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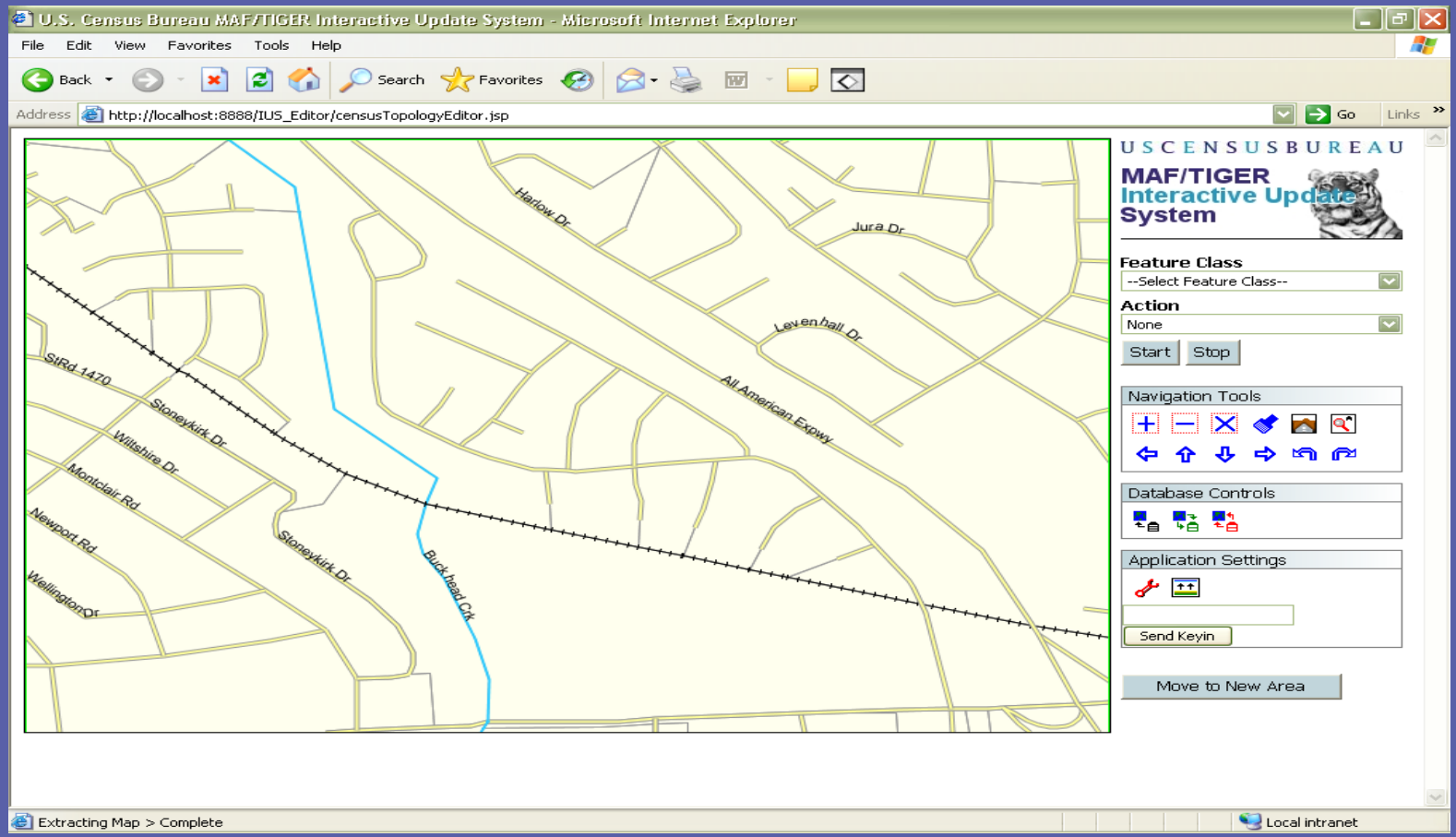
Topology at the US Census



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US Census

Requirement for a 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."**

US Census

- To help with its constitutionally mandated role, Census developed MAF/TIGER
  - 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 Geocoding and Referencing (TIGER)
  - Street center-line geographic database system of the entire US, Puerto Rico, and associated island areas
  - Streets and names, as well as the following:
    - Hydrographic information (lakes and streams)
    - Railroads
    - 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)

MAF/TIGER Redesign

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

- **Utilized persistent (stored) topology**
- **Automated production of digital mapping products**
- **Included spatial indexing**
- **Automated maintenance**
- **Provided for efficient retrieval**

Completely custom solution designed and implemented by the US Census

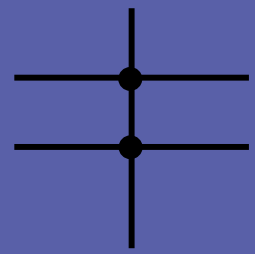
MAF/TIGER Redesign

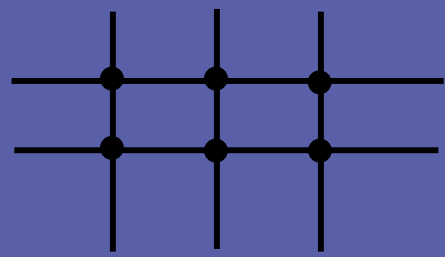
MAF/TIGER is now over 20 years old

- 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

Understanding Topology

- Topology systems decompose features into topology primitives
  - Nodes
    - Assigned where edges meet
    - Can be point features
  - Edges
    - Bound by start and end nodes
    - Have direction
  - Faces
    - Enclosed areas





Understanding Topology

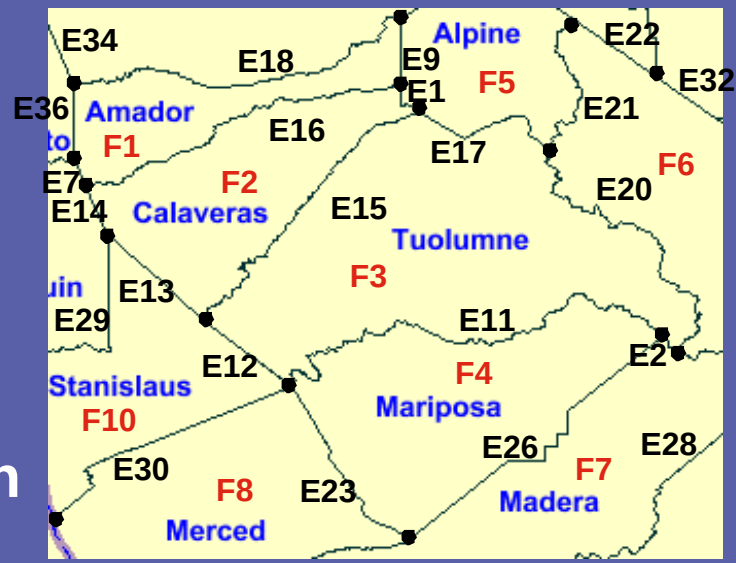
- **US Counties**

  Any county can be instantiated by getting the edges it is composed of

  Tuolumne is composed of edges E17, E15, E12 E11, E2, E20

  Mariposa is composed of edges E11, E23, E26

  Maintenance to edge E11 is automatically reflected in both counties



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Vertical Topology

- US States are composed of counties
  - We've seen that features of a particular type (counties) can share topology primitives
  - Different types of features can also share topology primitives

For instance, states and counties

Sharing primitives between feature layers is vertical topology

Topology Hierarchies

Features can be composed of sets of other features

- US Census has census blocks, which are small areas (faces)
- US Census has block groups, which are composed of sets of census blocks
- US Census has census tracts, created from sets of block groups

A topology hierarchy uses primitives at the lowest level of the hierarchy, but assigns a set of features to the feature at the next highest level in the topology

Vendor Selection

US Census decided to use Oracle Spatial Topology Data Model for several reasons:

- 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 MAF and TIGER data into a single enterprise model
- Oracle provides scalability and performance features such as partitioning and RAC

Interactive Updates at US Census

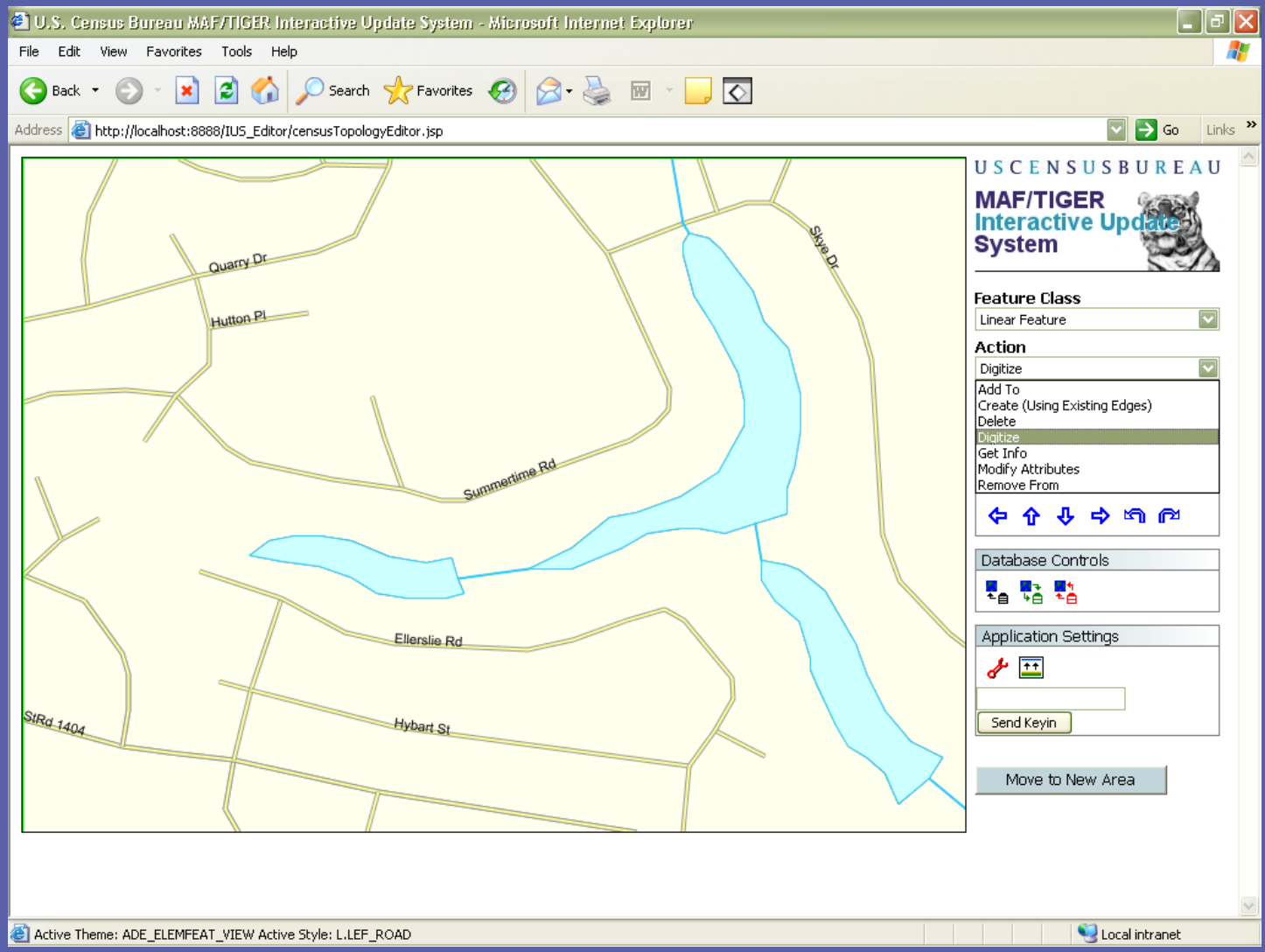
US Census decided to use Acquis ADE as the topology editing tool in the MAF/TIGER Redesign

- **An integral part of the requirements at US Census is the interactive update application**
  - **ADE is the only product designed from the ground up for viewing data in the Oracle Spatial Topology Data Model**
  - **The only product in the world that can natively update data in the Oracle Spatial Topology Data Model**
  - **The ability for the Geography's Division's software developers to customize ADE to support interactive update users for topology and spatial data is also important**

Benefits of the Redesign

- Use of highly functional commercial DBMS
  - Security, scalability, performance, replication, administration, etc.
- Integration of MAF and Tiger data
- 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

Main User Interface



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QUESTIONS
ANSWERS

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