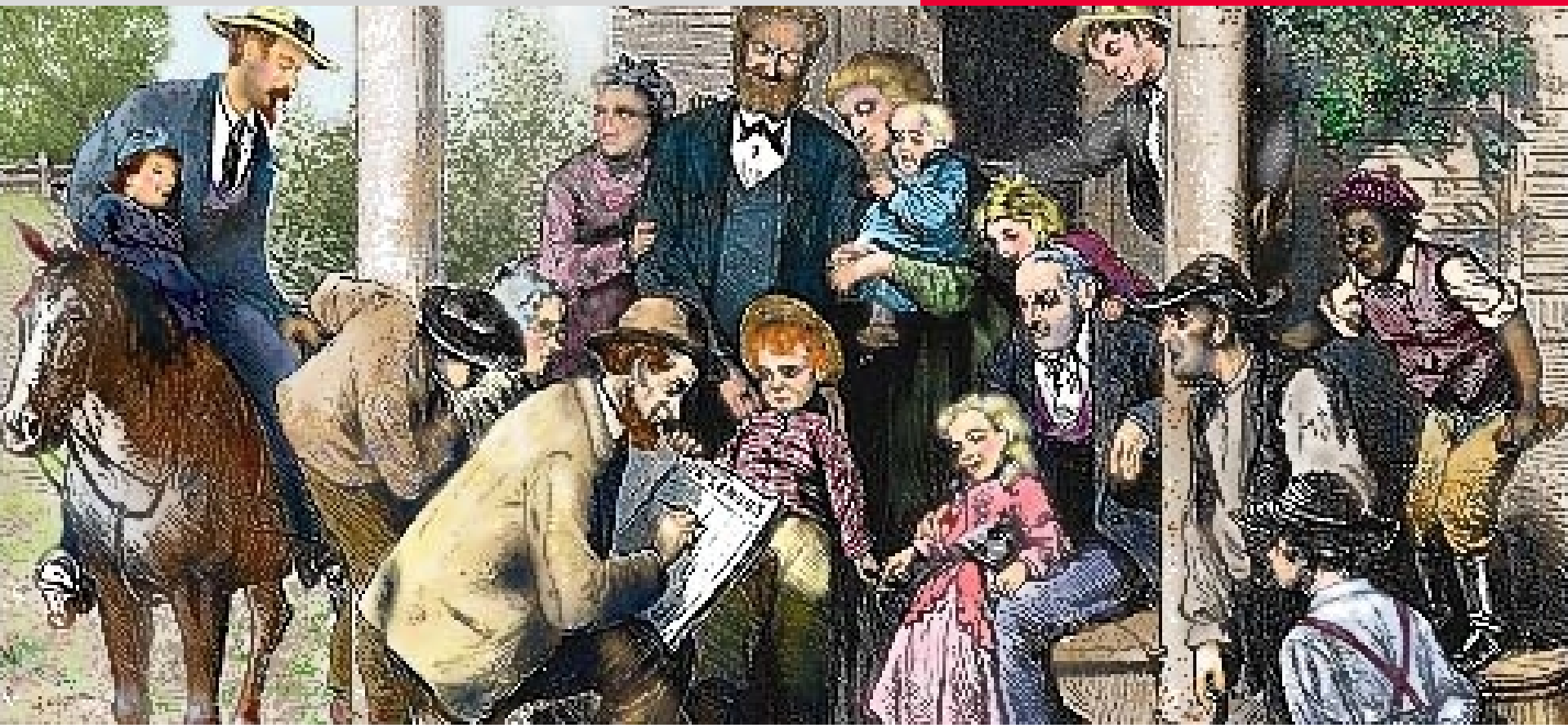


Harper's Weekly, 19 November 1870

2010 World Programme on Population and Housing Censuses:
Sub-regional Workshop on Census Cartography and Management

UNSD, Bangkok, Thailand
15 – 19 October 2007

- when it has to be **right**

Leica Geosystems

Leica Solutions for Census Management

Shanmugam Ganeshkumar

Enterprise Solutions Manager

- when it has to be **right**

Leica Geosystems

Agenda

- Leica's Commitment
- Overview of GIS and IT Issues
- Where Leica ADE Technology and Solutions Fit In
- Example – US Census Bureau
- Summary

Commitment to Standards

ISO

- Editor / Project Leader of ISO-19000 specifications (TC211) (19128, 19139, 19134, ...)
- Head of Belgium delegation at ISO TC211
  (Vincent Dessard, Ionic Software)
- Liaison officer between ISO TC211 and United Nations (UNGIWG)
  (Vincent Dessard, Ionic Software)

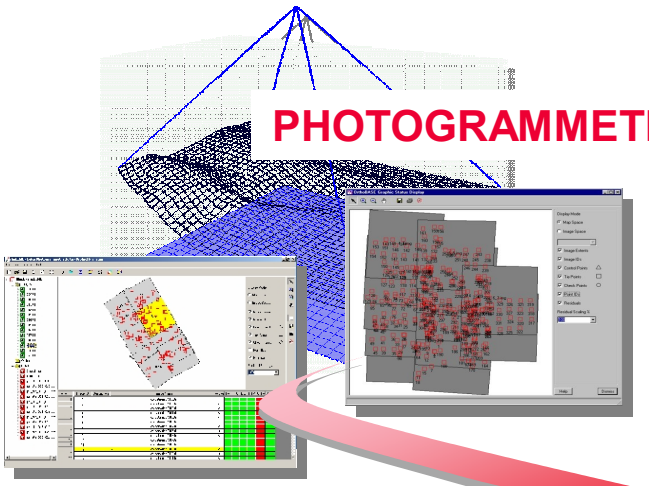
Commitment to Standards

Open Geospatial Consortium (OGC)

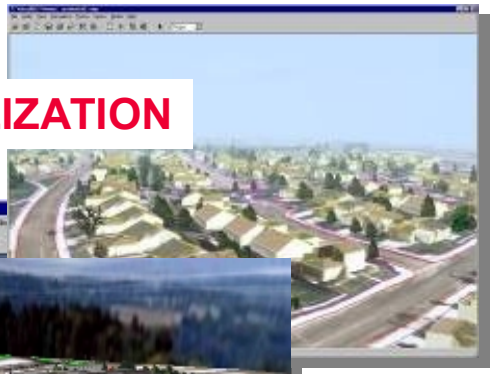
- Technical Member **since 1999, Principal Member since 2007**
- **Co-author of multiple** OGC specifications
  (WMS, WFS, WCS, Catalog, Context, GML, ...)
- **Seat at OGC** Management & Planning Committee **since 2002**
  (Vincent Dessard**, Ionic Software)**
- **Co-Chair of the** OGC Forum **(ex-SIG) since 2003**
  (Vincent Dessard**, Ionic Software)**
- Member of the OGC **Board Of Directors since 2005**
  (Chris Tucker**, Ionic Enterprise)**
- Member of the OGC **Board Of Architecture since 2006**
  (Bernard Snyers**, Ionic Software)**

W3C OGC Technical Committee Member OASIS ISO

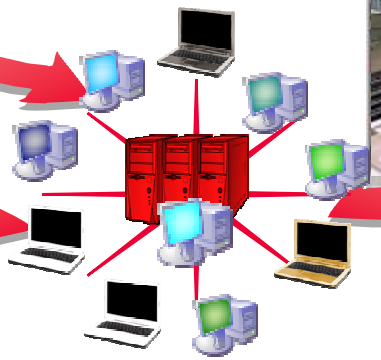
Leica's Response to the Enterprise Market

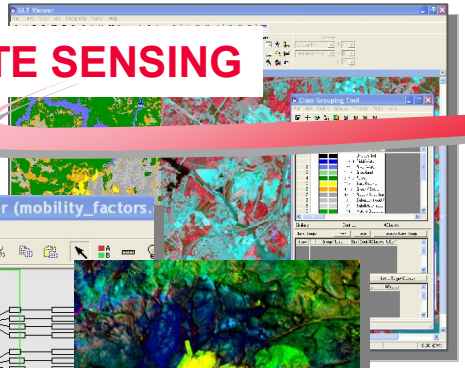


PHOTOGRAMMETRY



VISUALIZATION





REMOTE SENSING

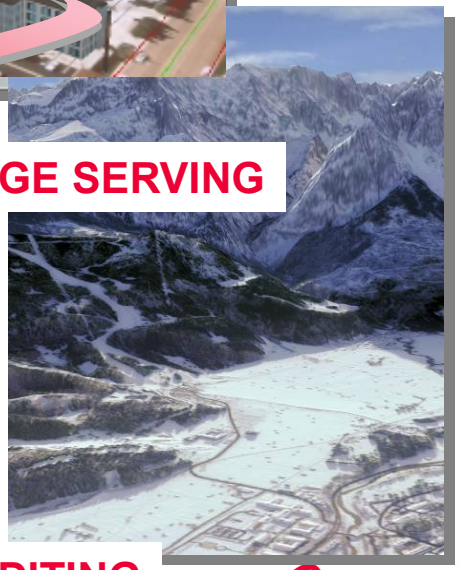
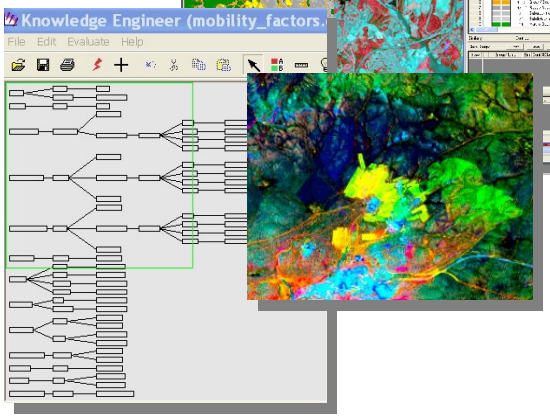
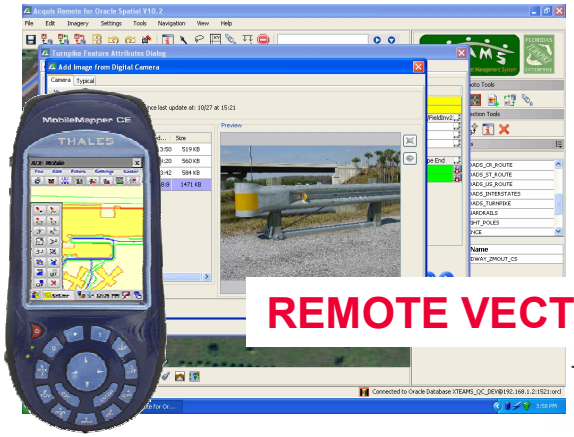


IMAGE SERVING



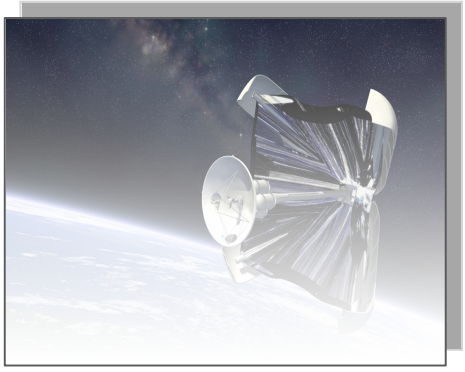


REMOTE VECTOR EDITING

- when it has to be **right**

Leica Geosystems

Market Positioning

Defense

- Geospatial Intelligence
- Security / Surveillance
- Homeland Security

Space

- Ground Segment Application
- Earth Observation
- Imagery Libraries

Government

- Spatial Data Infrastructures
- E-Gov & Geo-Portals
- Disaster management
- Public Safety

Enterprise

- Geo-enabled Systems
- Location Based Services
- New Mobility
- Geo Business Component

Leica ADE Enterprise Suite

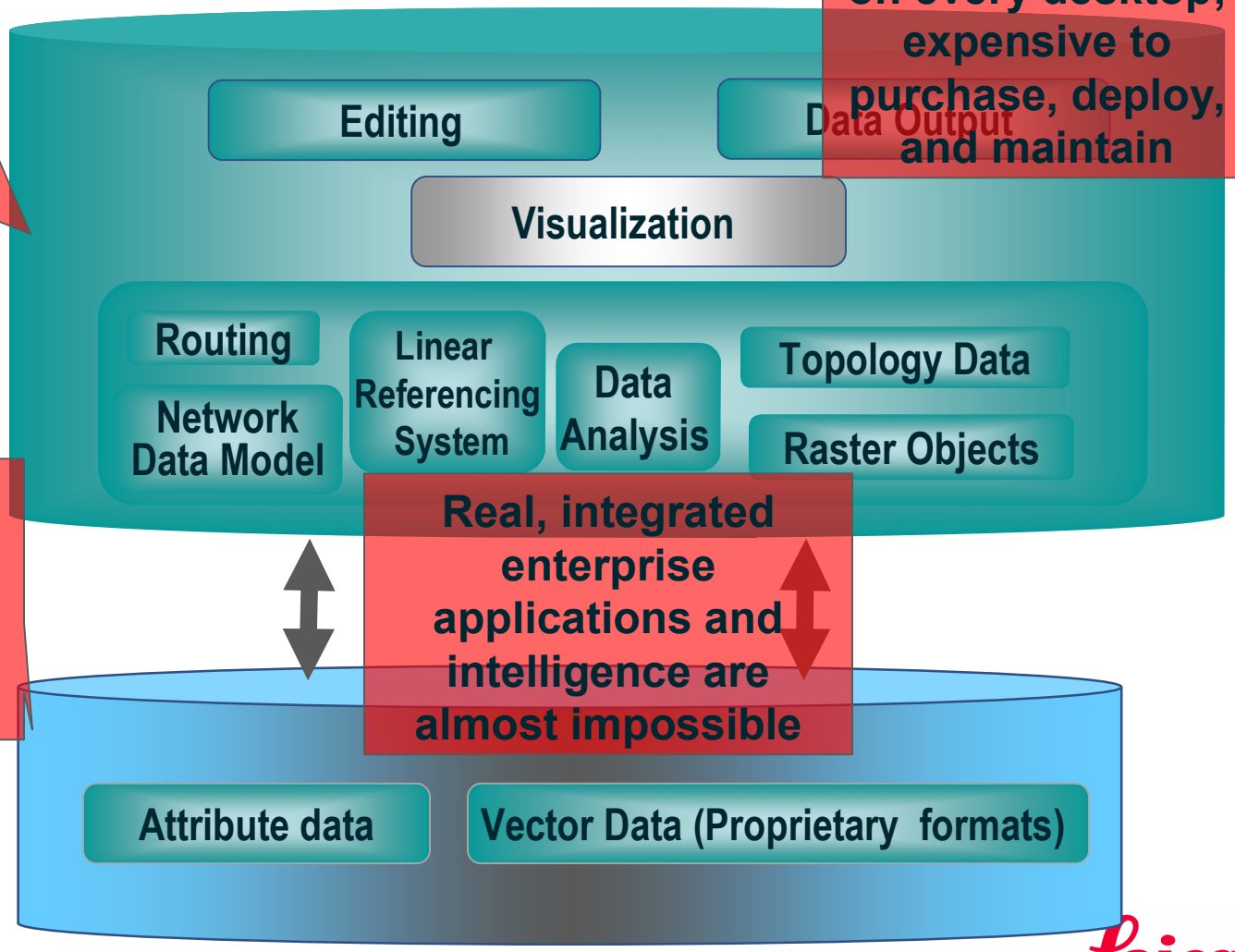
- when it has to be **right**

Leica Geosystems

Legacy GIS Architectures (2 Tier)

Specialized GIS developers needed to develop ALL location apps

Thick application on every desktop; expensive to purchase, deploy, and maintain



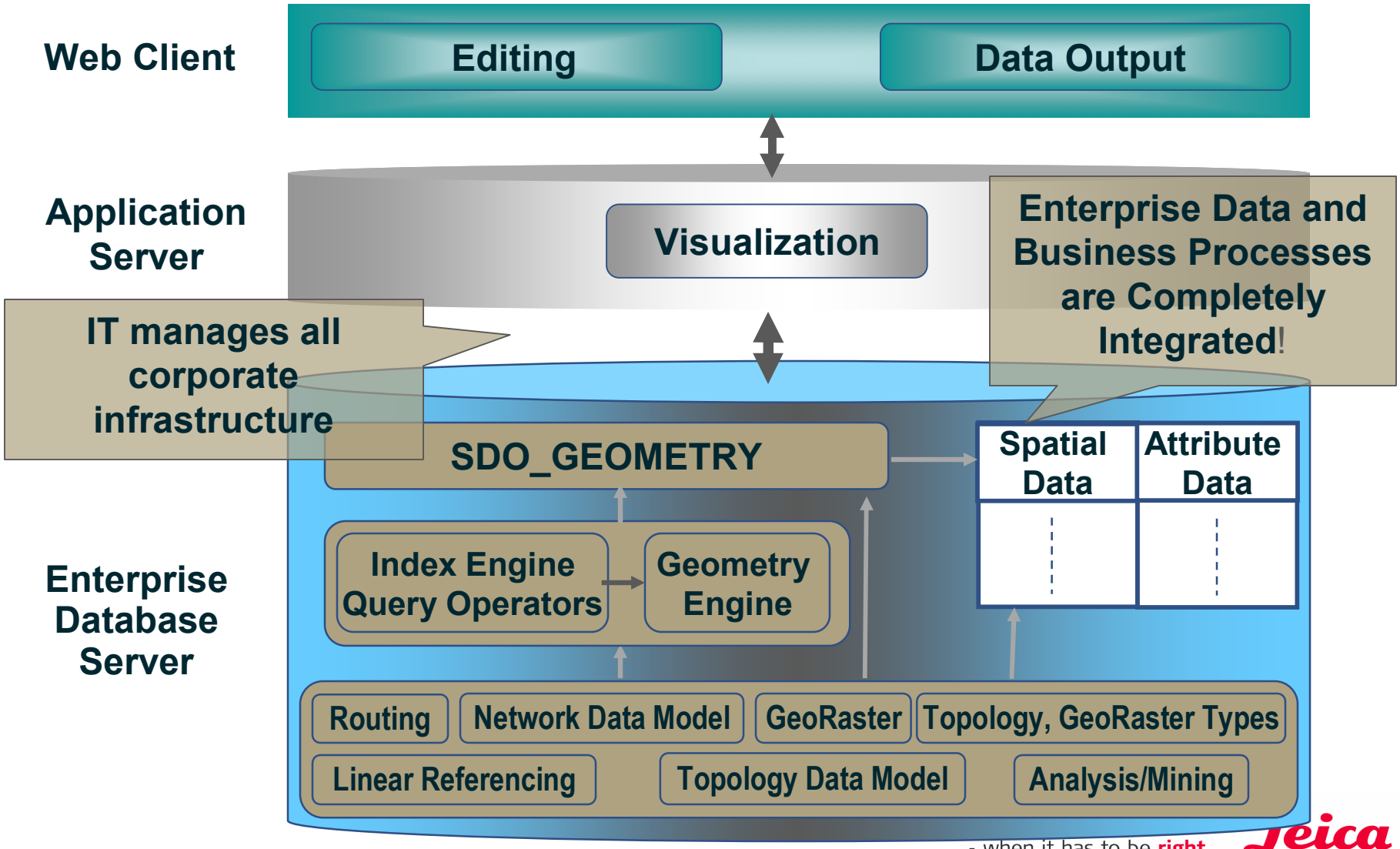
Desktop Clients

Non-Enterprise, disparate, proprietary data sources and business processes

Real, integrated enterprise applications and intelligence are almost impossible

Database Server

Leica ADE Enterprise IT Architecture

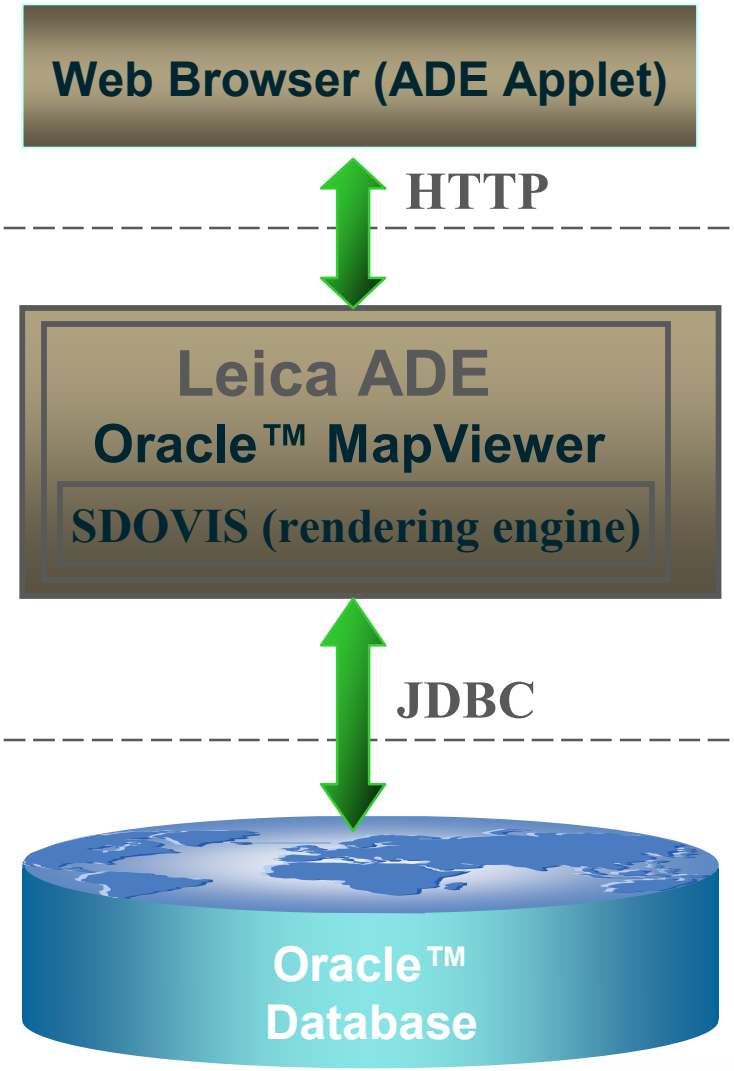


Leica ADE Architecture

Client

Mid-tier

Database



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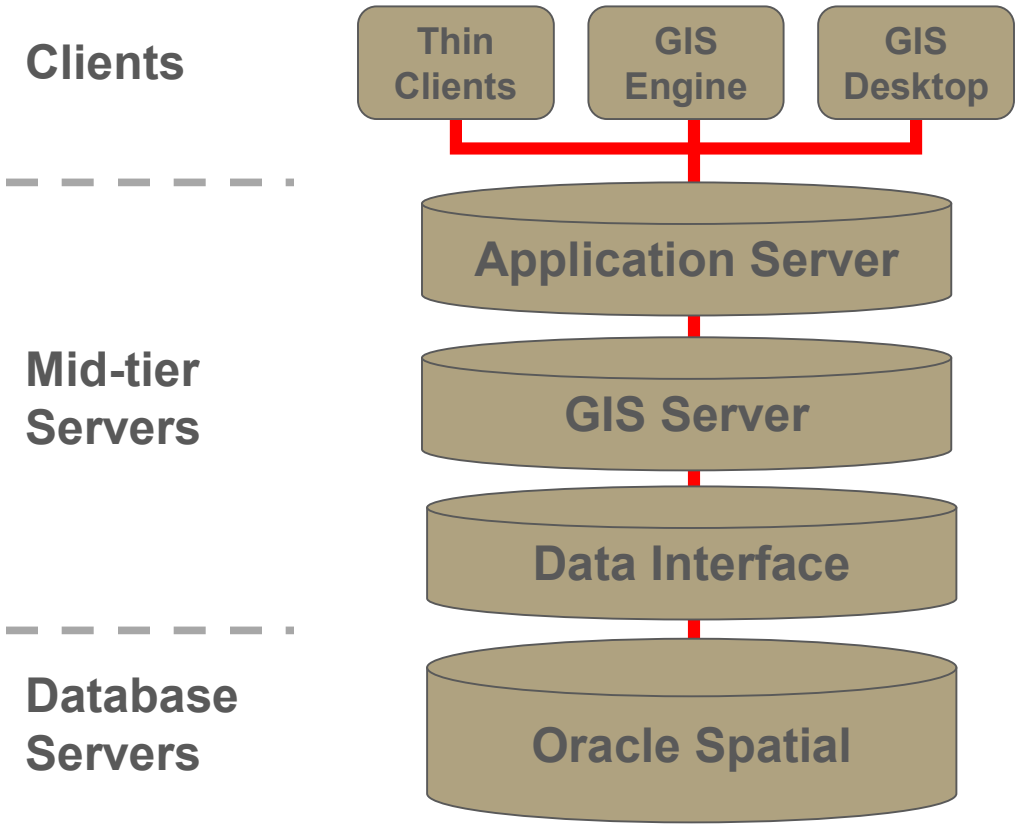
Legacy Architecture vs. Leica ADE Enterprise Architecture



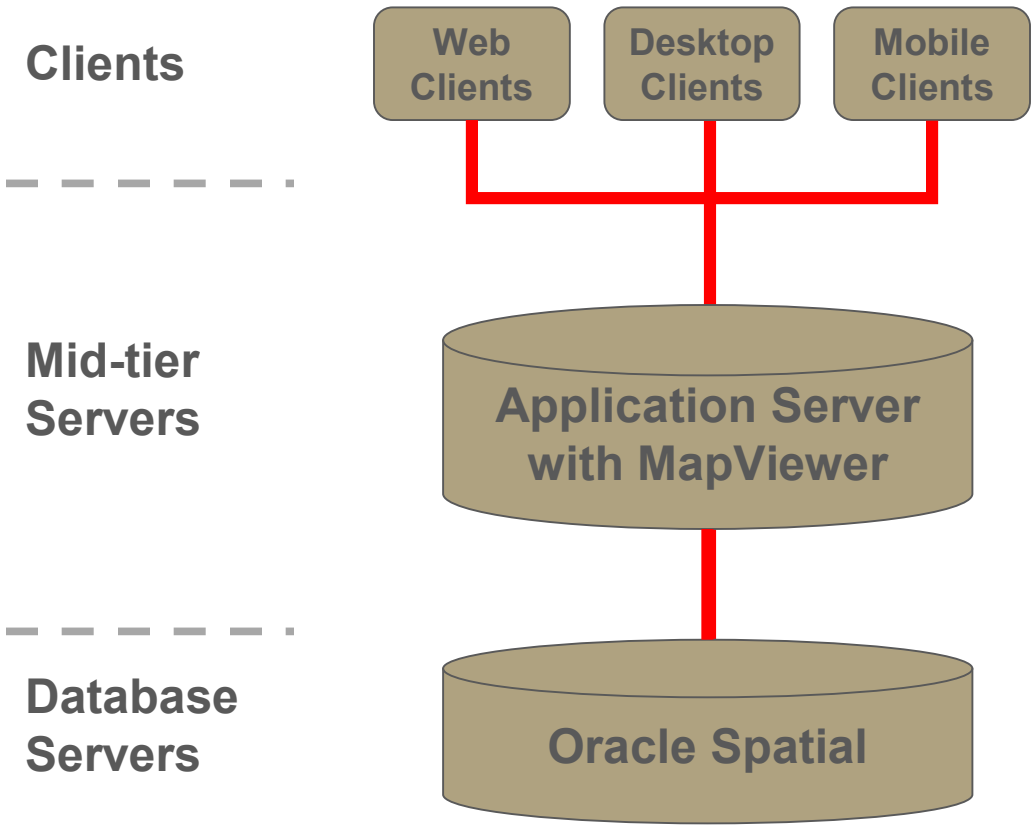
Database (including Spatial) used as a commoditized file system

Database design and data analysis beholden to GIS

No easy (or inexpensive) way to create custom applications or usage workflows

Must upkeep licenses for many servers etc.

Legacy Architecture vs. Leica ADE Enterprise Architecture



Same database, same database design, same queries

Flexible and scalable architecture

Inexpensive and easy to develop custom applications and workflows (XML, Java, JSP, WMS APIs)

Part of the IT architecture

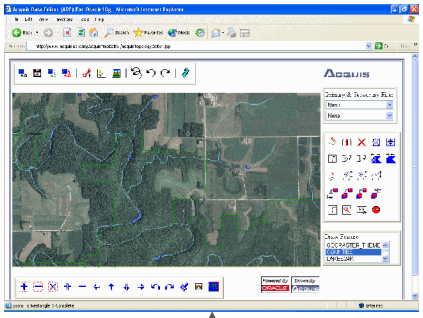
- Inherently integrated into CRM, ERP and other IT-centric solutions
- Can integrate common geospatial data types such as shape files

- when it has to be **right**

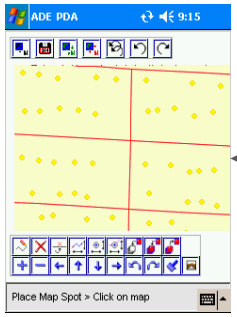
Leica Geosystems

Leica ADE Technologies

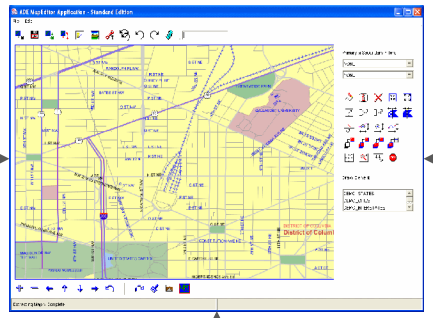
Leica ADE Enterprise



Leica ADE Mobile



Leica ADE Remote



HTTP

HTTP

HTTP

JDBC

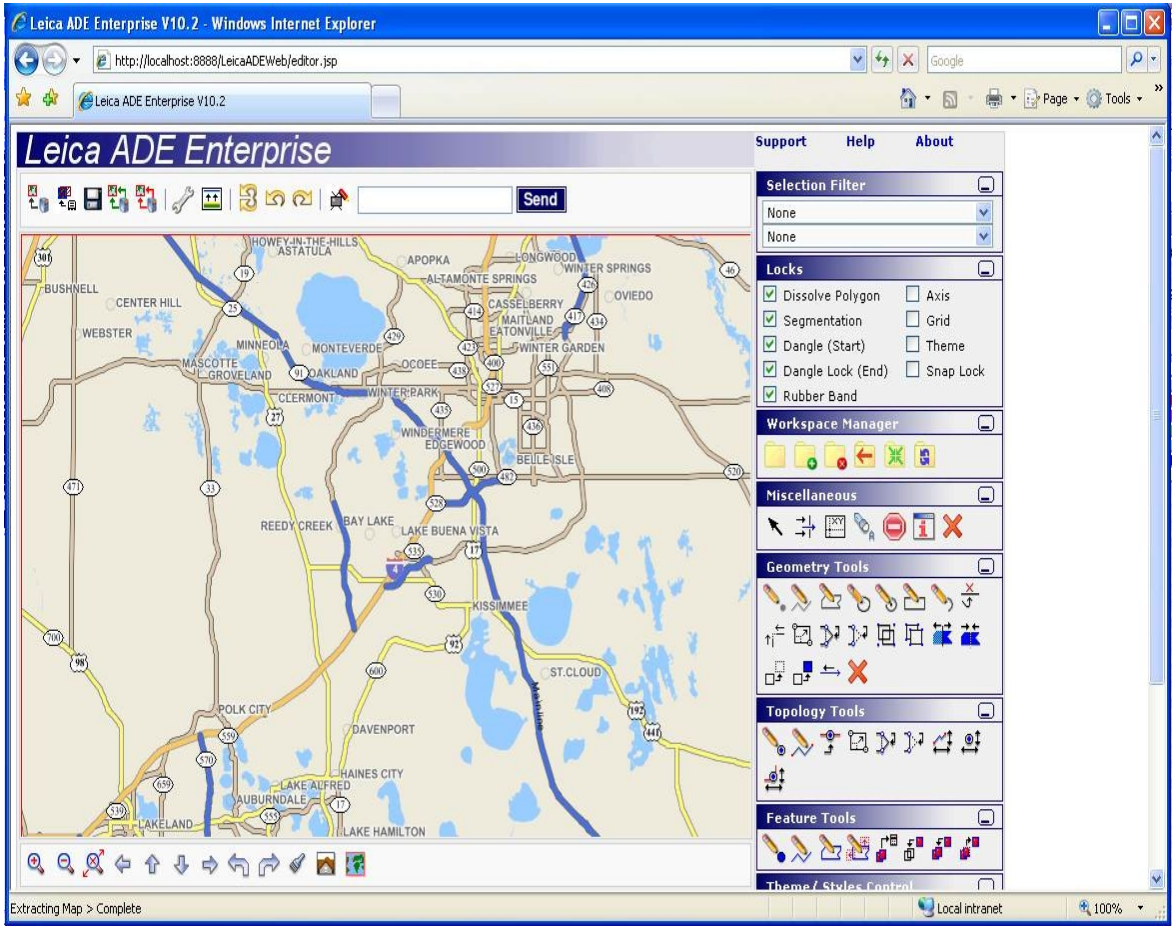
J2EE Application Server

HTTP Web Server

OC4J (Oracle Containers For Java)

JDBC

Leica ADE Enterprise



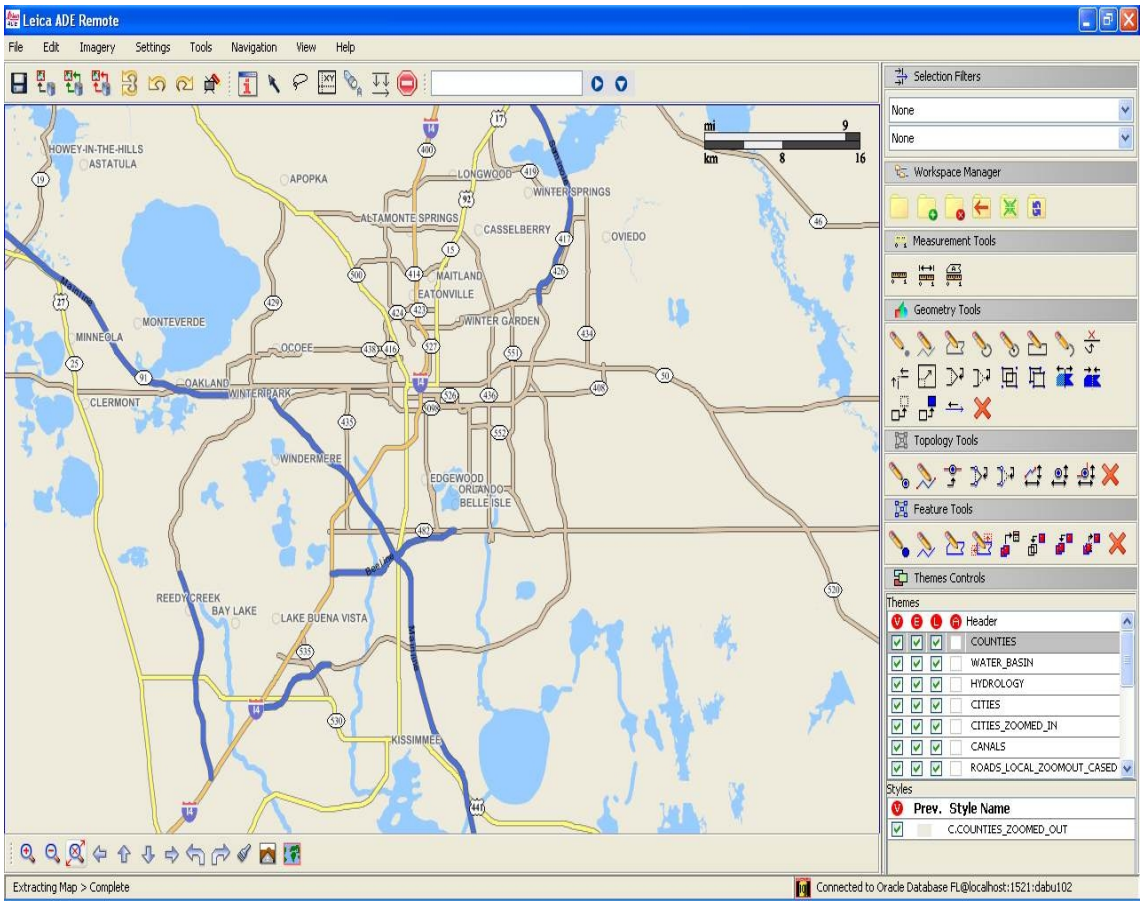
Develop Once – Deploy Everywhere

- Single code base for all platforms
- Common API
- Manages Oracle Spatial and attribute data in real time via the web
- Utilizes the entire Oracle enterprise architecture
  - Not legacy
  - Not proprietary
- Deploy to ANY J2EE application server on ANY OS platform:
  - Microsoft, Unix, Linux…

- when it has to be **right**

Leica Geosystems

Leica ADE Remote



- **Rich, secure, flexible spatial and asset management for desktops, laptops and tablet PCs**
  - ANY OS Platform!
- **Supports enterprise business rules (including topology) *in real-time and disconnected* modes**
- **Ensures clean data (no data cleansing/reconciliation processes required)**
- **Data changes made in the field are valid (no post processing of data is required)**
- **Dramatically reduces data maintenance costs – one update process, lower labor costs, lower application costs (web versus desktop)**

Leica ADE Mobile

- Real-time and disconnected access to spatial and non-spatial information via handheld, global positioning systems (GPS) and wireless devices.
- Supports enterprise business rules (including topological) in real-time and disconnected modes
- Ensures clean data (no data cleansing required)
- Data changes made in the field will be topologically valid (no post processing of data is required)
- Enables business, spatial data and mobile application to be written to an SD card – simply inserting the SD card into the device and launching the application - a user is not restricted by the limitations of the hardware device

Solution Case Studies

United States Census Bureau

Enterprise IT and Topology Management Solution

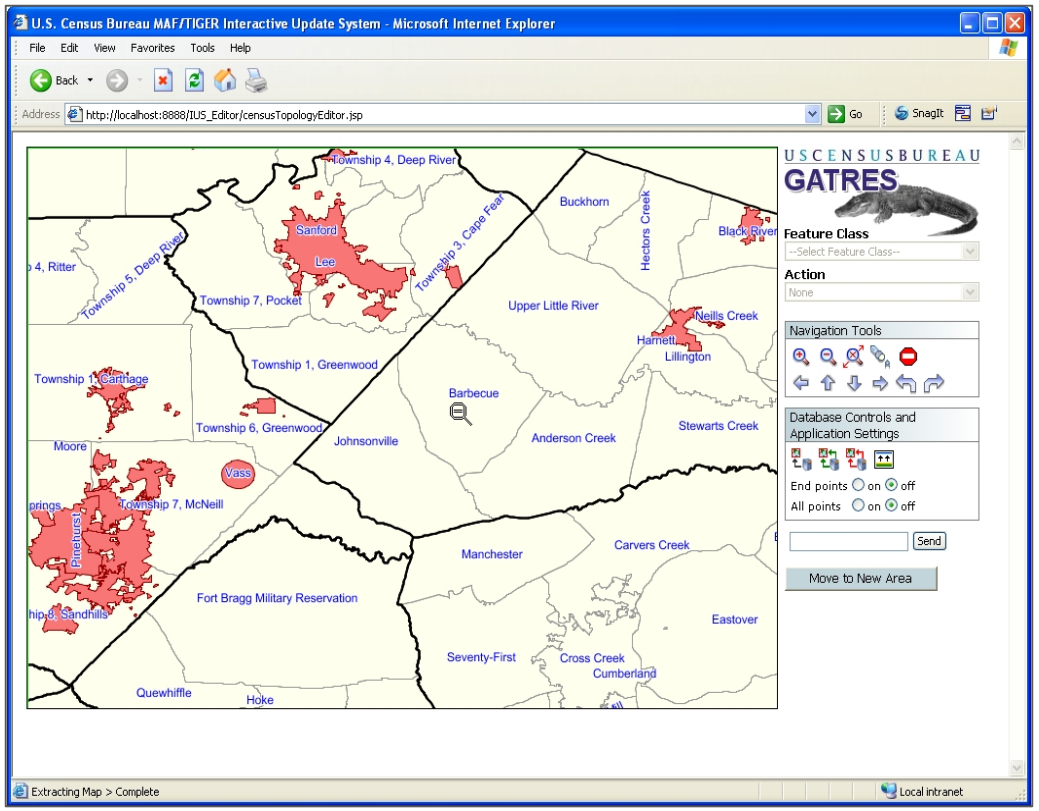
- when it has to be **right**

Leica Geosystems

Location-enabling the Enterprise with Oracle Spatial and Leica ADE Enterprise - US Census Bureau

Problem:

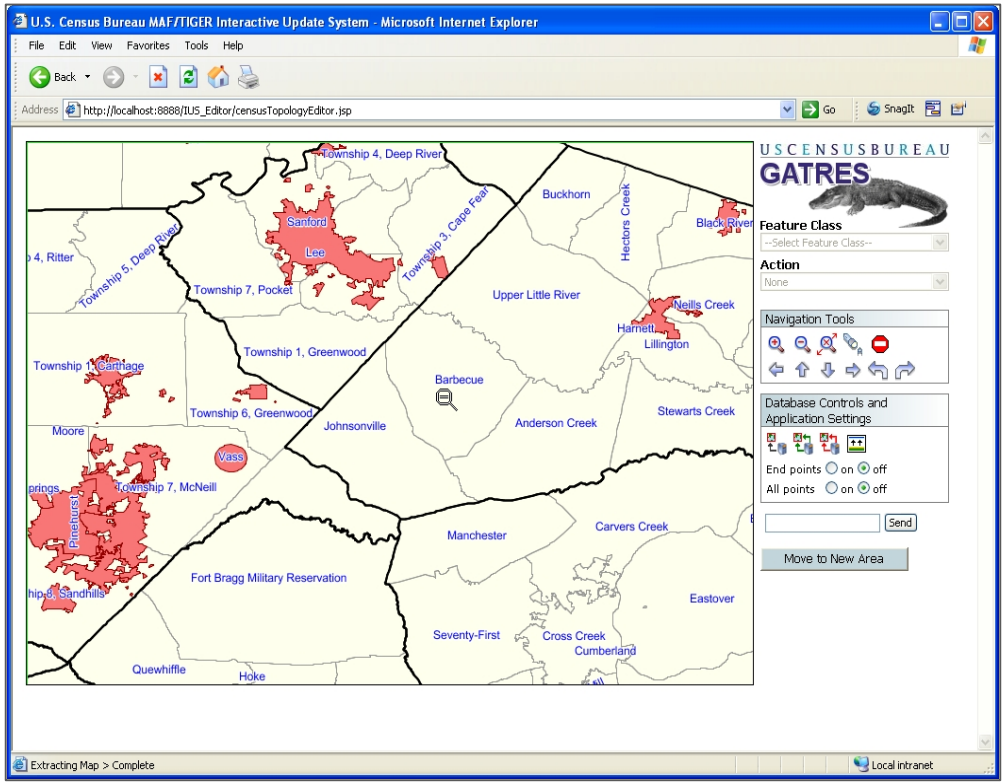
- USCB utilizing legacy architecture and solution - MAF/TIGER
- Was state-of-the art when created, but is over 20 years old
- NO web-based capability
- NOT a multi-user environment
- VERY hard to maintain and extend



Location-enabling the Enterprise with Oracle Spatial and Leica ADE Enterprise - US Census Bureau

Solution:

- Oracle Spatial and ADE Enterprise enable seamless management of data and core business rules
- Oracle Spatial topology model
- Scalable across the enterprise
- Centrally business rules and validations
- MAF and TIGER data seamlessly integrated into a National data set



An Intranet-Based Data Editor for Oracle Spatial 10g Topology, Built Around Leica ADE Technology

GATRES
U.S. Census Bureau

- when it has to be **right**

Leica Geosystems

What is GATRES?

- **GATRES – Geographic Acquis-based Topological Real-time Editing System**
- **A web-based data editor for the MAF/TIGER database (Oracle 10g and 10g Spatial Topology)**
- **Highly customized Leica ADE Enterprise**
- **Part of a heterogeneous processing environment that includes the Oracle, ESRI, other COTS software and in-house developed software**
- **Part of the MAF/TIGER Enhancements Program and MAF/TIGER Redesign project**

US Census

Requirement : Census is incorporated into the Constitution of the United States*

Used for:

- Congressional apportionment
- Electoral college voting
- Government program funding

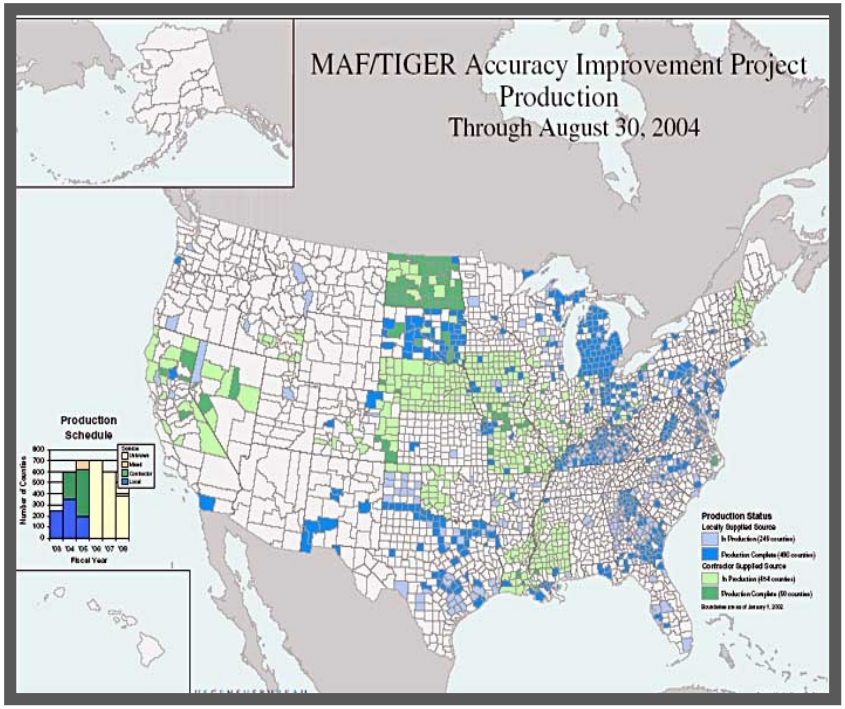
*Article 1, Section 2: "The actual Enumeration shall be made within three Years after the first Meeting of the Congress of the United States, and within every subsequent Term of ten Years, in such manner as they shall by law direct."

MAF/TIGER

US Census

To help with its constitutionally mandated role, Census developed the MAF/TIGER system

- Master Address File (MAF)
- Topologically Integrated Geographic Encoding and Referencing (TIGER)



US Census

Master Address File (MAF)

- **List of all known living quarters in the US, Puerto Rico, and associated islands**
  - Address
  - If no address, maintains description of location
- **Census Geographic Location**
- **Source and history information**
- **Currently has no geospatial component**

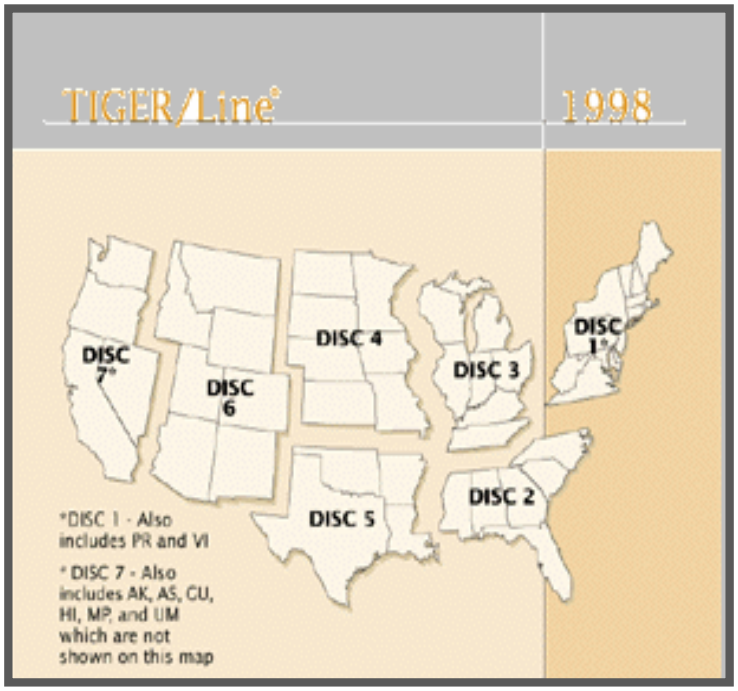
US Census

Topologically Integrated Geographic Encoding and Referencing (TIGER)

- **Street center-line geographic database system of the entire US, Puerto Rico, and associated island areas**
- **Based on street features and names**

TIGER system also includes many other feature classes with attribute information stored in a topologically consistent format

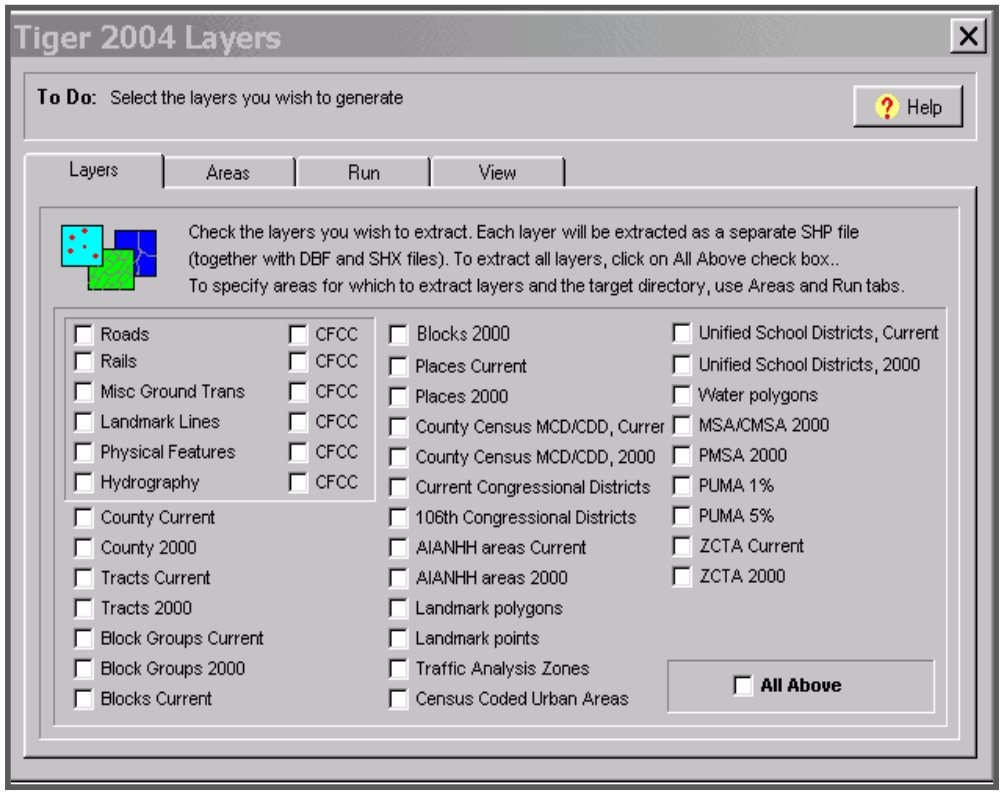
- **Hydrographic information (lakes and streams)**



US Census: Other TIGER features

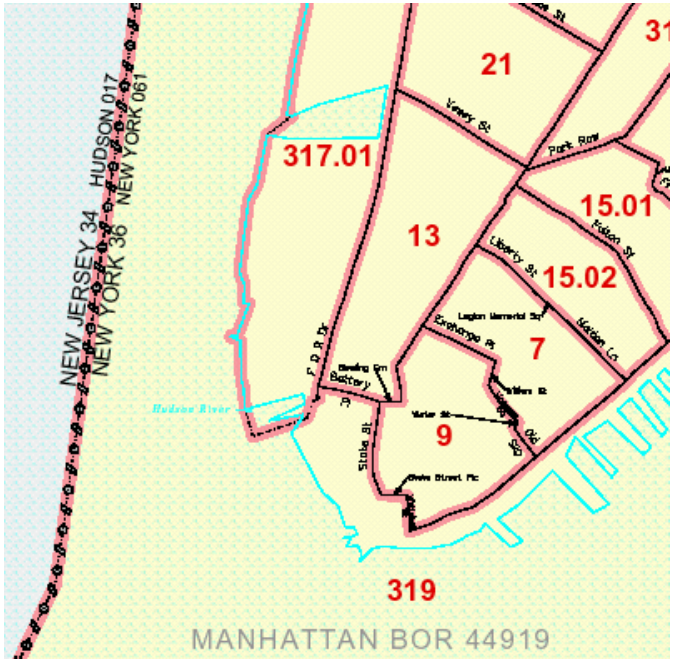
- Geopolitical boundaries, names, and codes (states, counties, census tracts, census blocks, etc)
- Housing unit locations (for certain areas)
- Key geographic locations (airports, schools, etc.)
- ZIP Codes and address ranges (for streets with city-style addresses)

Over forty different feature classes



MAF/TIGER – Mission Critical

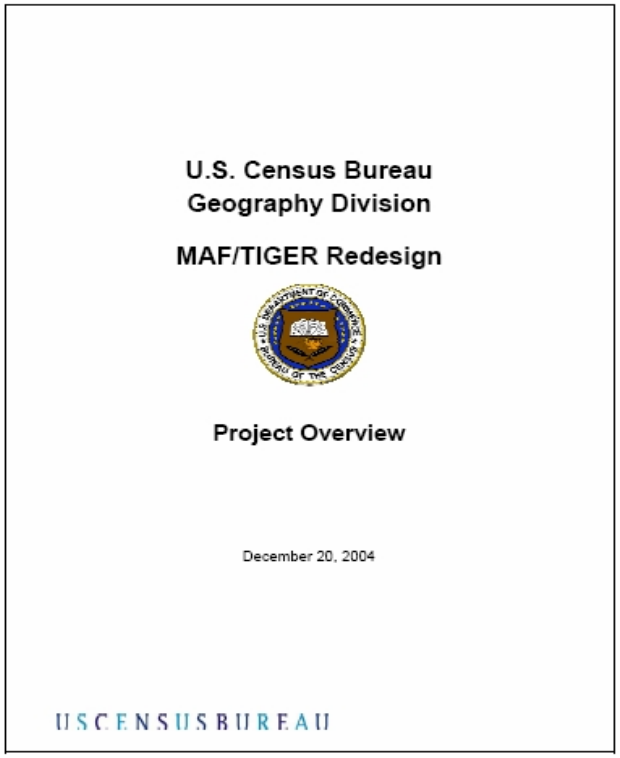
- **MAF/TIGER provides storage, processing, products and services that support agency's statistical programs**
  - Geocoding
  - Maps
  - Residential Address Lists
- **Continually updated with new address and geographic information**
- **Wide public use of geographic information**



MAF/TIGER Redesign

MAF/TIGER was an innovative state-of-the-art system when developed

- **Utilized persistent topology**
- **Automated production of digital mapping products**
- **Allowed batch processing for automated updates**
- **Provided for efficient retrieval**
  - Included spatial indexing


U.S. Census Bureau
Geography Division

MAF/TIGER Redesign

Project Overview

December 20, 2004

USCENSUSBUREAU

MAF/TIGER Redesign

MAF/TIGER is now over 20 years old…

- Does not integrate well with current commercial off-the-shelf (COTS) tools
- Pre-existed Web technology
- Cumbersome to change
- Difficult to learn for new developers
- Not integrated into a single national data set
- No multi-user access (one person per county)
- Not accessible via a standard query language
- MAF and TIGER completely separate

Foundations of GATRES: Oracle Spatial and Leica ADE

MAF/TIGER Redesign

In June 2000 US Census decided it was time to make a fundamental change in the way they manage their business...

Made the following decisions:

- **New system had to be based on a highly functional commercial DBMS**
  - Security, scalability, performance, replication, administration, etc.
- **MAF and TIGER data had to be integrated**
- **Can recruit developers with appropriate skill set**
- **Create and use a seamless national data set**
- **Improved concurrency (read and write)**
- **Open, interoperable environment**
- **Web-based tools, editing, and dissemination**

First Decision: Use Oracle Spatial as the Foundation

The Oracle Spatial Topology Data Model met the US Census requirements:

- Oracle's model stores the nodes, edges, and faces that features are composed of (persistent topology)
- Oracle's model includes vertical topology, so multiple feature layers can share the same primitives
- Oracle's model includes topology hierarchies
- Oracle's database infrastructure enables merging of the MAF and TIGER data sets into a single enterprise model
- Oracle provides scalability and performance features such as partitioning and the Application Server

Next Decision: Use Leica ADE for Interactive Updates

- **The only web-based product to natively update data in the Oracle Spatial Topology Data Model**
- **Leica ADE Enterprise supports concurrent editing of the same feature**
  - Special capabilities when adding/deleting primitives
- **Easily Customizable**
  - Geography Developers use standard code to support the specific requirements of the Census Bureau Users
- **Highly scaleable platform**
  - Maximizes Oracle's proven data management capabilities both at database and application server
- **Ease of Deployment**
  - No software required other than a web browser

Interactive Updates at US Census

An integral part of the requirements at US Census is the Interactive Update Application

After an evaluation of available products the US Census selected Leica ADE Enterprise as the topology editing tool in the MAF/TIGER Redesign

- Leica ADE Enterprise is the only product designed from the ground up for viewing and editing data in Oracle's Topology Data Model

MAF/TIGER INTERACTIVE UPDATE SOFTWARE

U.S. Census Bureau

"…the government knows of only one product:

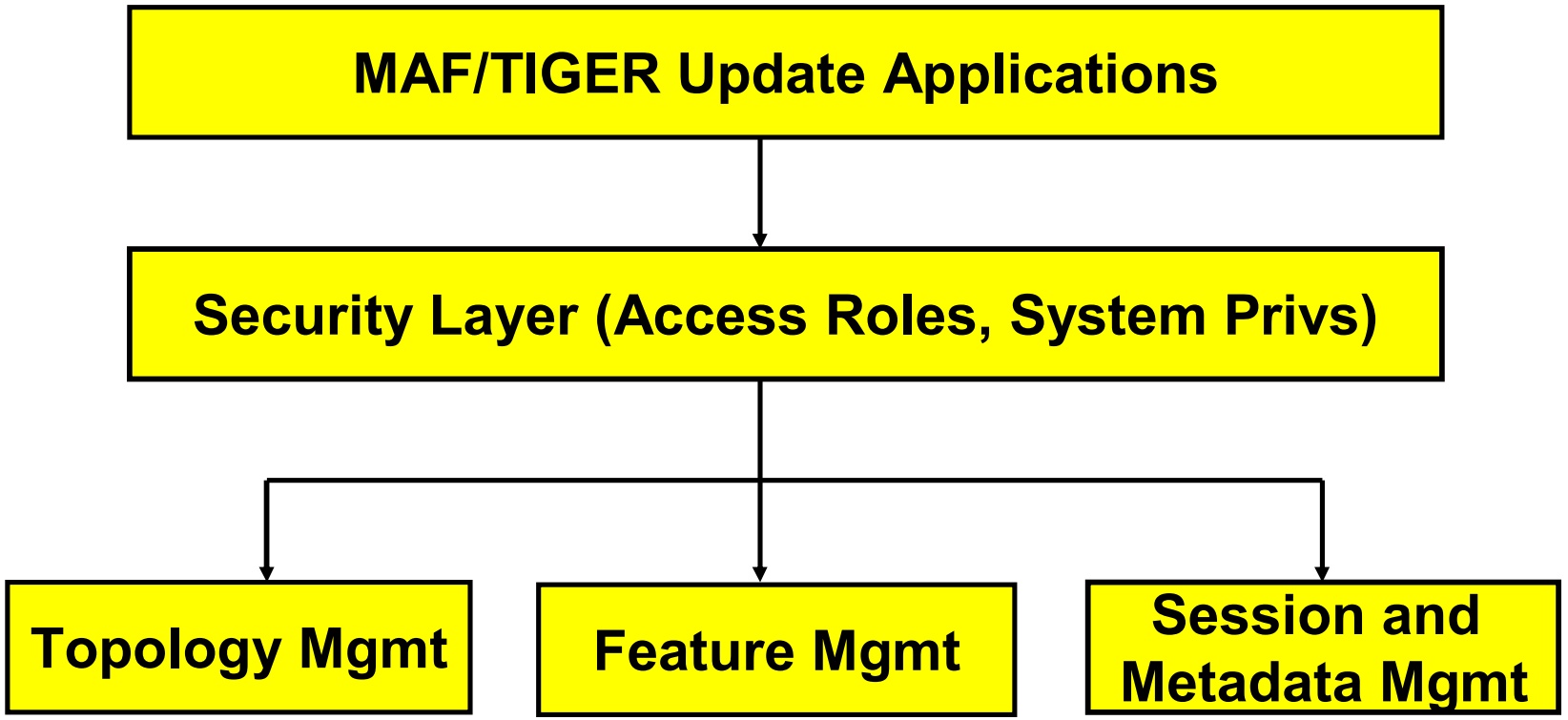
***ADE R2* that meets the Government's functional requirements offered by the following source:**

***LEICA INCORPORATED, SILICON VALLEY* …"**

Additional Benefits of Leica ADE

- **Automated topology loading**
  - Directly import shape files into topology model processing, all topology rules followed
- **Full disconnected topology editing capability**
  - All topology capabilities are available in Leica ADE Enterprise, Leica ADE Desktop, and Leica ADE Mobile
- **Highly customizable with open APIs**
  - All Acquis functionality is highly customizable with open, published APIs
- **Develop Once - Deploy Anywhere**
  - Identical code base for ADE Enterprise, ADE Desktop and ADE Mobile means that functionality customized for any application can run in all

Update System Design (simplified)



Topology Management (simplified)

Topology Management
(Manages primitive attributes and tracking)

- **Gets update permission**
- **Checks to ensure update allowed in the context of all census topology business rules**
  - Legal values
  - Rules repository
- **Checks how change effects features**
- **Understand relationships to other primitives**
- **Assigns ID**
- **Use Oracle's topology update routines**

Feature Management (simplified)

Feature Management
Spatial and non-spatial features

- **Feature standardization**
  - Addresses
  - Feature names
- **Geocoding/address matching**
- **Census business rules ensure feature update valid**
  - Legal values
  - Business Rules repository
- **Update metadata**
- **Understand/manage relationships to primitives**

Session and Metadata Management

Session and Metadata Management

- **Manages operational history**
  - Adds
  - Deletes
  - Updates
- **Manages Global Metadata**
  - Data: How collected, when was updated, by whom
- **Provides session metadata**
  - Business rules for update
    - Don’t override GPS collected data with hand digitized data

Database Design

Other interesting facets of the database design:

Includes feature to master address file (MAF) relationship table

- Gives a spatial component to the MAF data

There are over 40 tables related to the different geographic entities

- One of the reasons vertical topology is so important

Each feature appears 5x to keep some historical information on-line and available

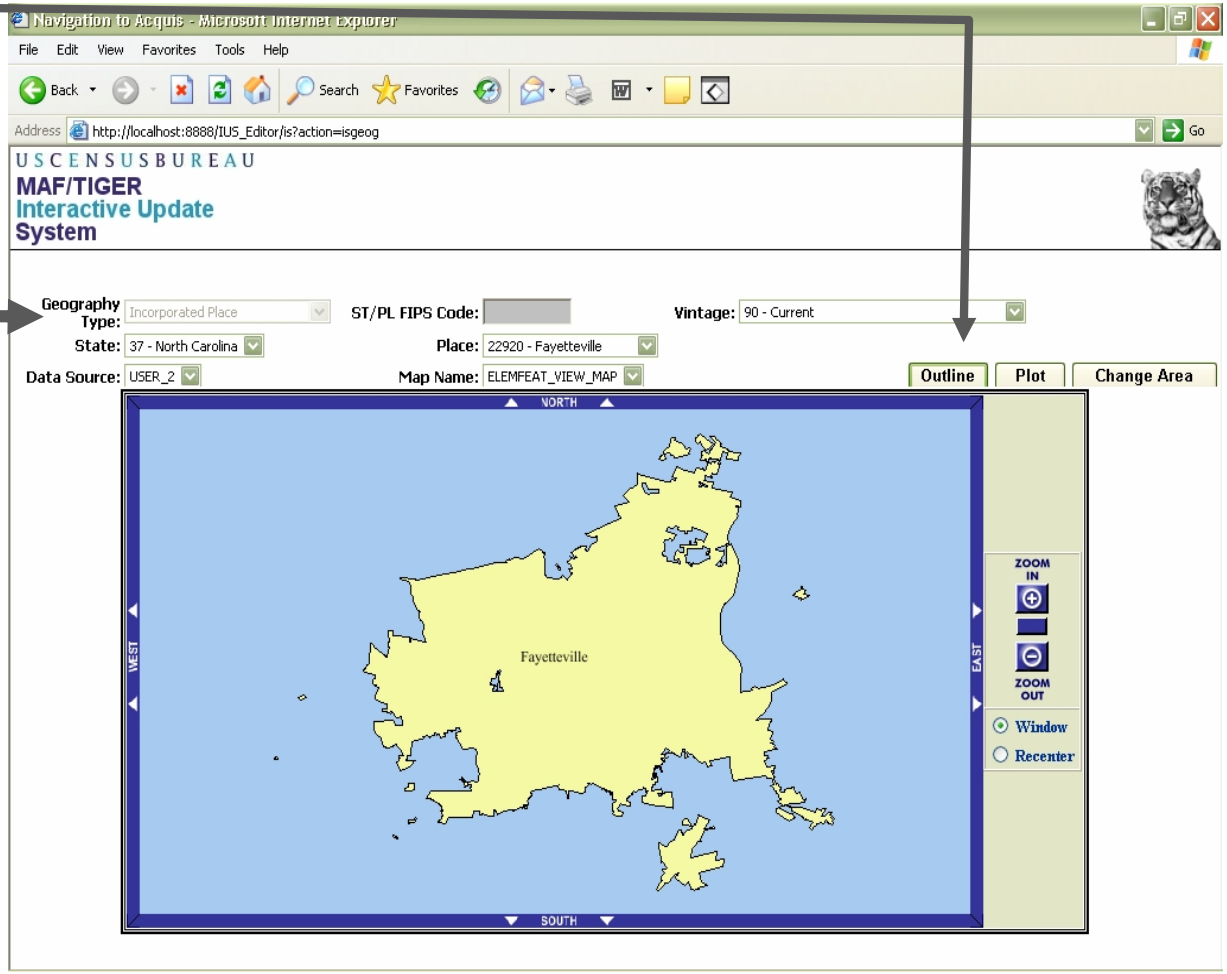
- 2000 census
- 2000 census corrected
- etc.

User Interface and Business Rules

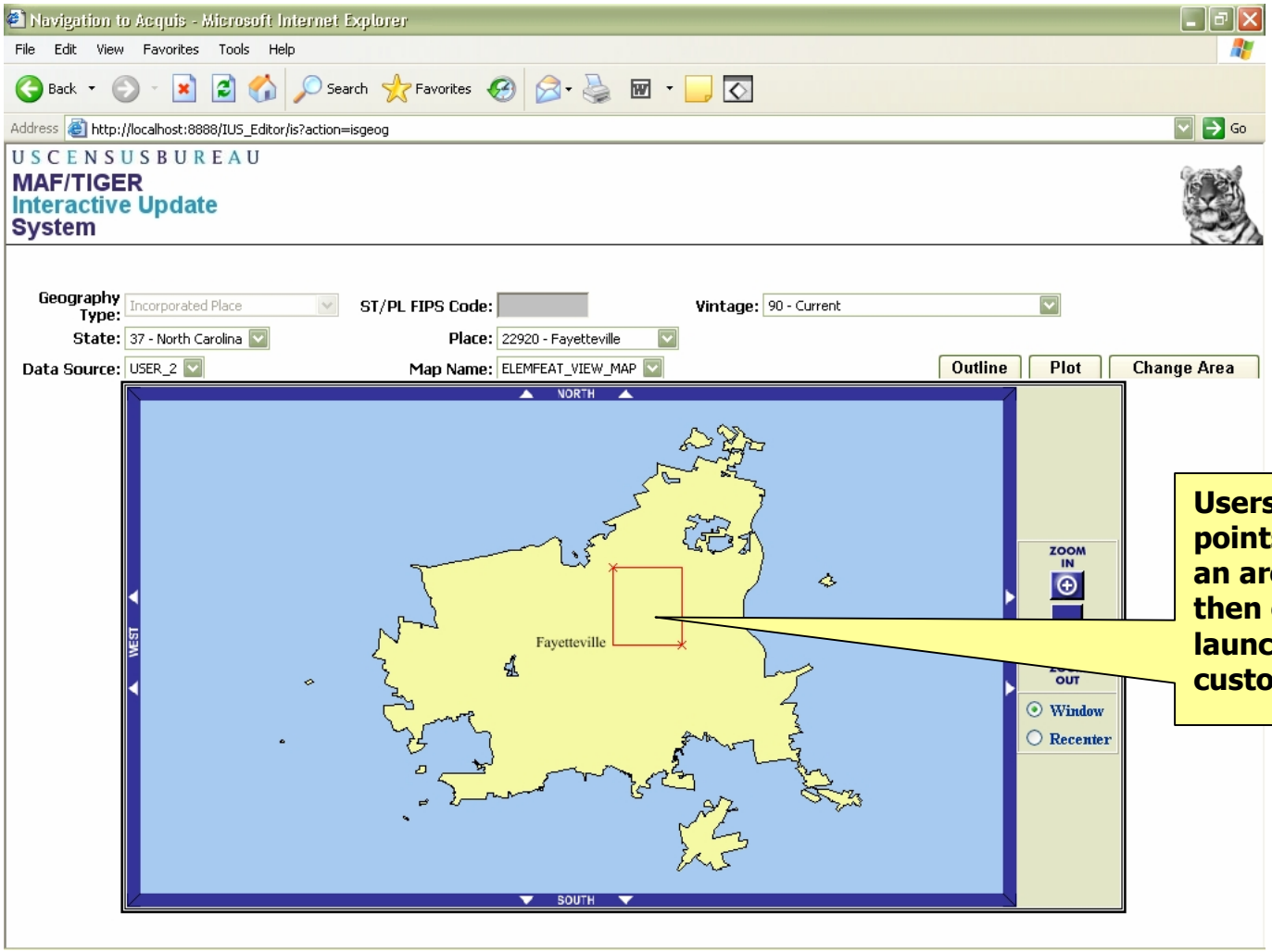
Navigation Module

- Clicking “Outline” retrieves a map of the geographic area

Users select a geography type and location using form controls on the navigation screen.

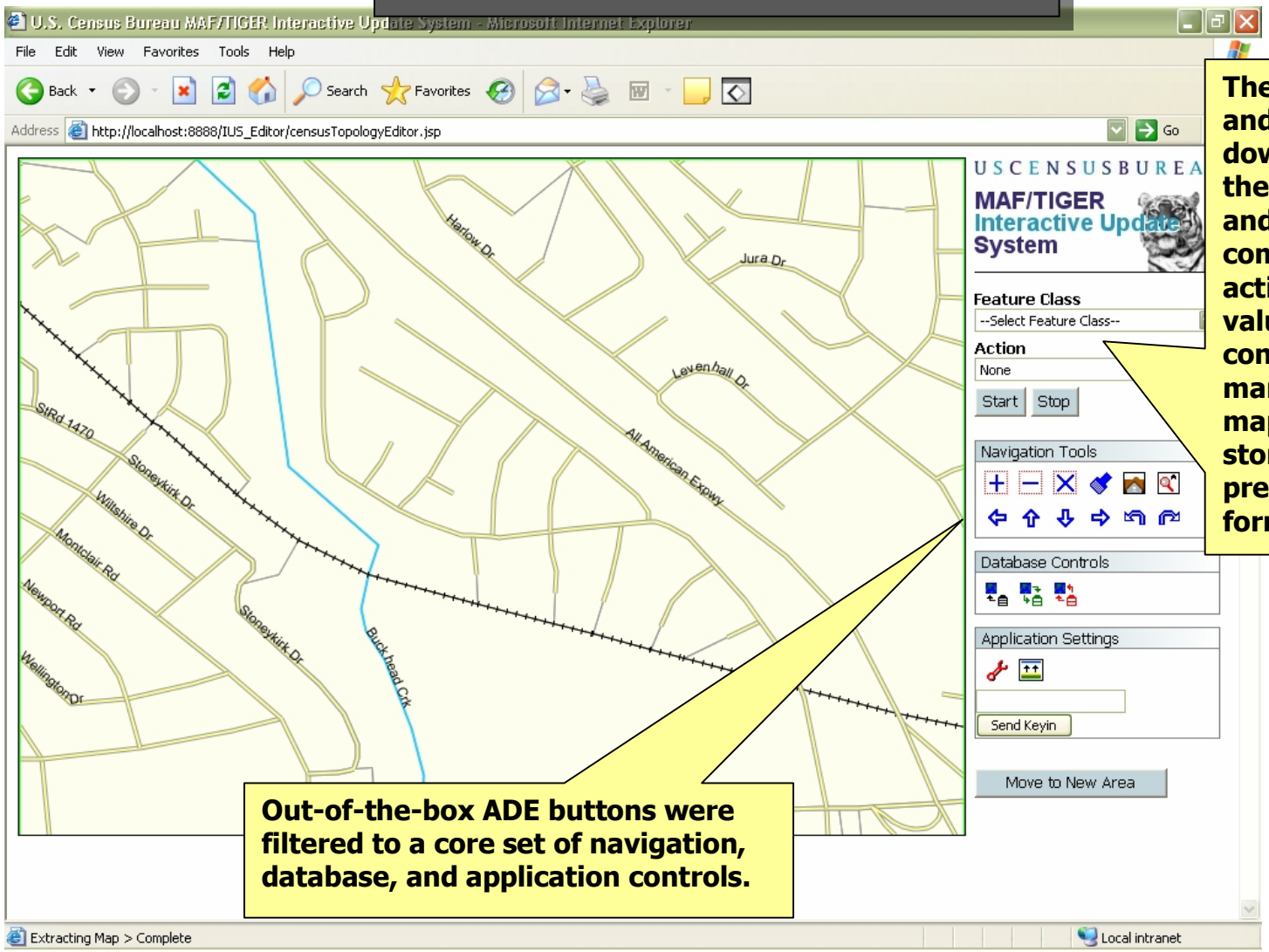


Navigation Module



Users click two points to delineate an area of interest, then click "Plot" to launch the customized ADE.

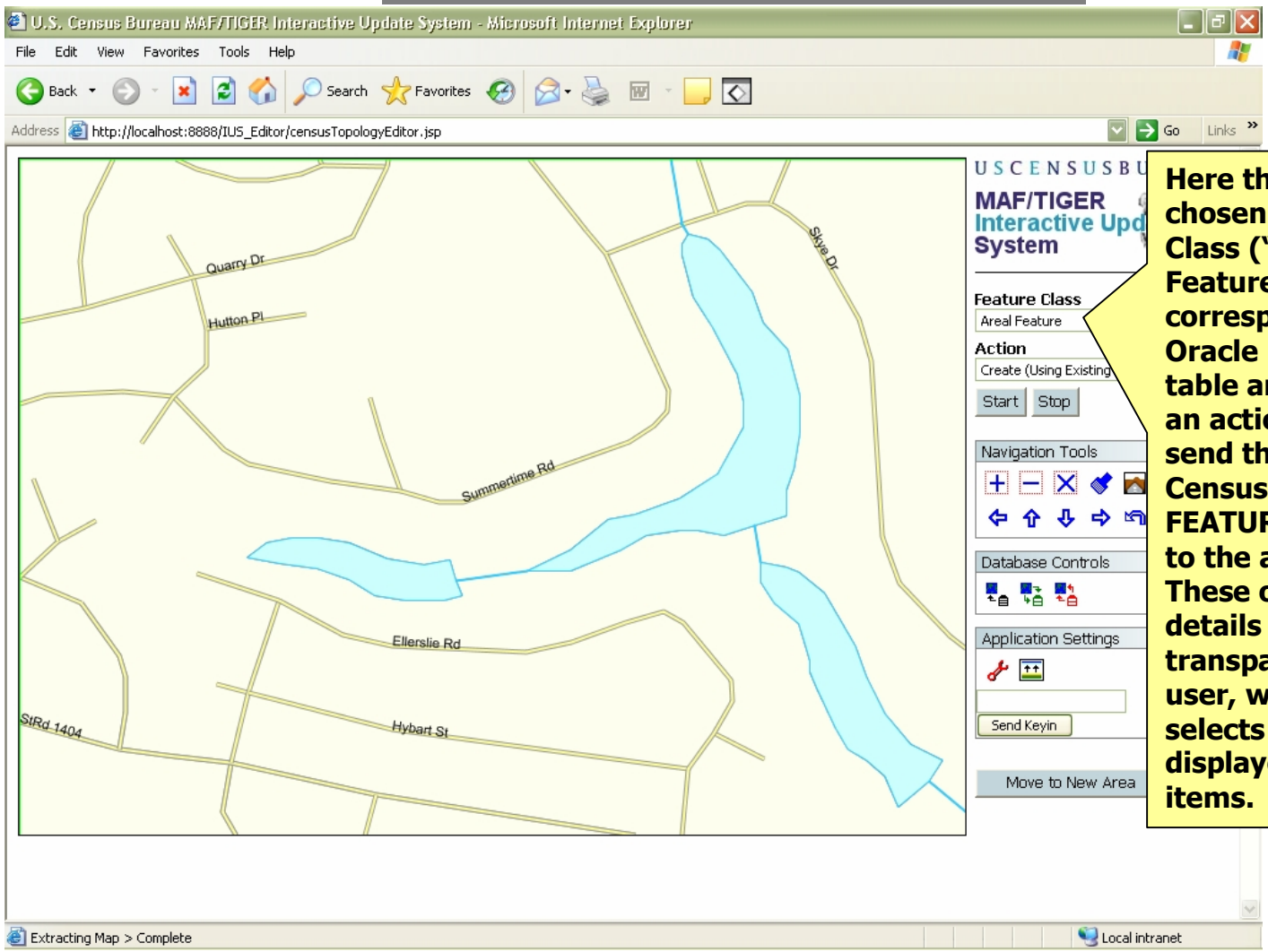
Main User Interface



The Feature Class and Action drop-down menus set the active theme and apply the command for each action. Labels and values for these controls are managed through map metadata stored in Oracle's predefined format.

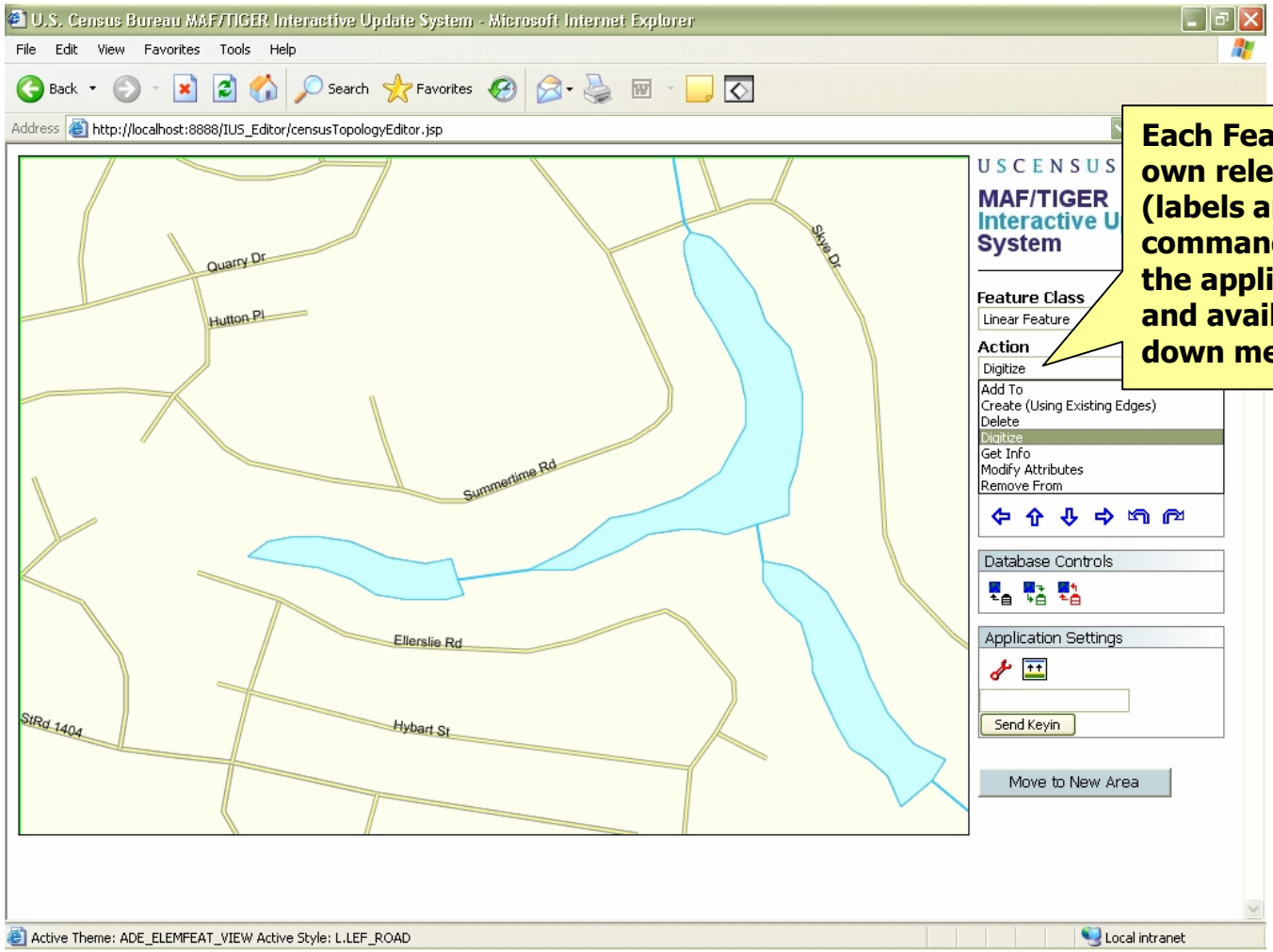
Out-of-the-box ADE buttons were filtered to a core set of navigation, database, and application controls.

Main User Interface



Here the user has chosen a Feature Class ("Areal Feature") corresponding to the Oracle ELEMFEAT table and selected an action that will send the custom Census MT ADD FEATURE command to the application. These operational details are transparent to the user, who simply selects from the displayed menu items.

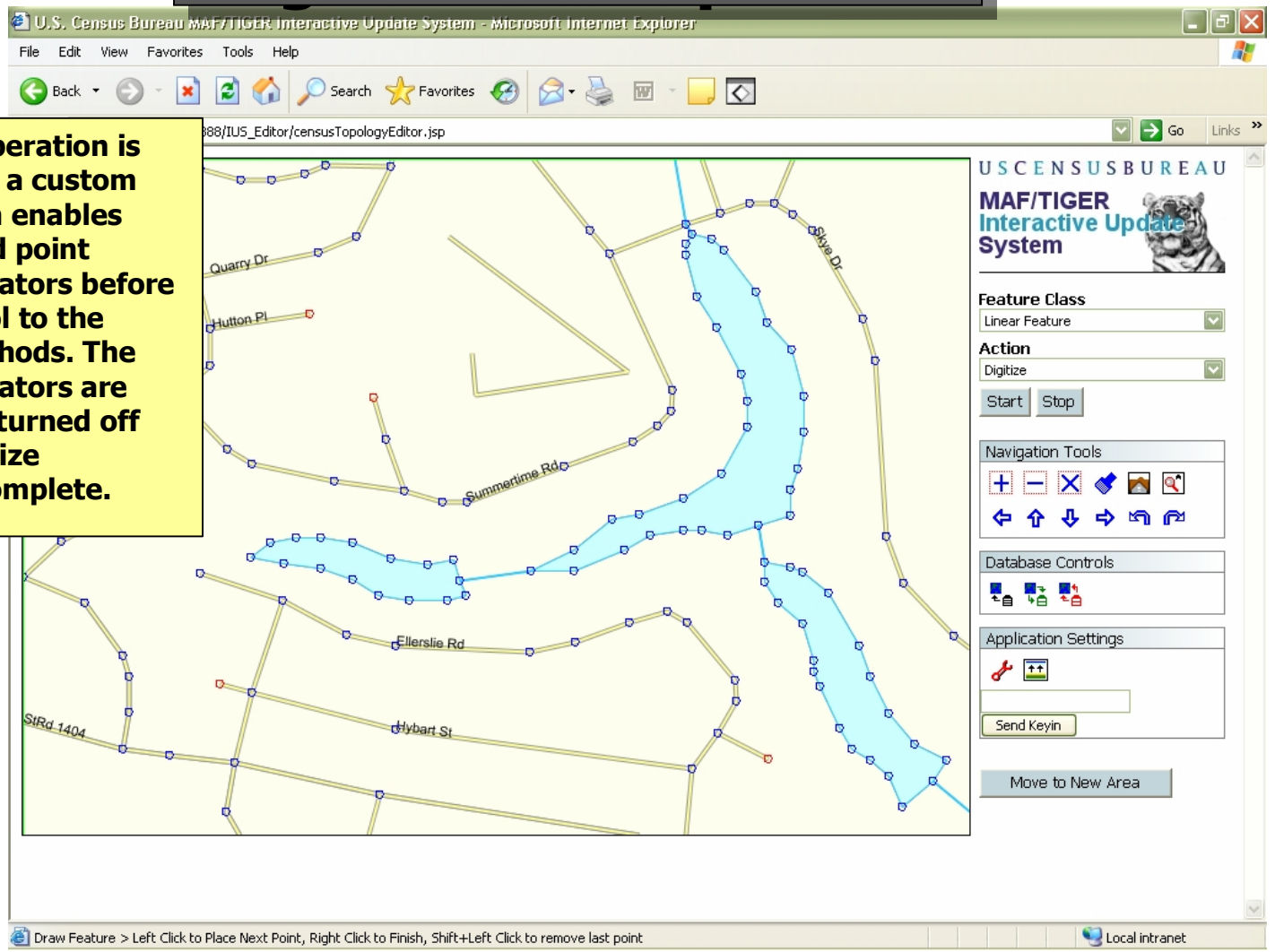
Main User Interface



Each Feature Class has its own relevant set of Actions (labels and keyin commands) supplied by the application database and available in the drop-down menu.

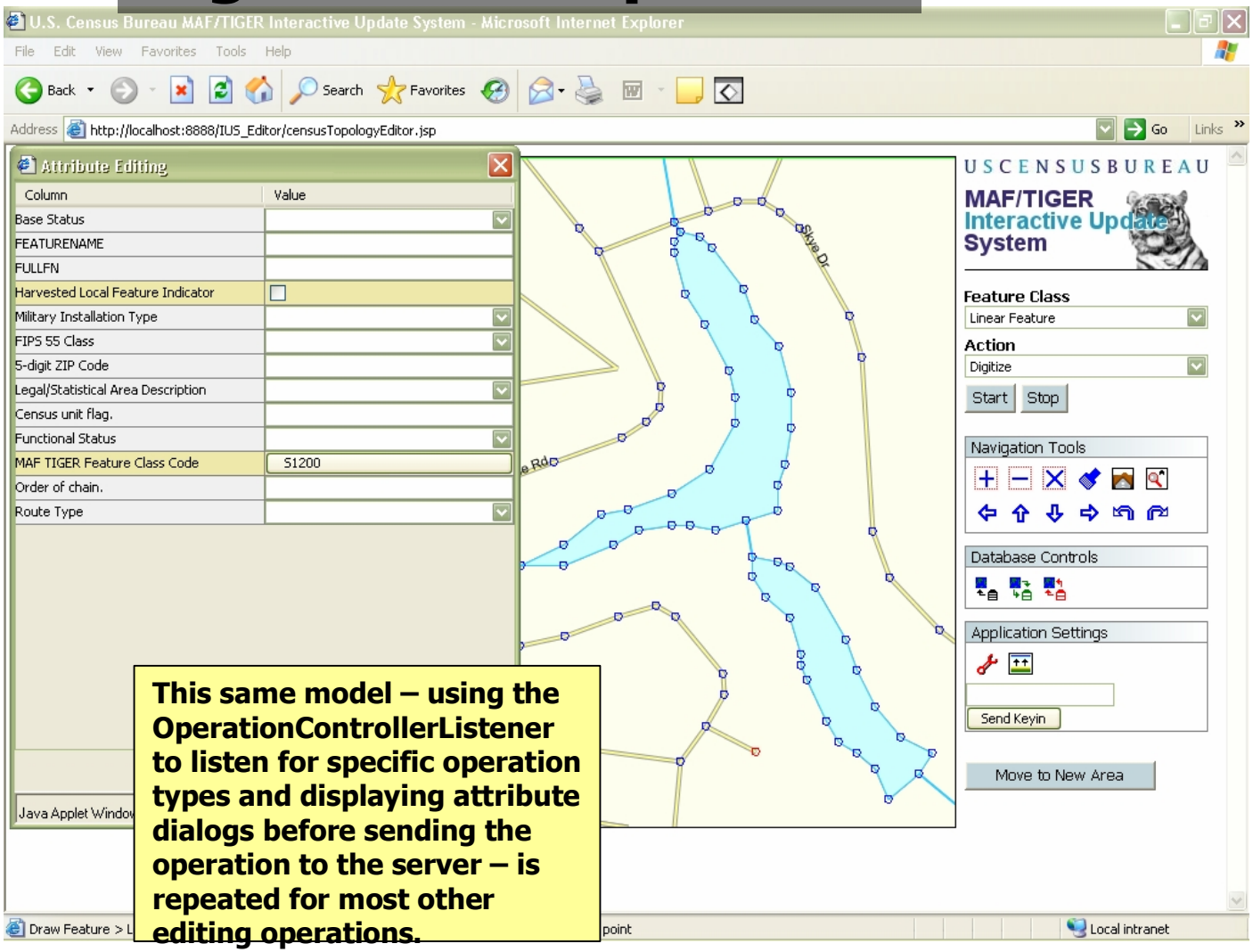
Digitize Line Operation

The Digitize operation is listened for by a custom listener, which enables vertex and end point snapping indicators before passing control to the command methods. The snapping indicators are automatically turned off when the digitize operation is complete.



Digitize Line Operation

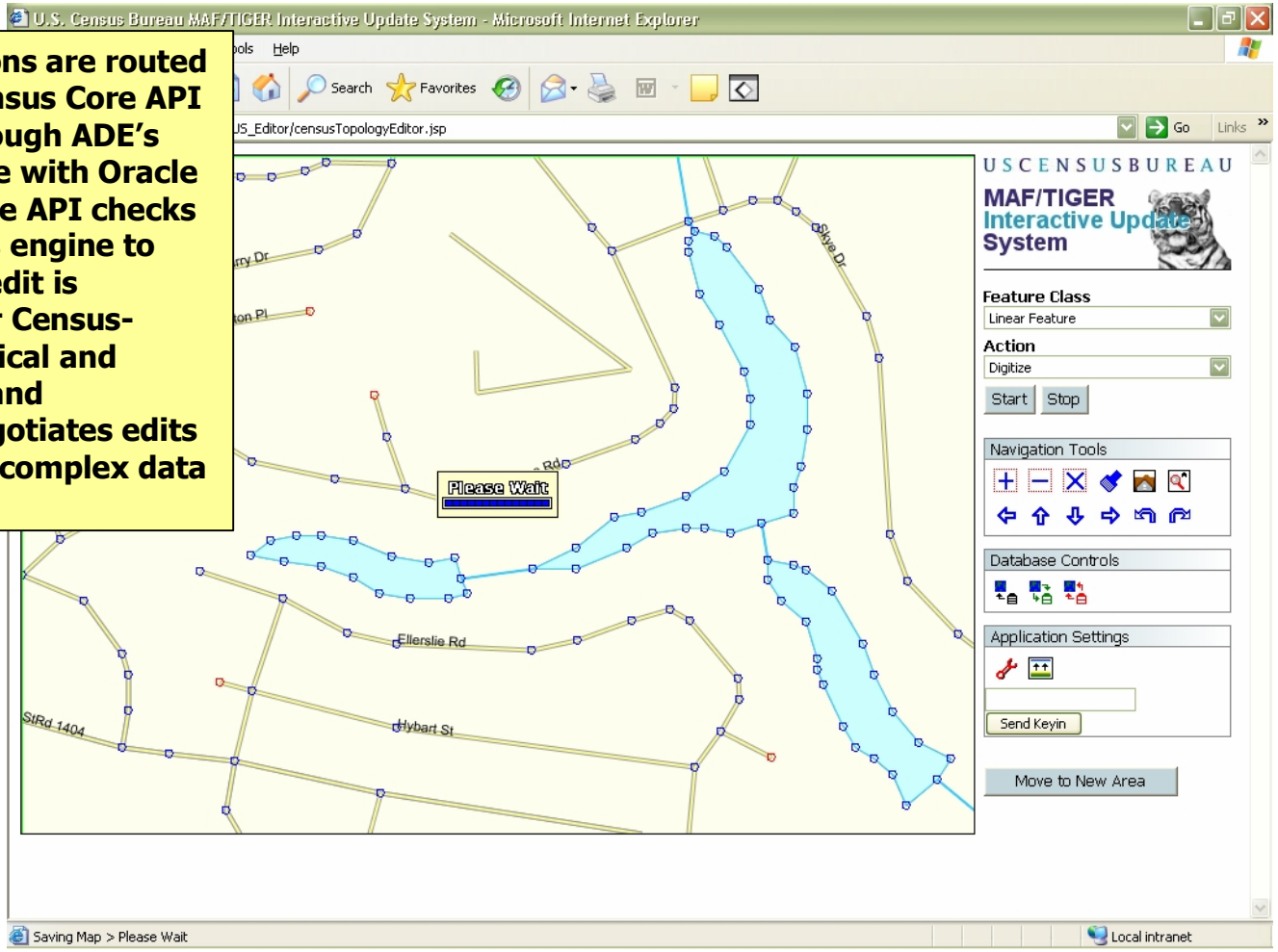
A Census OperationControllerListener listens for digitize operations and opens two custom Swing JDialog windows before such operations are applied on the application server. These dialogs ask the user to supply a classification code for the new feature and appropriate attribute values. Various attribute fields are constrained by database-supplied legal values, which are presented in the form of drop-down menus. Required values are highlighted for the user.



This same model – using the OperationControllerListener to listen for specific operation types and displaying attribute dialogs before sending the operation to the server – is repeated for most other editing operations.

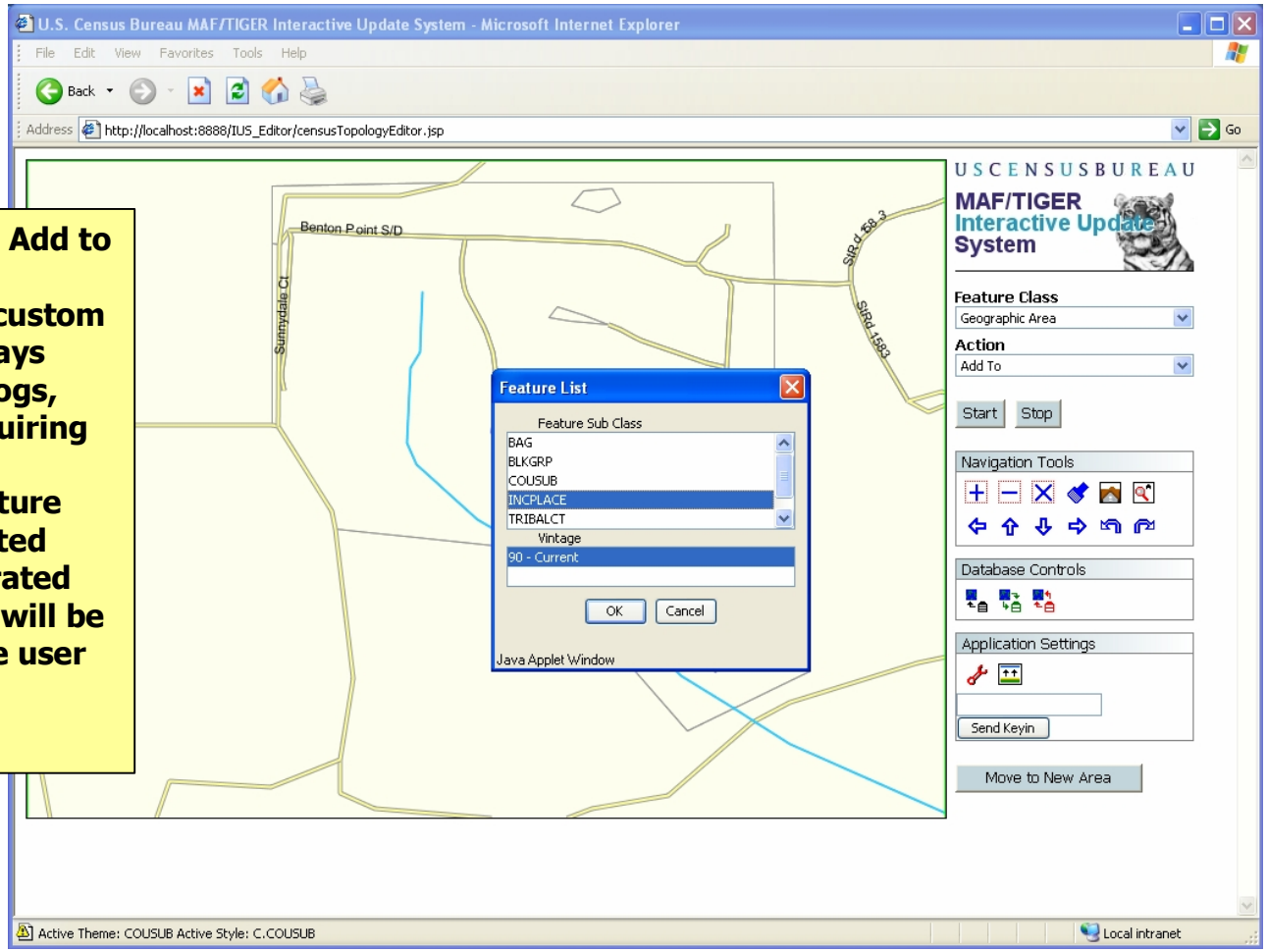
Editing and Core API

Editing operations are routed through the Census Core API rather than through ADE's default interface with Oracle Spatial. The Core API checks a business rules engine to make sure the edit is allowable under Census-specific topological and attribute rules and successfully negotiates edits to the Bureau's complex data model.



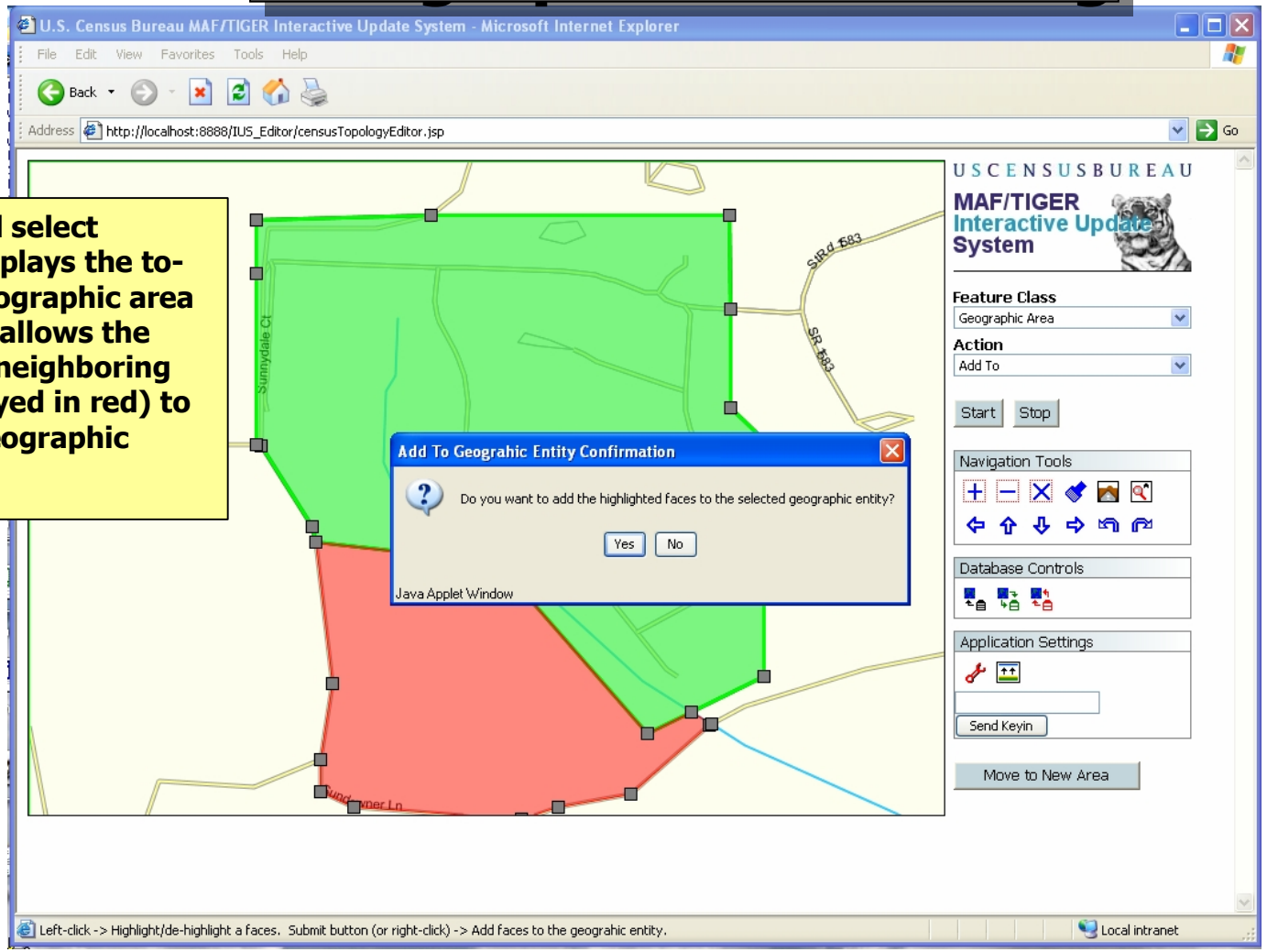
Editing and Core API

This slide shows the Add to Geographic Area operation. This is a custom operation that displays Census-specific dialogs, such as this one requiring the user to specify a geographic area feature sub-class. The selected sub-class, "Incorporated Place (INCPLACE)," will be highlighted after the user clicks "OK."

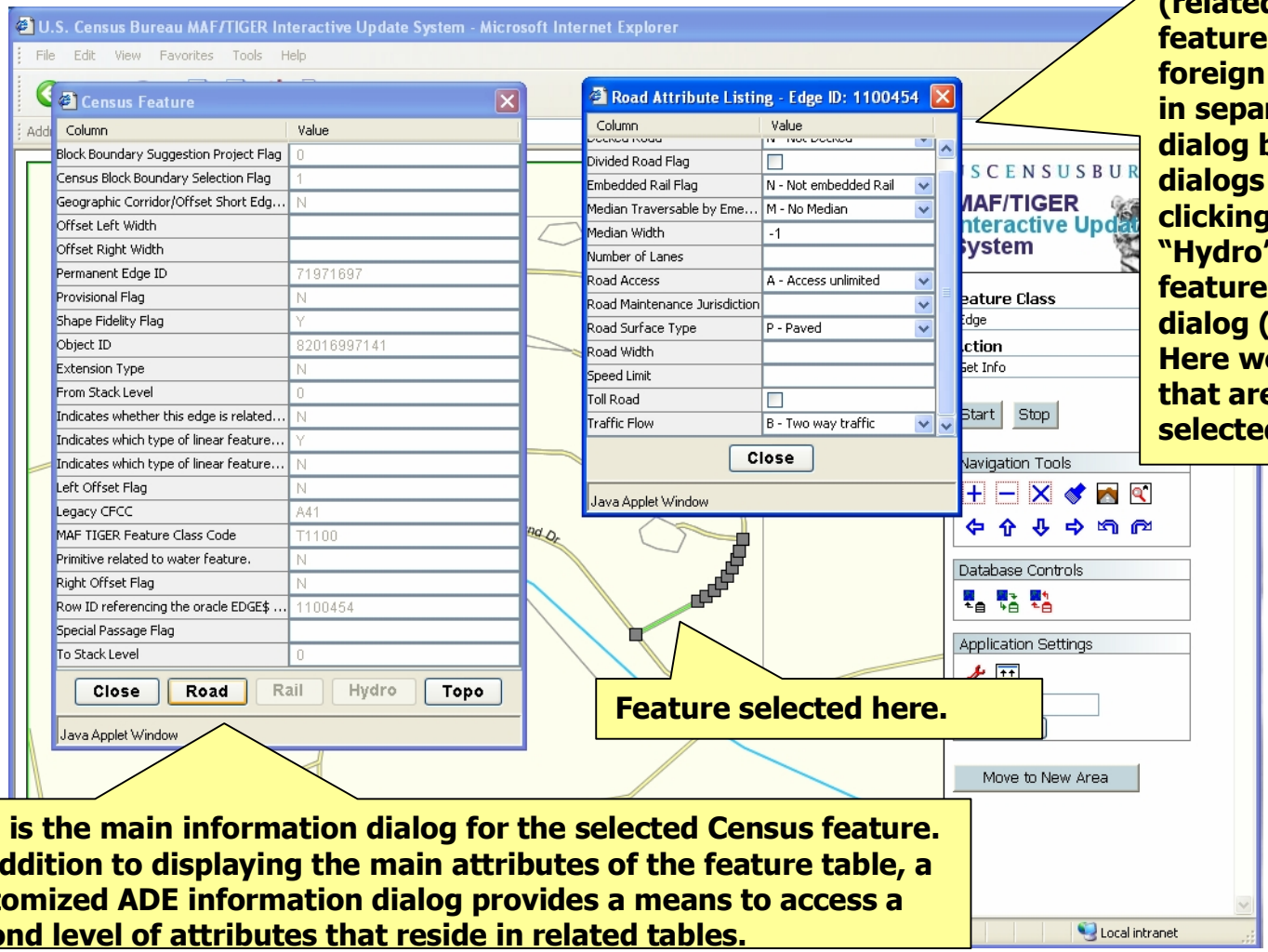


Geographic Area Editing

A customized select operation displays the to-be-edited geographic area in green and allows the user to click neighboring faces (displayed in red) to add to the geographic area.



Attribute Info Dialogs

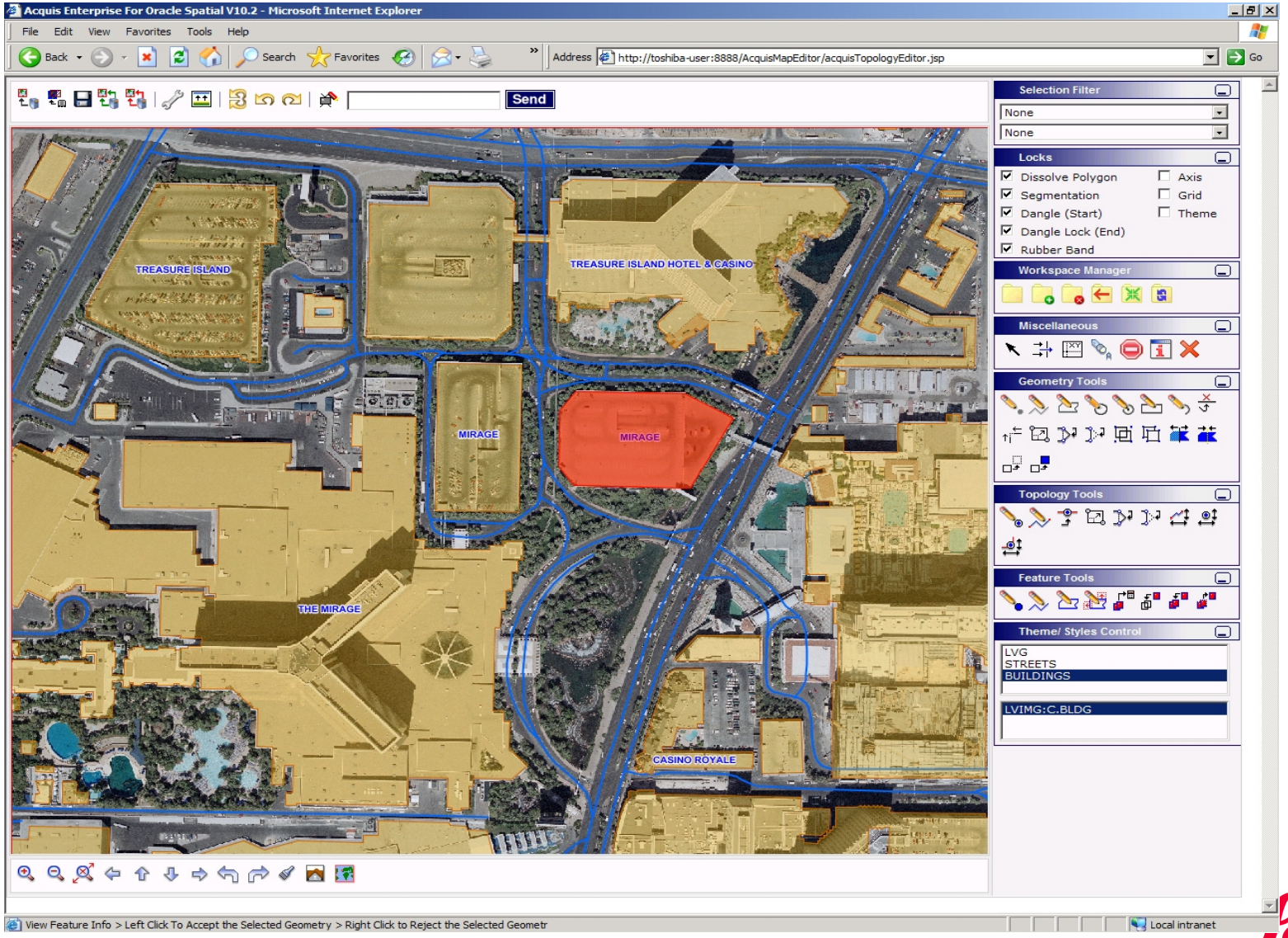


Second-level attributes that exist in related tables (related to the main feature table through a foreign key) are displayed in separate information dialog boxes. These dialogs are accessible by clicking "Road," "Rail," or "Hydro" in the main feature's information dialog (see below left). Here we see road details that are related to the selected Census feature.

Feature selected here.

This is the main information dialog for the selected Census feature. In addition to displaying the main attributes of the feature table, a customized ADE information dialog provides a means to access a second level of attributes that reside in related tables.

Vector /Georaster Display



- when it has to be **right**

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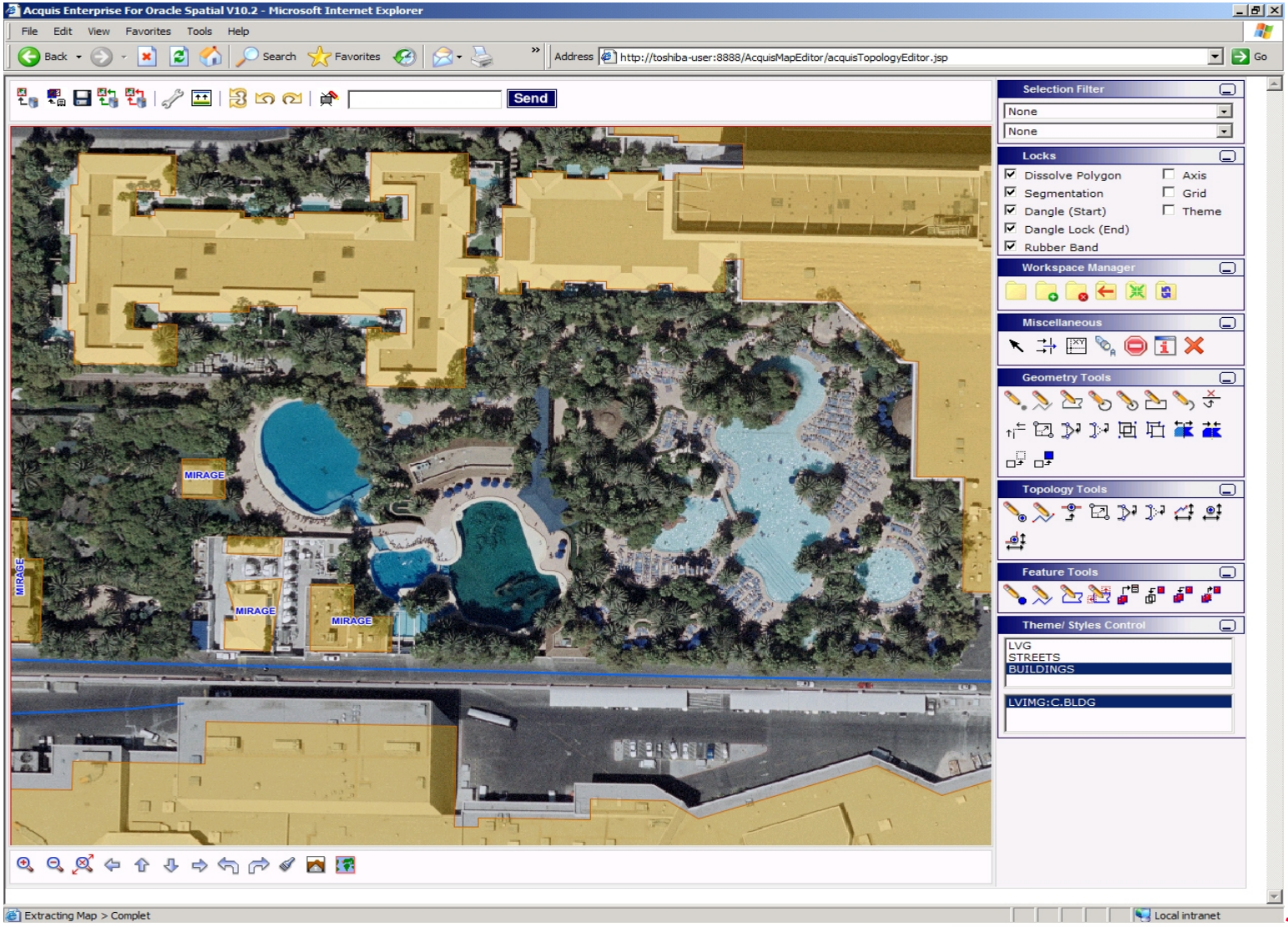
High Resolution Georaster Display



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Offline Demo

Remote Polygon Editing

Future Plans…

Leica ADE Future Projects

- Orthophoto backgrounds through in-house or external imagery web service
- Scanned paper map backgrounds for heads up digitizing and editing
- Workflow integration with “Northbound” (Harris Corp.) TIGER editing process

Summary

Geospatial data is simply data in an enterprise IT infrastructure

Integrate geospatial data into business applications to turn geospatial data into geospatial information

Using Location-enabled enterprise IT architectures and effective tools has a TREMENDOUS effect on IT efficiency and budget

Leica can help

- **Enterprise Products and Services**
- **Based on Oracle's Enterprise Technologies and Application Platform**
  - **Oracle Spatial Development Partner**
  - **Oracle Certified Partner**
  - **Oracle Approved Education Center for Spatial Courses**

ORACLE APPROVED EDUCATION CENTER

ORACLE PartnerNetwork CERTIFIED PARTNER

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