change of cell state indicates the creation of an xml file. A trigger executes and ingests the xml file and creates a record of only the required attributes and inserts it into the respective PMDs at the production sites. These records are inserted into the aggregate database periodically. The aggregate database is connected to the main PMS. The reports are available for viewing using the main PMS menu. The process flow is shown in Figure 3.

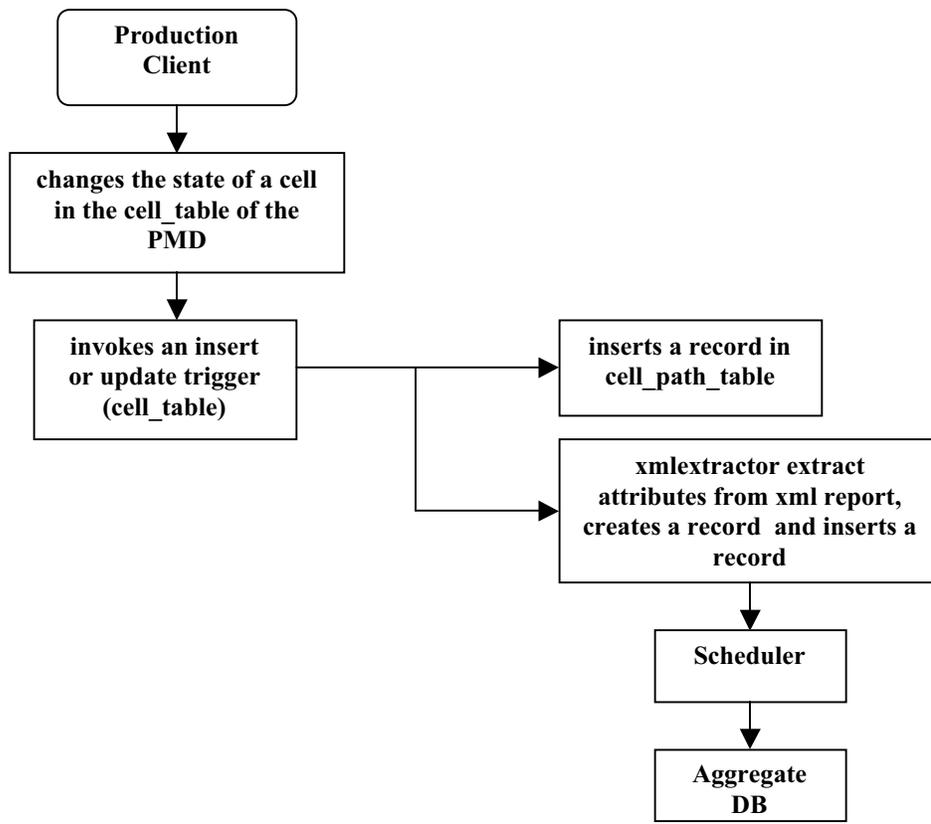


Figure 3. Process Flow

Engineers at Boeing made significant contributions to the database design to interface with the IES and improve the functionality of the PMS system. We appreciate the help provided by the team.

Interface Implementation

The PMS interface was developed using ESRI's ArcIMS. The interface components consist of a main menu, map window, toolbar, map legend, logo and submenu query and reporting panel. Main menu and toolbar components interact with the master PMD. The interface is user-friendly. The map window interacts with the database only as required. The reporting is completely done within the submenu query and reporting panel. Most of the reports are available in Excel dynamically formatted as per NIMA requirements. The interface framework and web interface are shown below in figure 4 and 5 respectively.

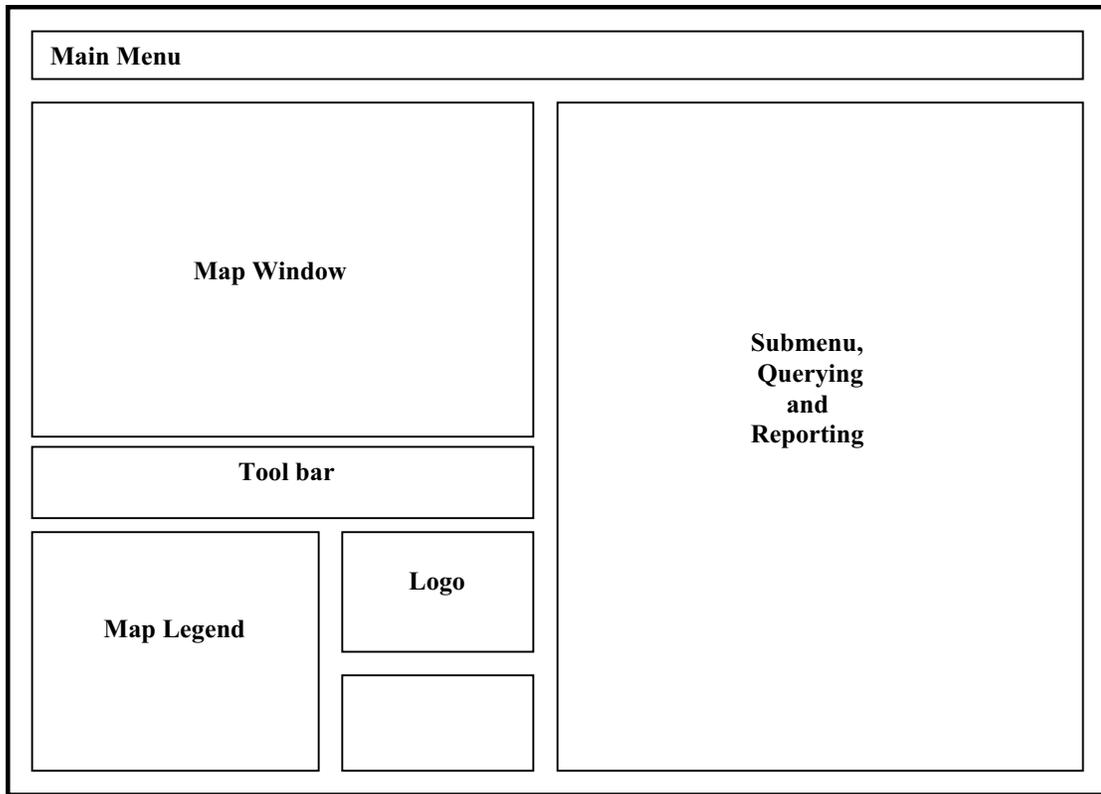


Figure 4. Interface Framework

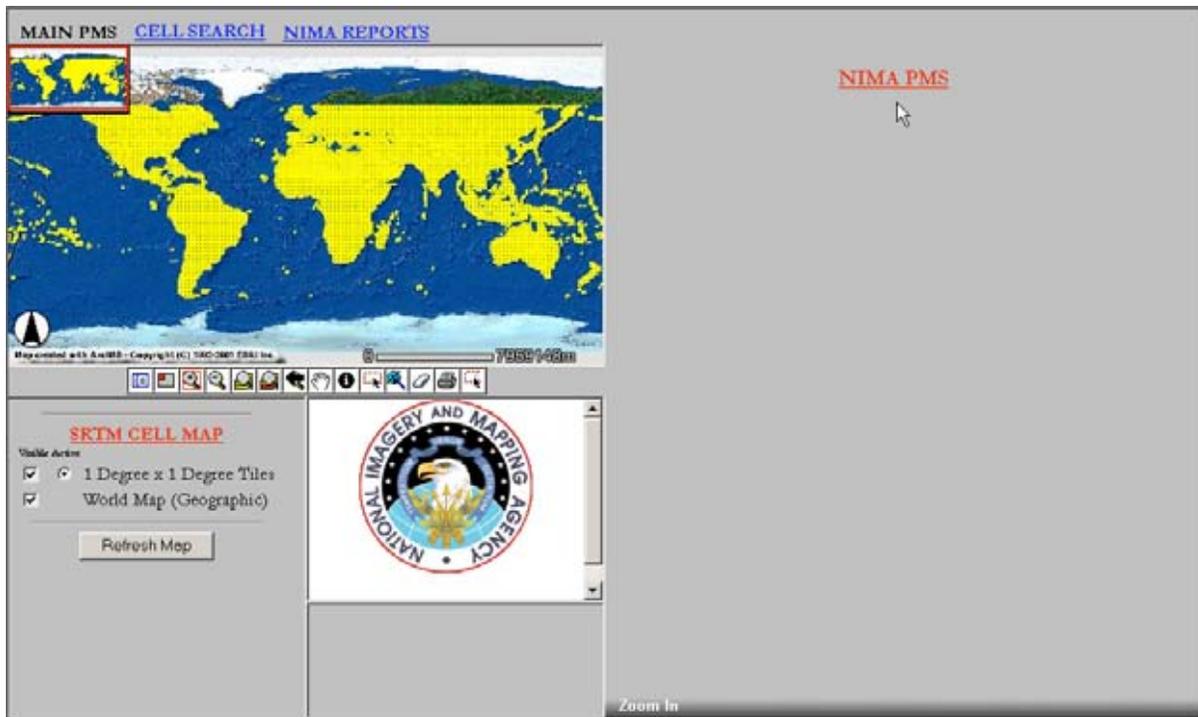


Figure 5. Web Interface

Main Menu

The main menu consists of links to the submenu. The submenu is a collection of links to generate map views and custom reports in excel format of the statistics and reports of the production status of SRTM cells.

The “Cell Searches” dropdown menu provides the functionality of searching SRTM cells using four criteria to create map views as shown in figure 6. Cell Status (Graphics) link gives an option to select a continent. Once the continent is selected, the count and current processing status of the SRTM cells that were assigned within the continent for the project can be viewed in real-time. The status information is queried from the main PMD. The main PMD is updated daily.

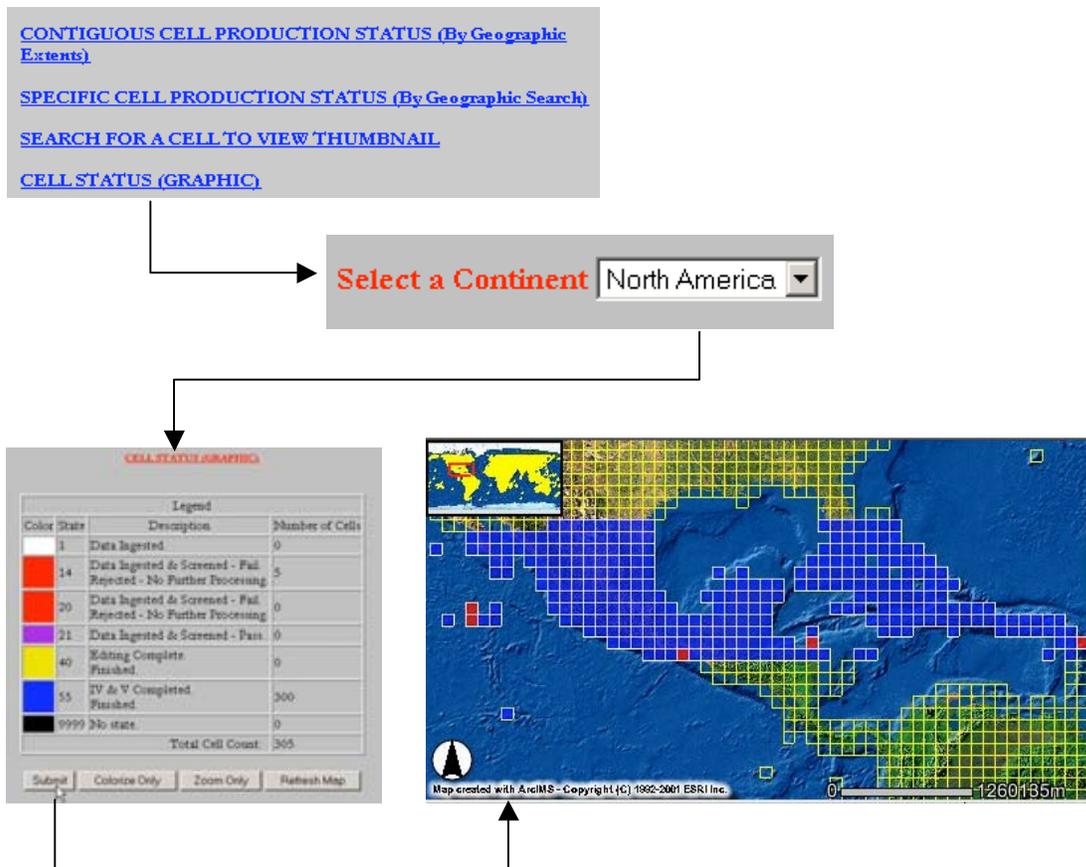
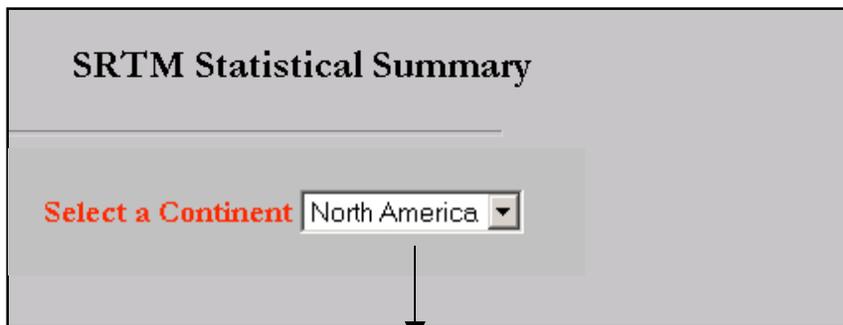
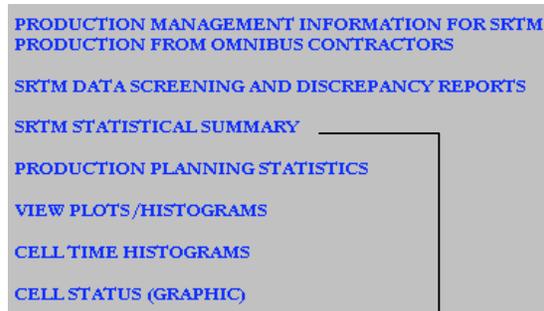


Figure 6. Cell Search Menu Selection

The colorize button uses active server pages script (ASP), acetate layer functionality to create an ArcXML, a protocol to communicate with ArcIMS spatial server, request and response to update the map. The zoom only button uses the northwest corner of the cells from a table in the database to create the extent of zoom to perform a quick zoom. Submit button performs colorize and zoom functions simultaneously.

The “NIMA Reports” dropdown menu provides access to statistics and report on the production status of SRTM cells as shown in Figure 7. SRTM statistical summary gives an option to select a continent. Once the desired continent is selected, the statistical information for the selected cells is generated as an excel spreadsheet. The statistical information of each cell is derived from automated processing that is performed by the IES. An xml file is created. Required information for each cell is extracted from the xml file and inserted as a record into the PMD. The results are dynamically formatted and output as an Excel spreadsheet in a popup form for viewing and saving as a report.



Cell ID	INITIAL (I) /FINAL (F)	DATE	LAT SW (deg)	LONG SW (deg)	MIN ELEV (m)	MAX ELEV (m)	NO. OF NULL POSTS	SPIKES WELLS (no.)	GCP:No. of Posts	GCP:Mean Elev Diff (m)	GCP:Std. Dev. of Diff (m)	GCP:Ri Diff (m)
w121n35	I	3/16/02	35	-121	-78	1492	79524	0	284	-3.8	5.4	
w121n35	F	3/21/02	35	-121	-14	1492	13167	0	284	-3.8	5.4	
w121n36	I	3/16/02	36	-121	-14	1601	18109	0	175	-3.5	6.6	
w121n36	F	3/21/02	36	-121	-14	1601	5440	0	175	-3.5	6.6	
w121n37	I	3/16/02	37	-121	-16	1775	187452	0	259	-0.5	3.9	
w121n37	F	3/21/02	37	-121	-12	1775	24747	0	259	-0.6	4.1	
w121n38	I	3/16/02	38	-121	22	3146	209329	0	217	-2.3	6	
w121n38	F	3/27/02	38	-121	22	3146	110376	0	217	-2.2	6.3	
w121n39	I	3/16/02	39	-121	236	2827	99361	0	85	-0.6	6.9	

Figure 7. Statistical Summary Report

Functionality

The functionality was achieved by integration of Internet, database and mapping technologies. Javascript, vbscript and ASP were used for the web interface programming. T-SQL and stored procedures were used for database programming. ASP, javascript and ArcXML were used for mapping.

Conclusions

NIMA currently uses the PMS for checking the current status of SRTM data processing and creating the required production and statistical summary reports. Similar applications will be useful for any production management tasks that have a spatial context in any field.

Acknowledgements

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Author Information

Sridhar Katragadda
Senior Database Developer (GIS)
PixSell, Inc.
Bldg. 9313, Room 144
John C. Stennis Space Center
Bay Saint Louis, MS 39529
Email: skatragadda@pixsell.com
Phone: (228) 813-1900
Fax: (228) 813-1903

Nathan Scretching
Computer Science (Bachelor of Science Degree Candidate)
Undergraduate - Junior
Mississippi State University
P.O. Box 4908
Mississippi State, MS 39762
Email: njs2@msstate.edu
Phone: (228) 467-4579