GIS/IT Integration – UDOT Experience

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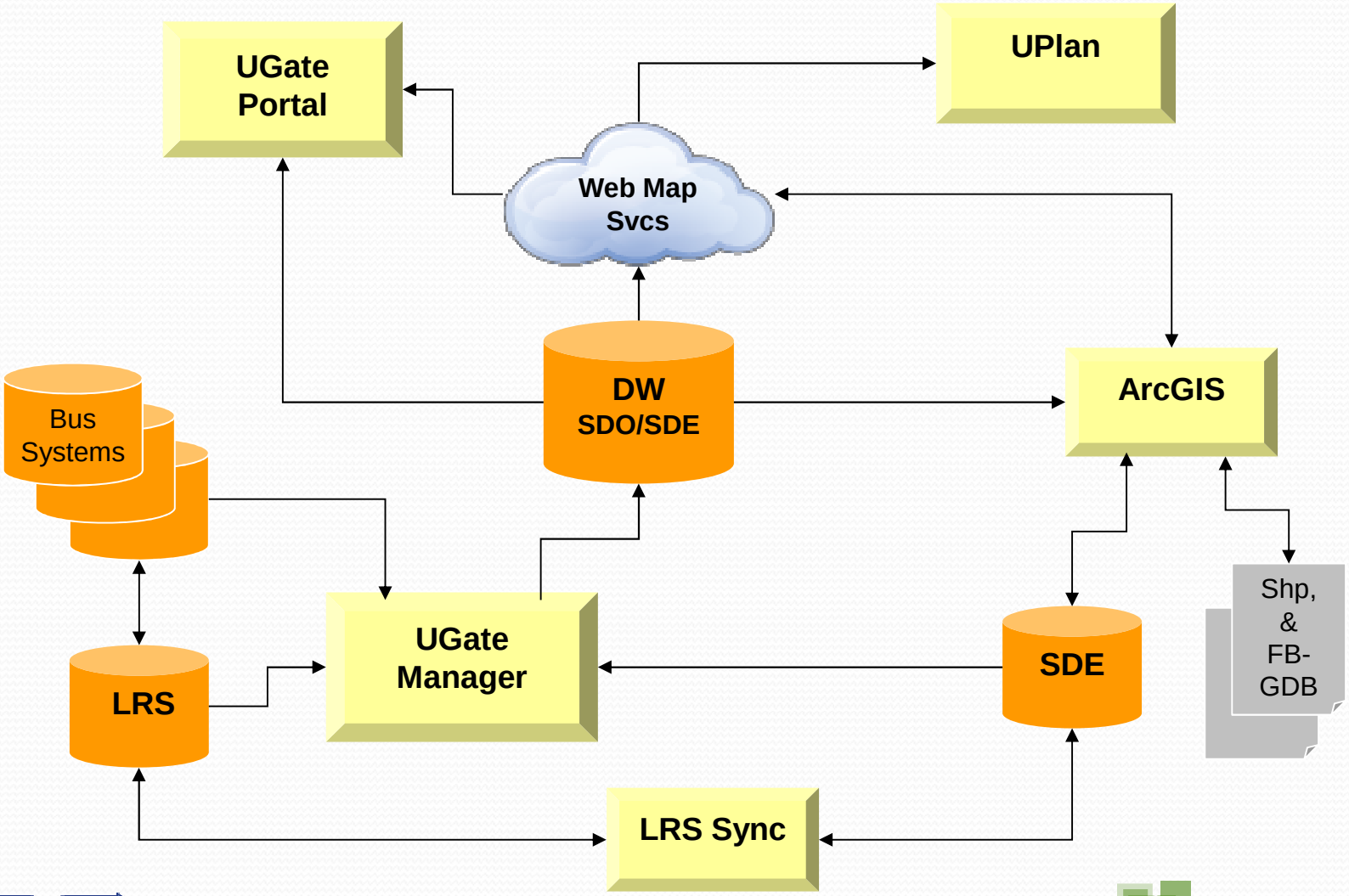
The Journey


UGate Portal
UPlan
Web Map Svcs
DW SDO/SDE
ArcGIS
Bus Systems
LRS
UGate Manager
SDE
Shp, & FB-GDB
LRS Sync

The UDOT LRS

- Prior to this effort, there were 8 LRMs with 26 variations used by various systems.
- LRS is used to define the state network and how assets reference to the network over time
- Some key features in the LRS Policy
  - Basic LRM is route mile point or accumulated miles
  - Two other supported LRMs
    - Route + coordinate
    - Route + reference post w/ offset
  - Temporal LRS
  - One-time load of route geometry (Esri->Oracle)

Common LRS/LRMs Benefits

- Position UDOT to move forward as technology changes
- Insulate UDOT systems from changes in location methods
- Create uniformity
- Allow data sharing between UDOT systems
- Eliminate data duplication and ambiguity
- Eliminate discrepancies and need for data reconciliation
- Provide audit/history of changes
- GIS integration!

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GIS Ready?

- Voila, we are able to see asset locations! But…
  - Do we have bridges in the Pacific Ocean?
  - Why are only 2/3s of my assets geo-locatable?
- Causes
  - Asset data has incorrect or incomplete LRM designations
  - Route geometry is incorrect or incomplete or not up-to-date
- Conclusions
  - We needed an LRS build and maintenance program to keep route geometry updated and cleansed
  - We needed a mapping plug-in that can be used in different asset systems for correcting LRM issues

LRS Route Build & Maintenance

- Phase I - Initial LRS Synch (2008 – 2009)
  - AGRC builds routes on the State System
  - UDOT QCs
- Phase II - LRS Maintenance (2010 -)
  - In-house GIS group builds and QCs routes
  - Focus on State and Federal Aid System
- Software
  - ArcEdit for LRS route building and calibration
  - Oracle for route QC

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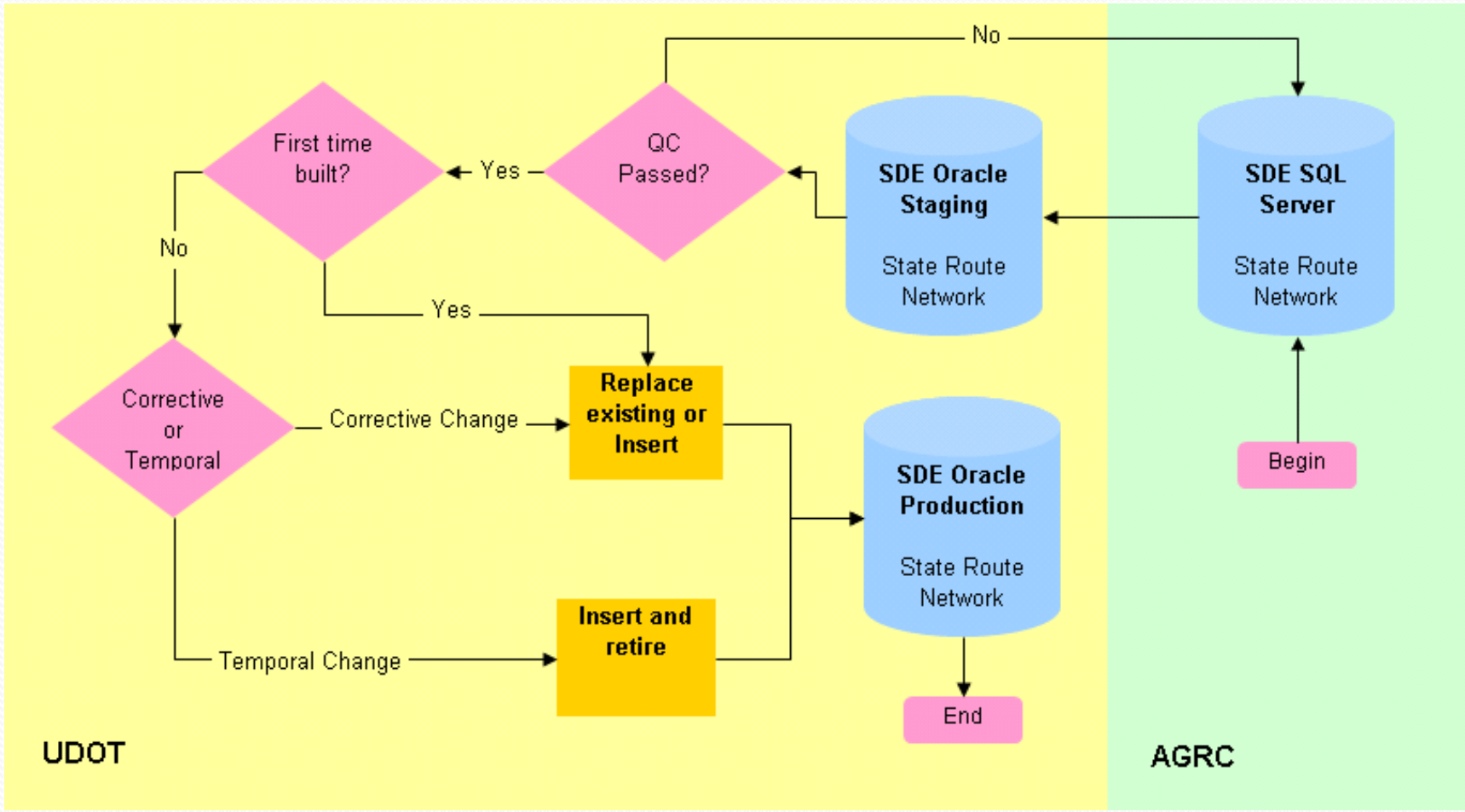
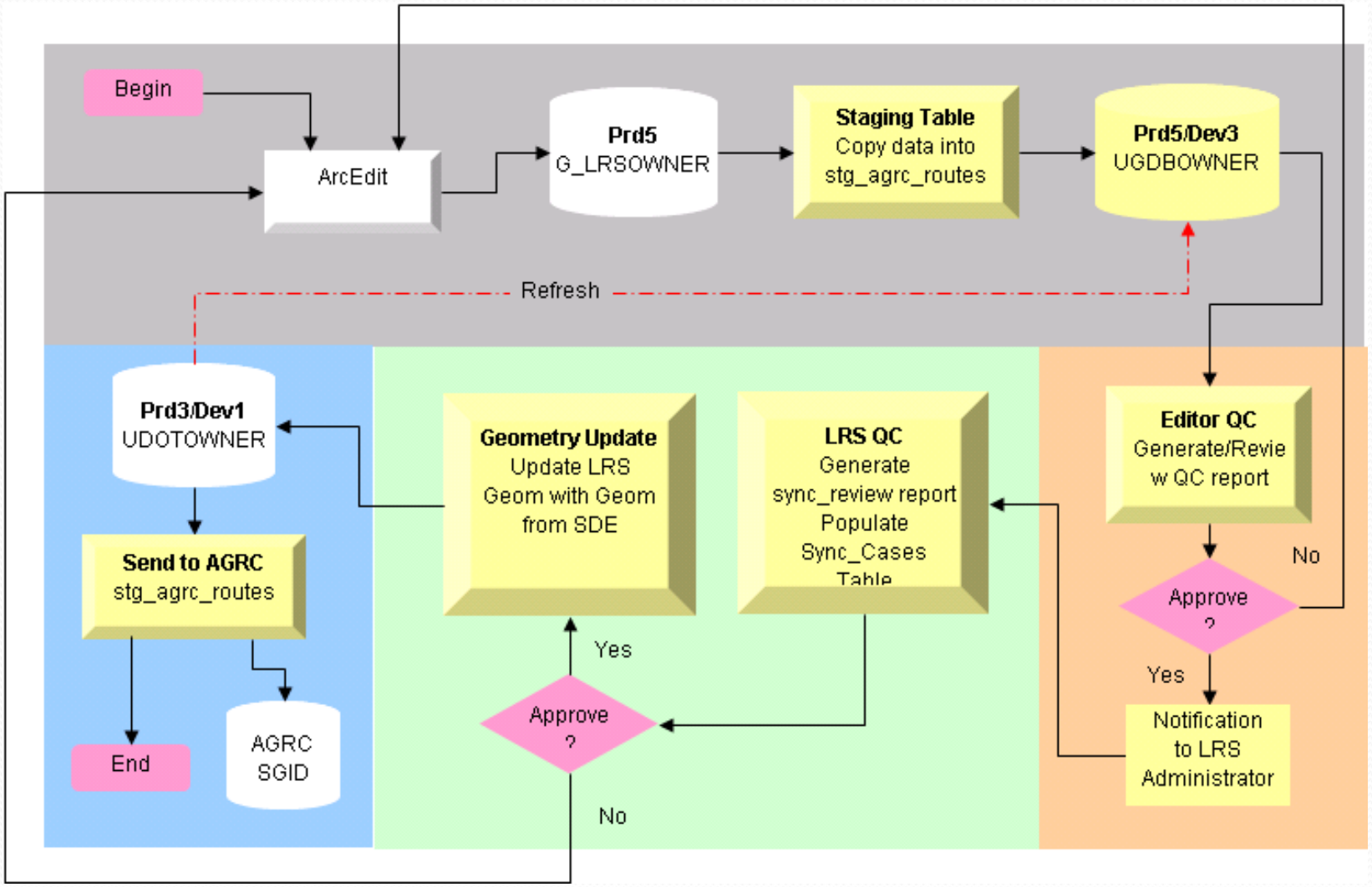
Phase I - Initial LRS Sync Flow



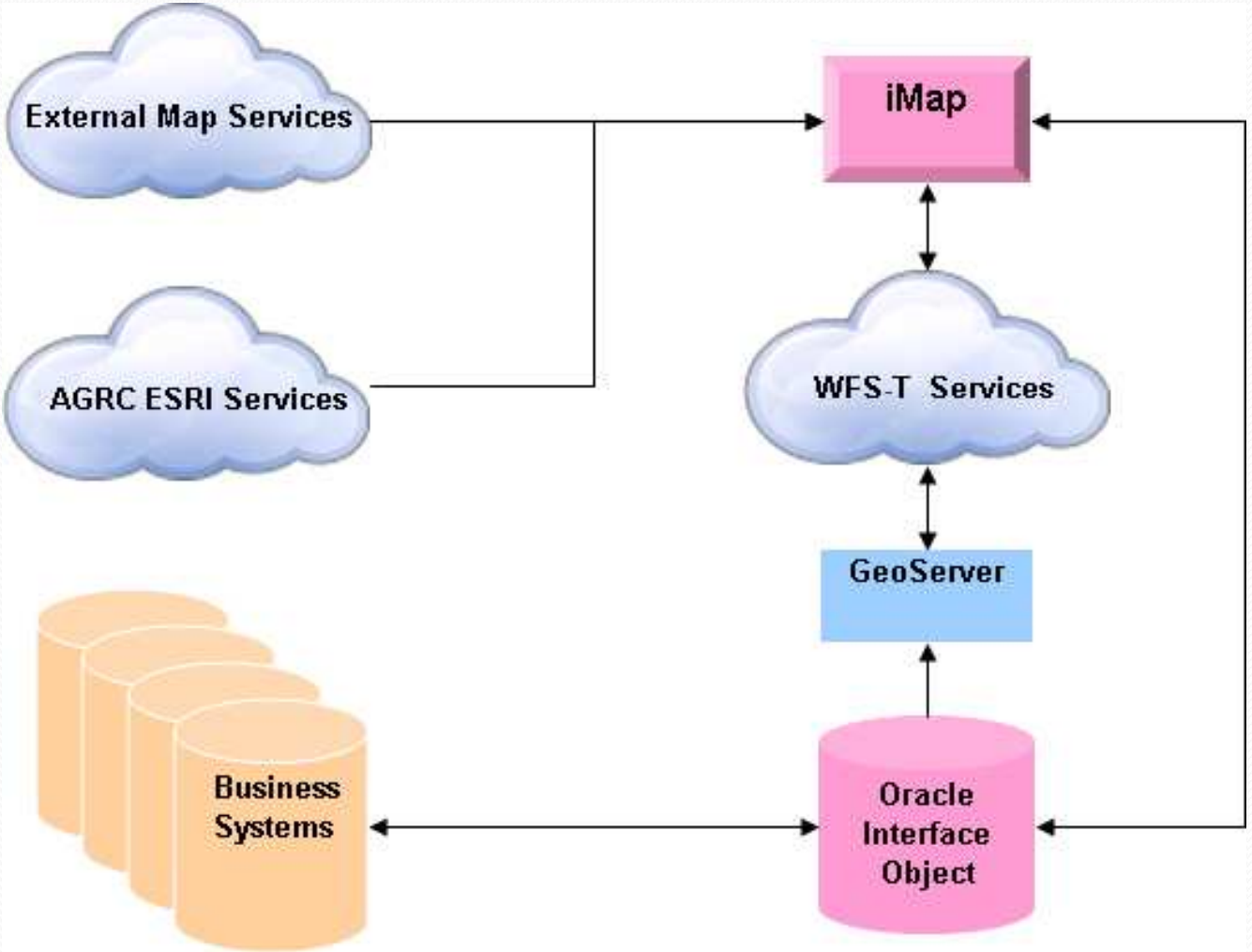
Phase II - LRS Maintenance Flow



LRS QC Error Codes

TYPE	CODE	CODE_DESC	FIX
COMP	DR	Duplicate routes	Y
	ID	Inconsistent route_name, direction, type and label descriptions	Y
	MR	Routes missed by GIS	Y
	NR	New routes built by GIS	Y
GEOM	DF	Three or more duplicate X-Y points on a route forming a fork	N
	DP	Duplicate X-Y points on a route part	Y
	IG	Invalid Oracle SDO geometry	Y
	ML	Measure length vs GIS length of routes or route parts	N
	ST	Routes with switchbacks	N
MEAS	AD	Ascending measurements on decreasing routes	Y
	DI	Descending measurements on increasing routes	Y
	GL	GIS measure length differs from LRS route length	Y
	MD	Inconsistent measure-segment directions	Y
	OM	Out-of-bound measures	Y
TOPO	DM	Duplicate measures on a route part	Y
	RG	Route gaps	N
	SS	Short or zero-length (GIS length) routes or route parts	N

iMap - Map UI Plug-in



iMap Key Features

- LRS Support
  - Snapping – point event snaps to route
  - Following – linear event follows route
  - Defining event by route measure(s)
  - Dynamically measurement readout
- Plug-in designed
- Openlayers Javascript
- Support Esri REST services and WFS-T services
- Simple UI
- Light-weight

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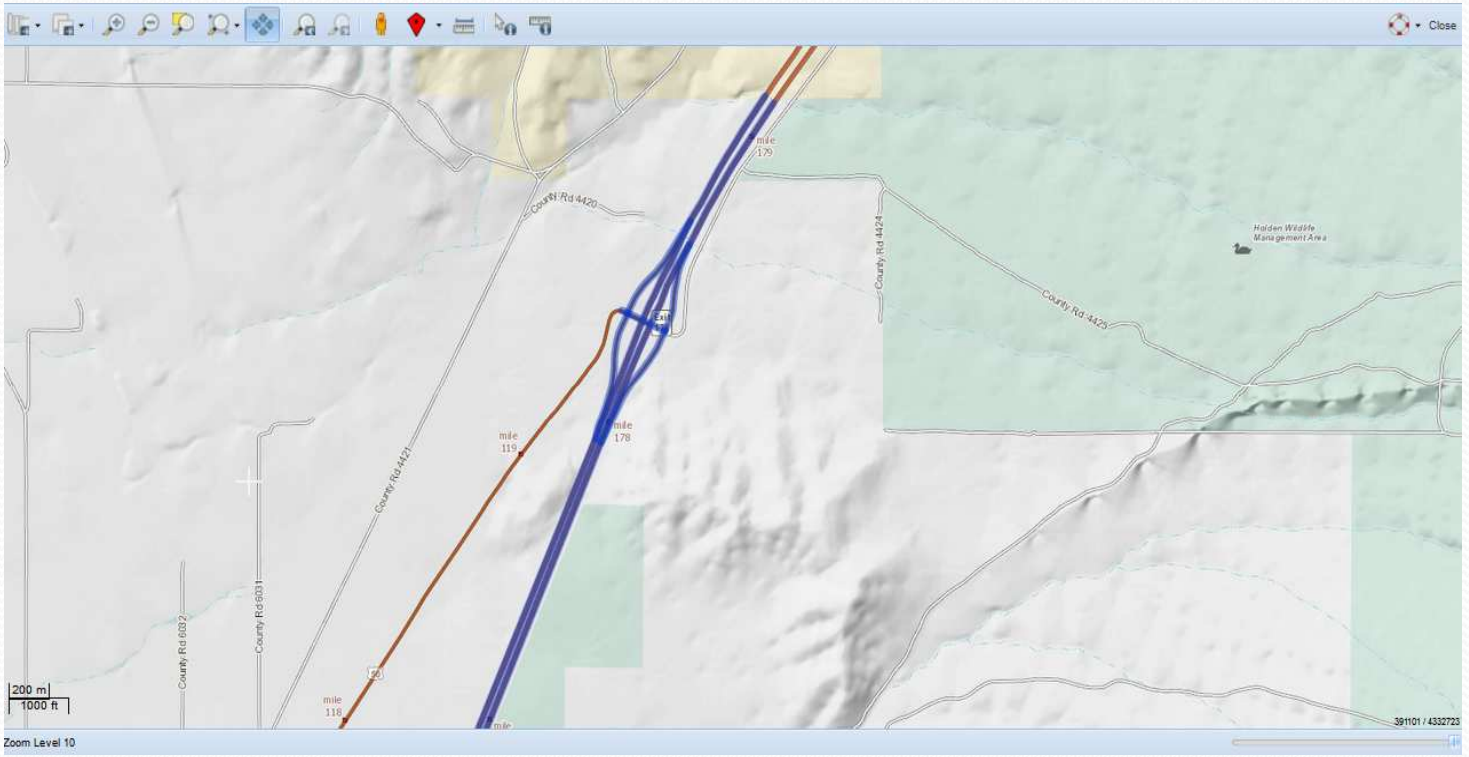
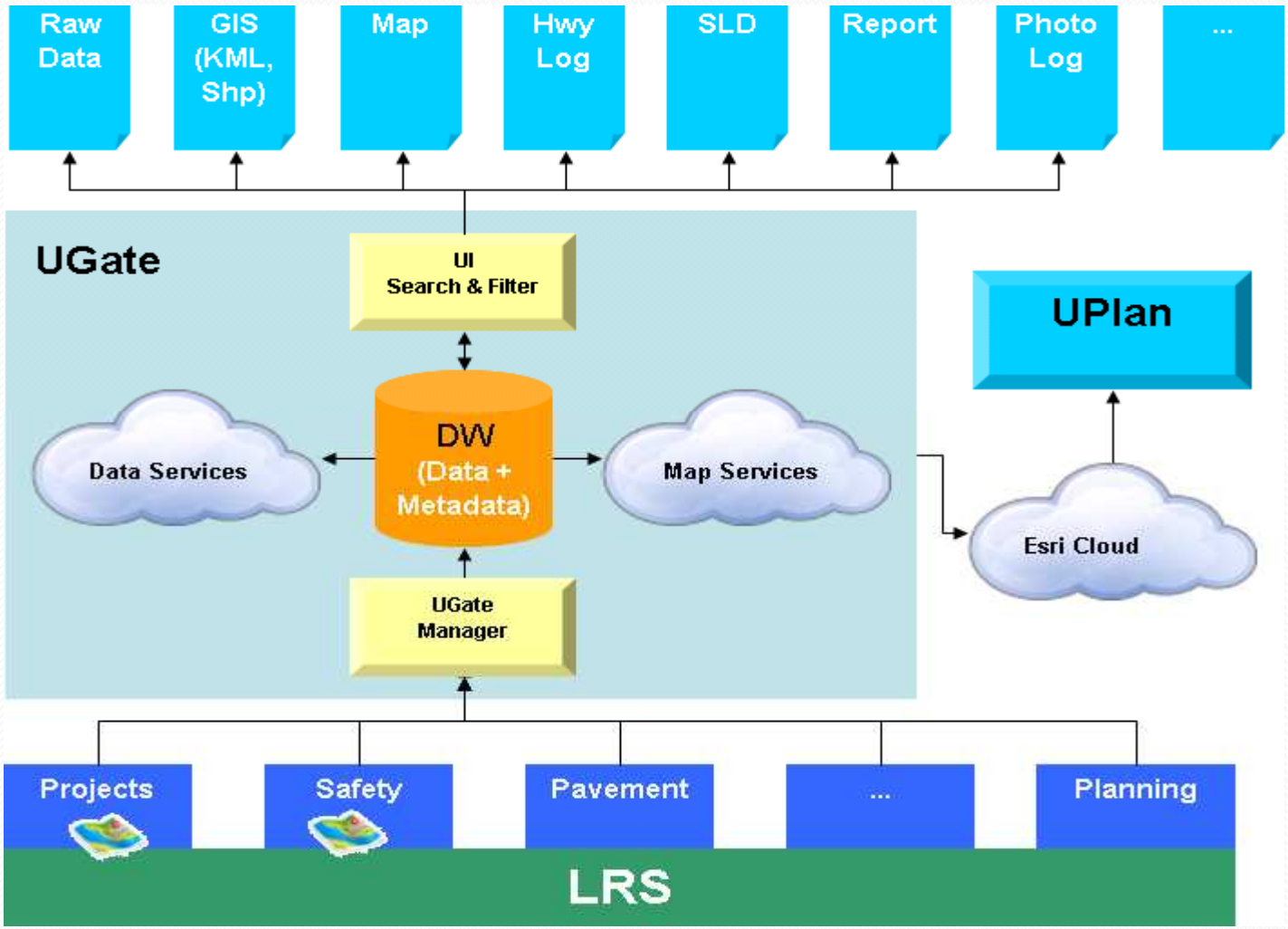
iMap Screen


Close
County Rd 4420
County Rd 4424
County Rd 4425
County Rd 4421
County Rd 6032
County Rd 6031
Holden Wildlife Management Area
mile 179
mile 178
mile 119
mile 118
200 m
1000 ft
Zoom Level 10

IT Infrastructure

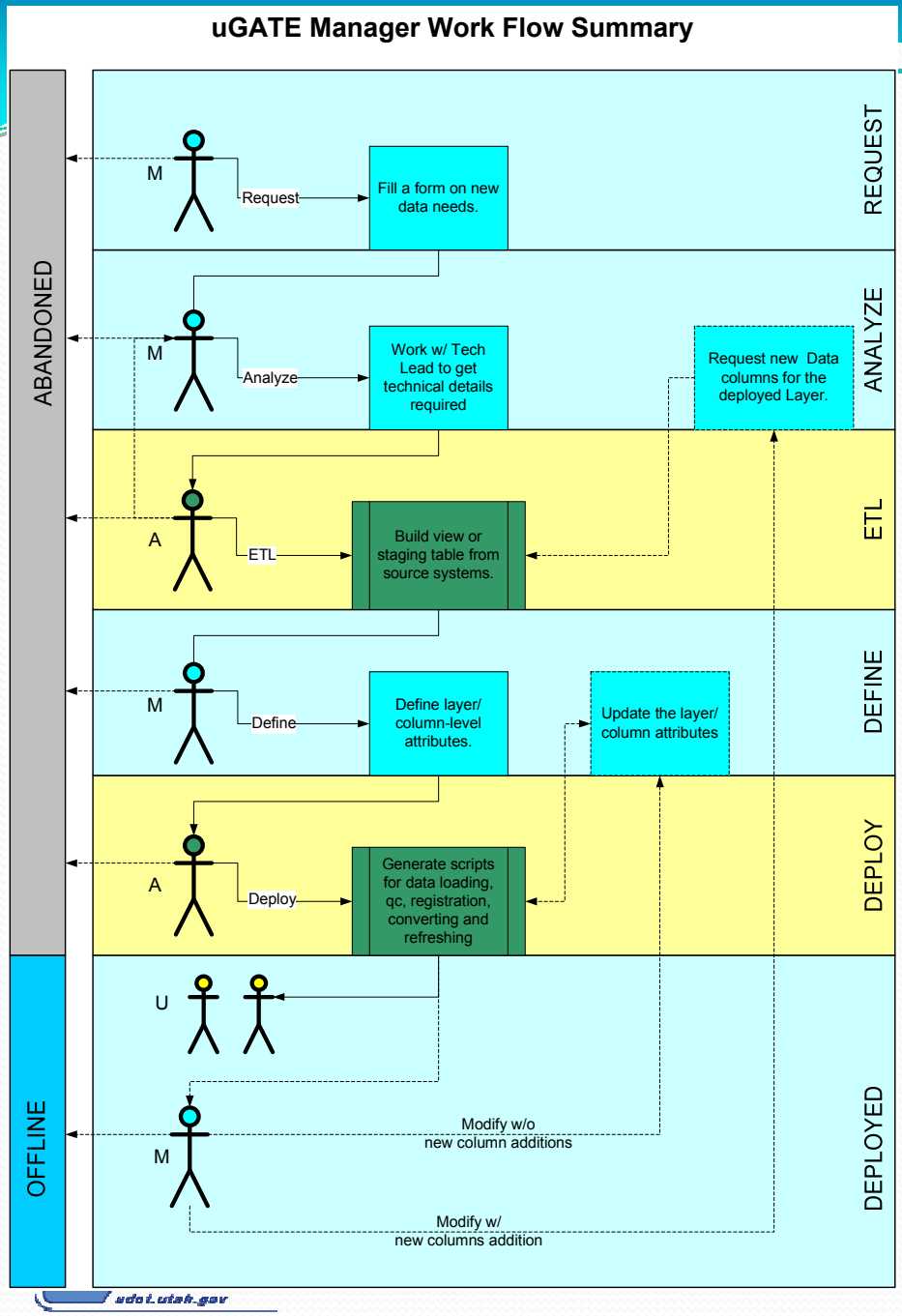
- Database
  - 13 or so Oracle 11g instances
  - Many SQL server instances that came with canned applications
- Operating systems
  - Linux for Oracle servers
  - Linux and Windows for other application servers
- CAD
  - Bentley Microstation with ProjectWise for document management
- GIS
  - Oracle, Esri, GeoServer, Intergraph
- Development platforms
  - PL-SQL, APEX, Oracle forms 10g, JavaScript
  - .Net used at Traffic Operations Center

Integration Architecture



Data Warehouse

- Data warehouse is centerpiece of system
- UDOT's Financial DW
  - FY 05 through 07
  - Draws data from 12 different systems
- UGate DW was different
  - Large and diverse user base, both internal and external
  - Security levels
  - Spatial dimension and LRS



UGate Manager

- Users
  - System Manager
  - GIS Administrator
  - DBA
- Provides work flow management
- Empowers users

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GIS Administration Utility

- Web application
- Liberates DBA and GIS Administrator from tedious and error-prone spatial layer registration and other tasks
- Enforces UDOT standards in SDE and SDO registration
  - Spatial reference
  - Bounding box
  - Tolerance
  - Build index
- Enforces UDOT standards in user/group management
- Features QC capabilities
  - Layer validation
  - Remove phantom layers
- Other
  - Displays SDE version hierarchies
  - Displays connection sessions

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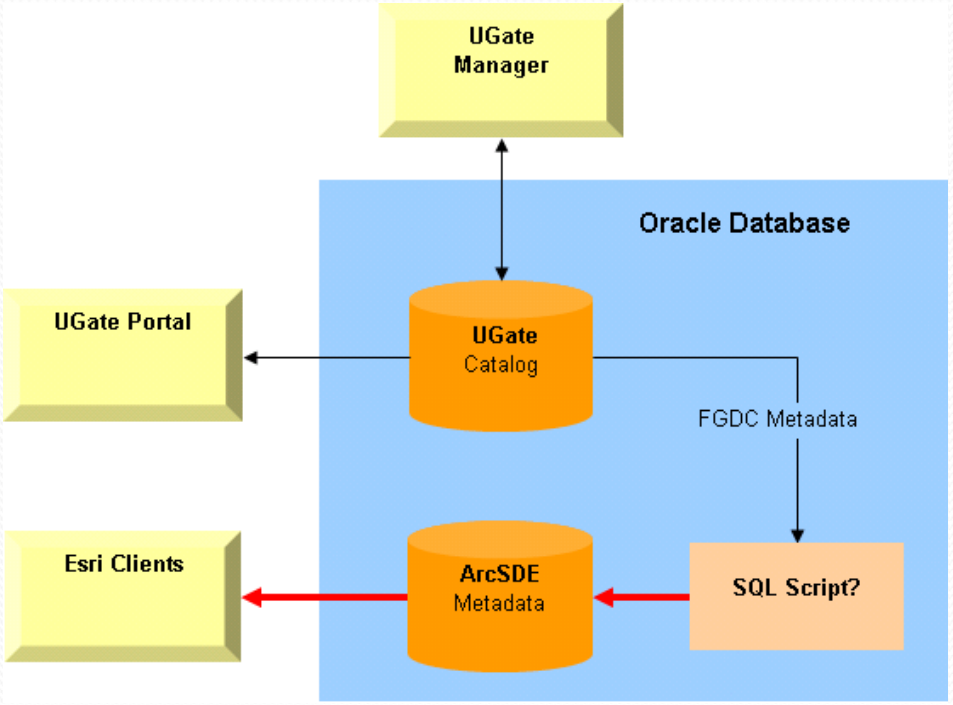
Metadata Synch Options

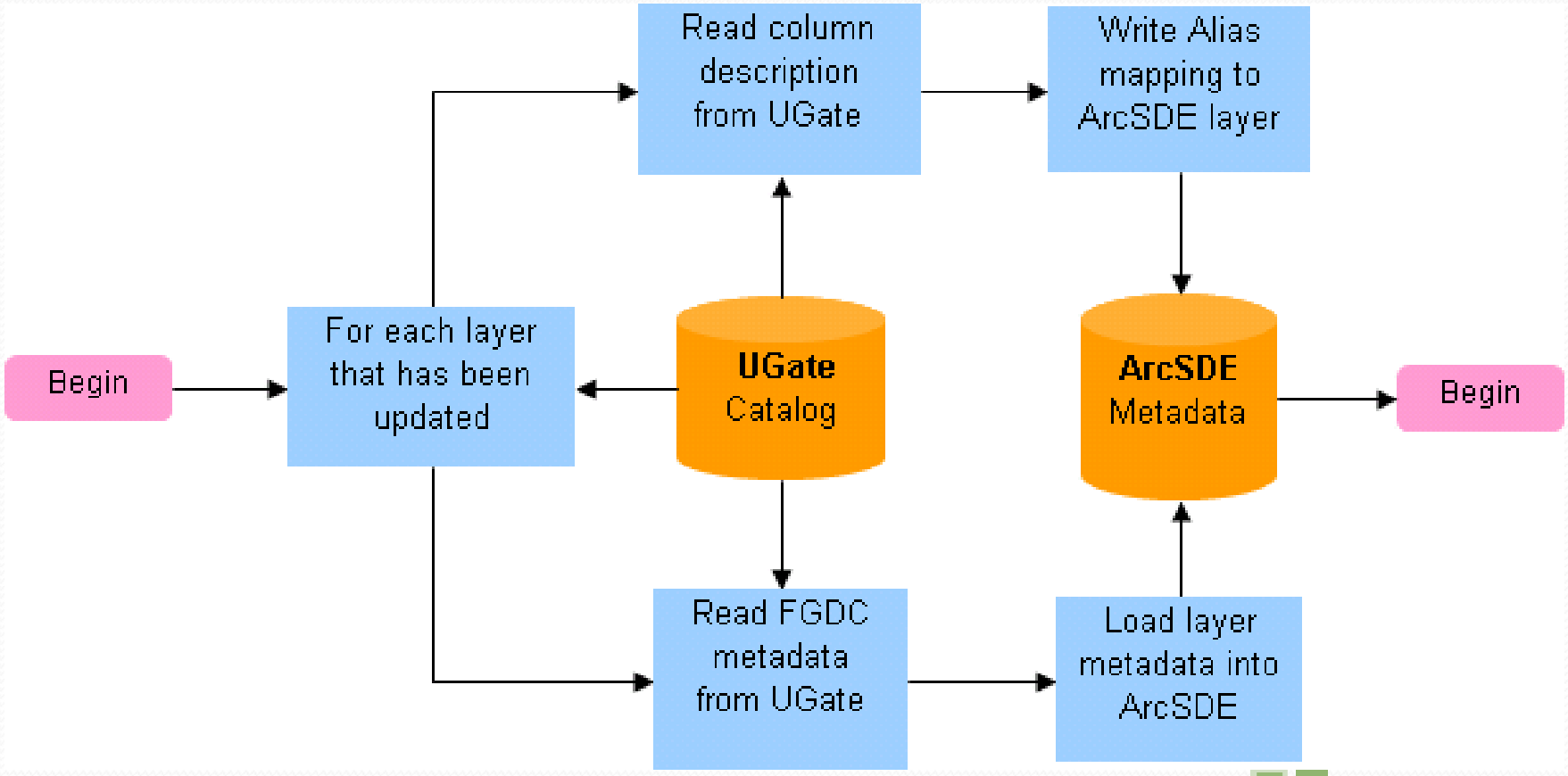


- Manual import
- Python automation in ArcGIS?

- ArcObjects programming in Python
- http://www.pierssen.com/arcgis/upload/misc/python_arcobjects.pdf

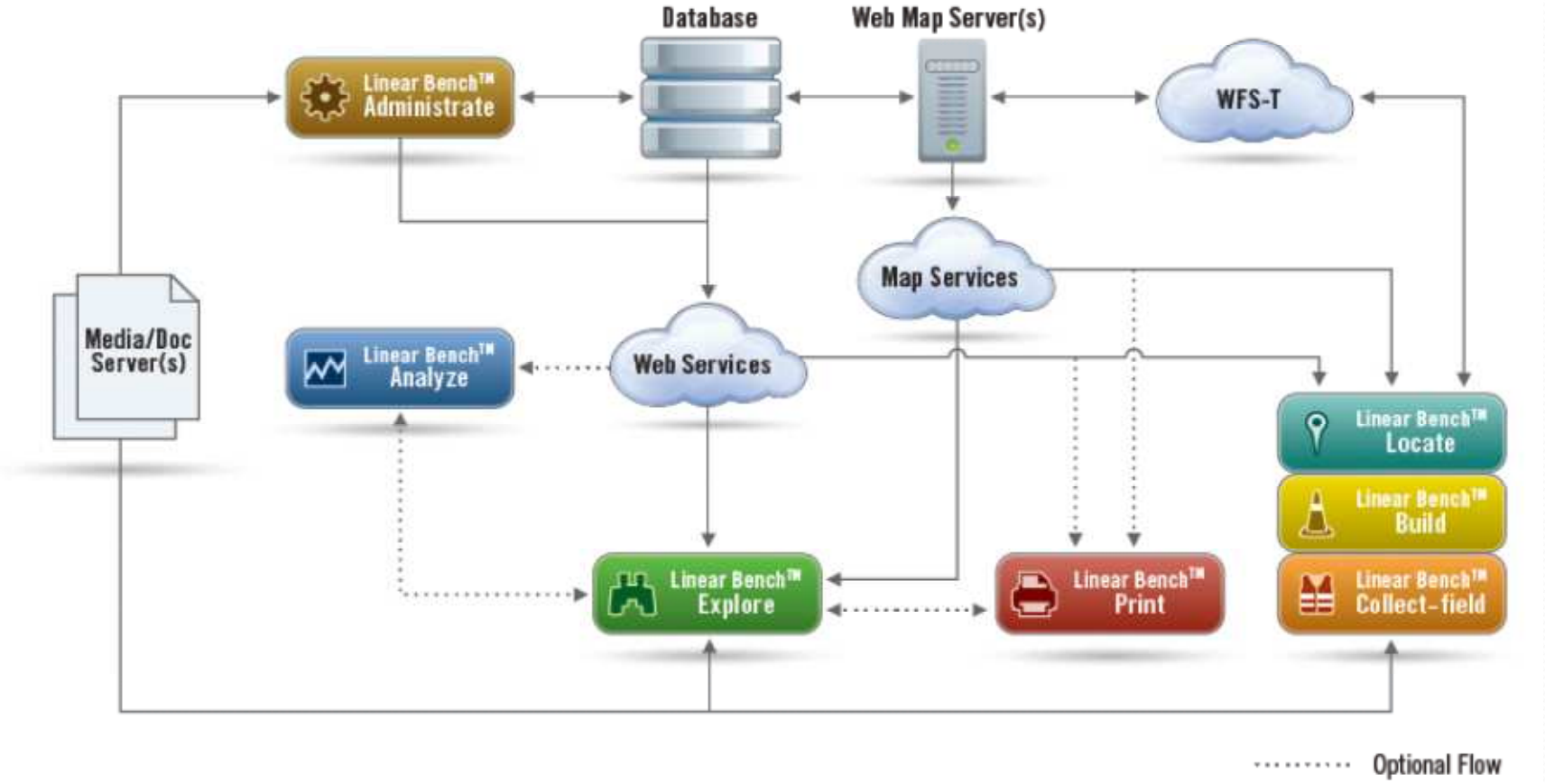
Metadata Synch Flow

General flow of Python script using ArcObjects



Adoption of LinearBench™ Technologies

UGate components include LinearBench™ Explore (LBE) and Print (LBP) modules for visualization, analysis and output of LRS data



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LinearBench™ Demo

- Multi-dimensional visualization
  - Map
  - Straight Line Diagram
  - Time Space Diagram[new]
  - Photo log[new]
  - Asset document/images[new]
  - Traffic cams[new]
- Output
  - PDF and Excel
- Analysis functions[new]

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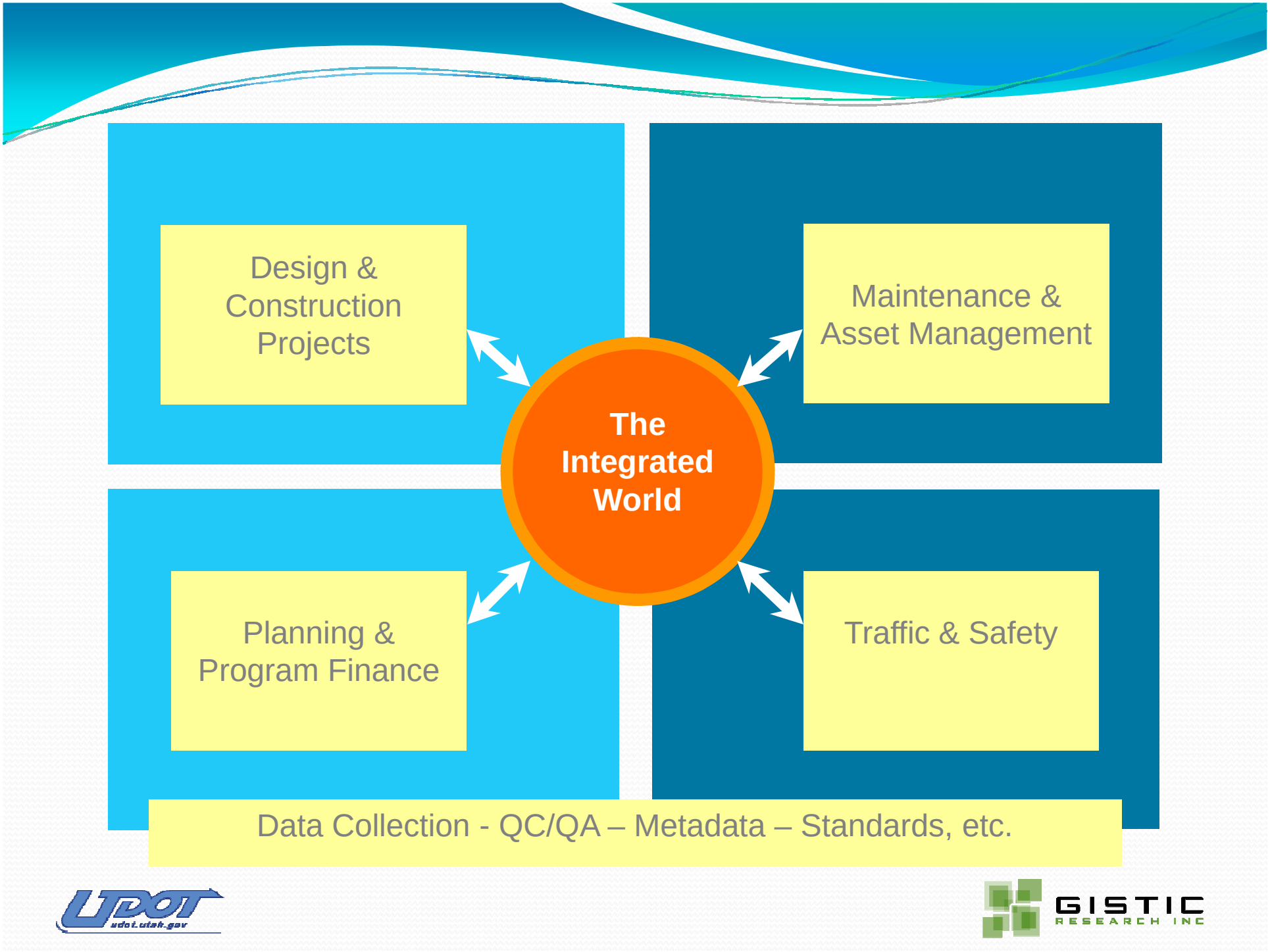
UGate / UPlan Demo and Wrap up

Frank Pisani

GIS Manager


Design & Construction Projects
Maintenance & Asset Management
The Integrated World
Planning & Program Finance
Traffic & Safety
Data Collection - QC/QA – Metadata – Standards, etc.

Challenges

- ETL Process – Cumbersome, Time Consuming, Too Manual.
- Straight-Line Diagram – Cool Technology Looking for a Reason to Exist (Needs Data and Users)
- Delivering Value – Closing the Loop
- Roadway Data Collection Data – (30+ TB)
  - All State Roads, Ramps & Collectors (14,000 driven miles)
  - All Visible Assets – (signs, barrier, pavement markngs, etc)
  - Pavement Condition Data
  - High Definition Images (20 per mile)
  - LiDAR

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Roadblocks

- Legacy Systems & Technologies
- Disparate Technologies (Esri, Oracle, Intergraph, Bentley, Various Web and Map Services)
- Build vs. Buy
- Sufficient Funding
- Managed Growth
- How Accurate is Good Enough
- Data Storage – Requirements, Methods, Costs
- Converting Data to Information (BI, Maps, Analytics, etc.)