MTA LINEAR REFERENCING DATA MODEL

MTA – Geospatial Technologies and Applications

MTA

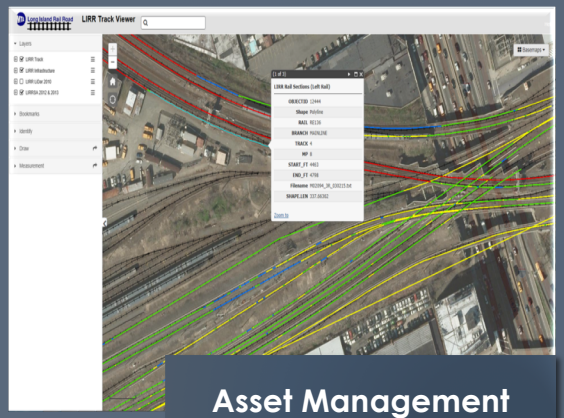
- New York City Transit
  - Department of Subway
  - BUS
  - Paratransit
  - Staten Island Railway
- Long Island Rail Road
- Metro-North Railroad
- Bridges and Tunnels
- Capital Construction

MTA Totals at a Glance*

2017 operating budget	$13 billion
Annual ridership	2,658,000,000
Average weekday ridership	8,600,000
Rail and subway lines, and bus routes	357
Rail and subway cars	8,863
Buses	5,725
Track miles	2,080
Bus route miles	2,952
Rail and subway stations	736
Employees	73,575

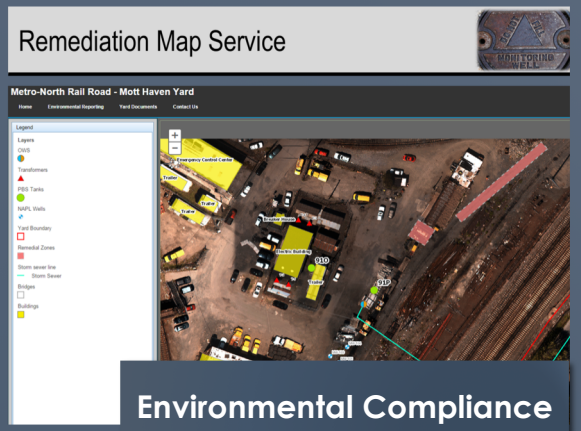
*Financial data estimated as of Feb. 2018;
statistical data projected for year ending Dec. 31, 2017.

GIS at MTA



Asset Management

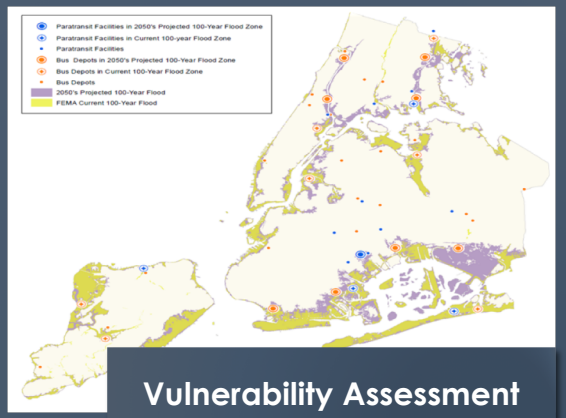
Vehicle Tracking



Environmental Compliance

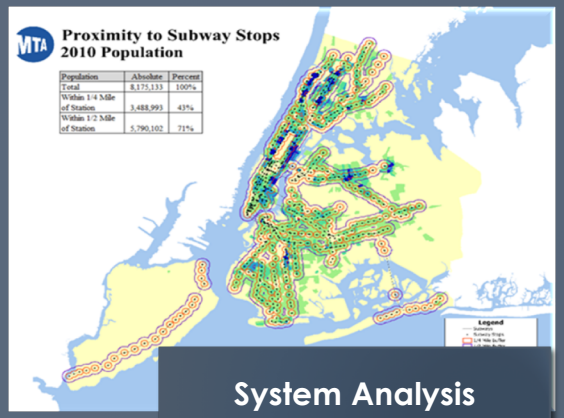
Emergency Management

Real Estate Management

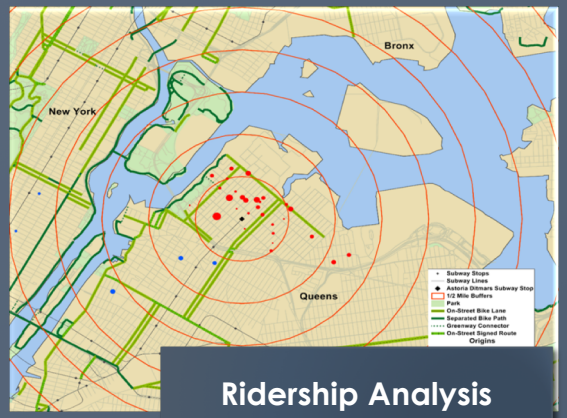


Vulnerability Assessment

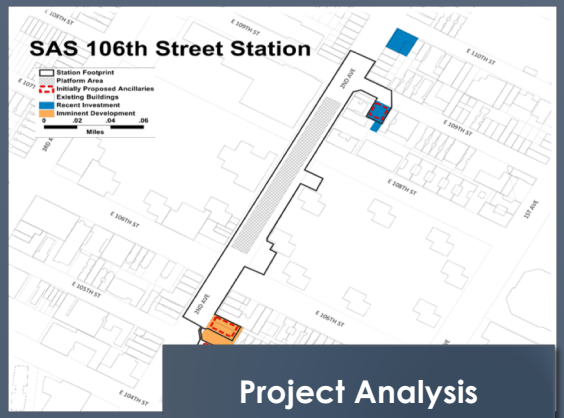
GIS at MTA



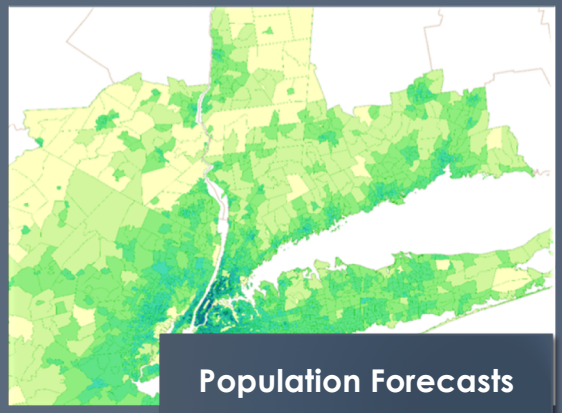
System Analysis



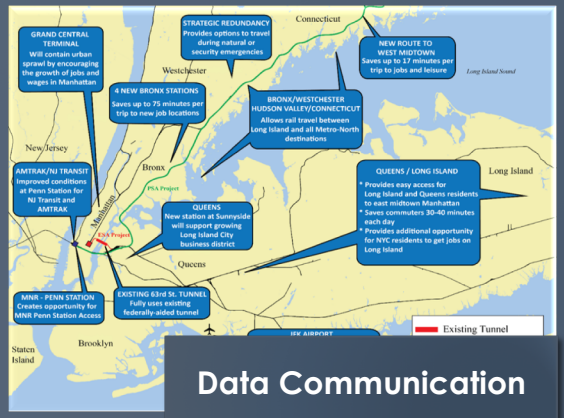
Ridership Analysis



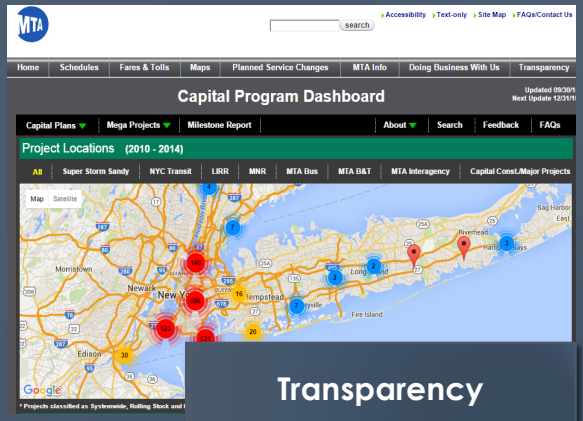
Project Analysis



Population Forecasts



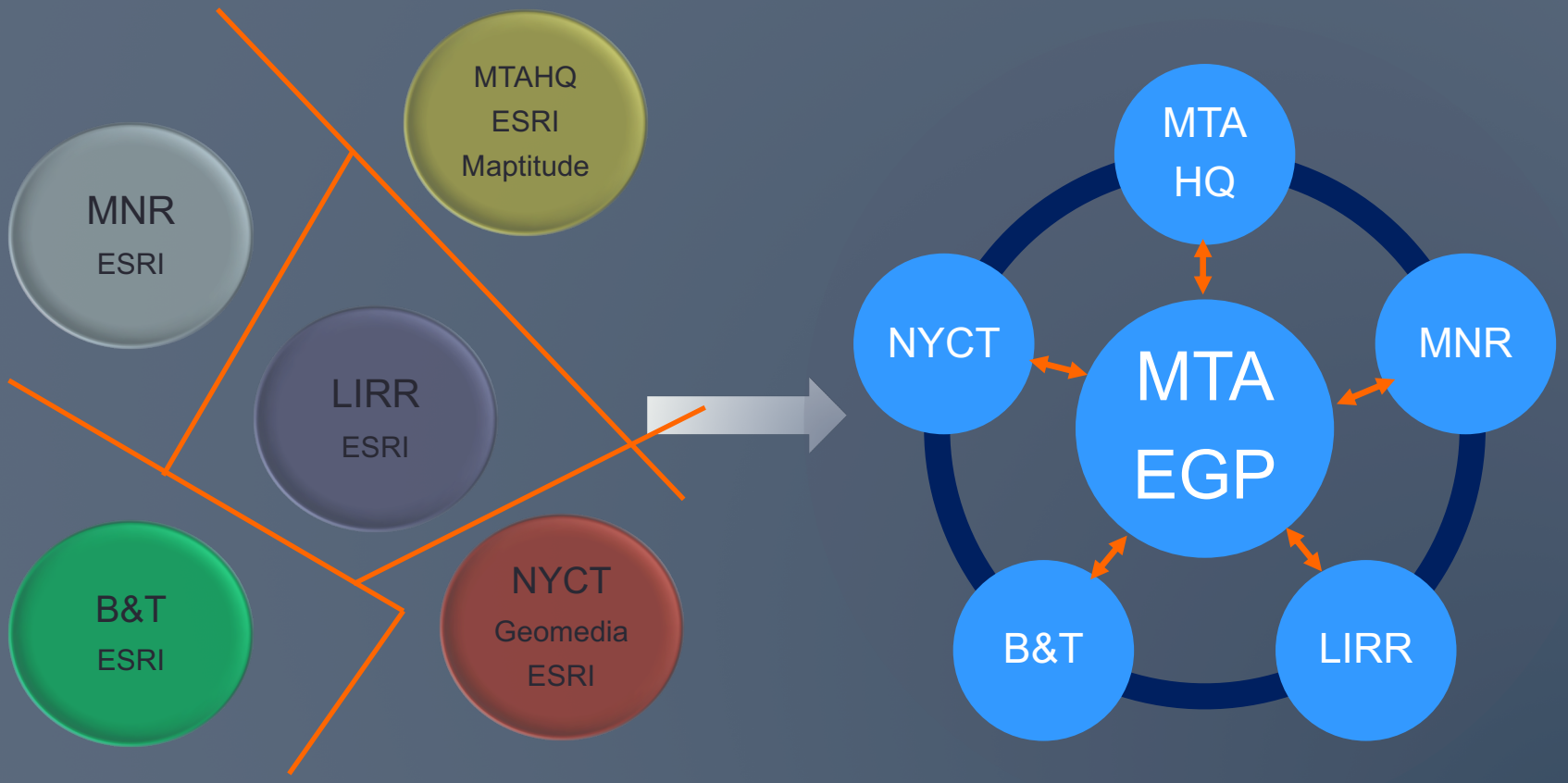
Data Communication



Transparency

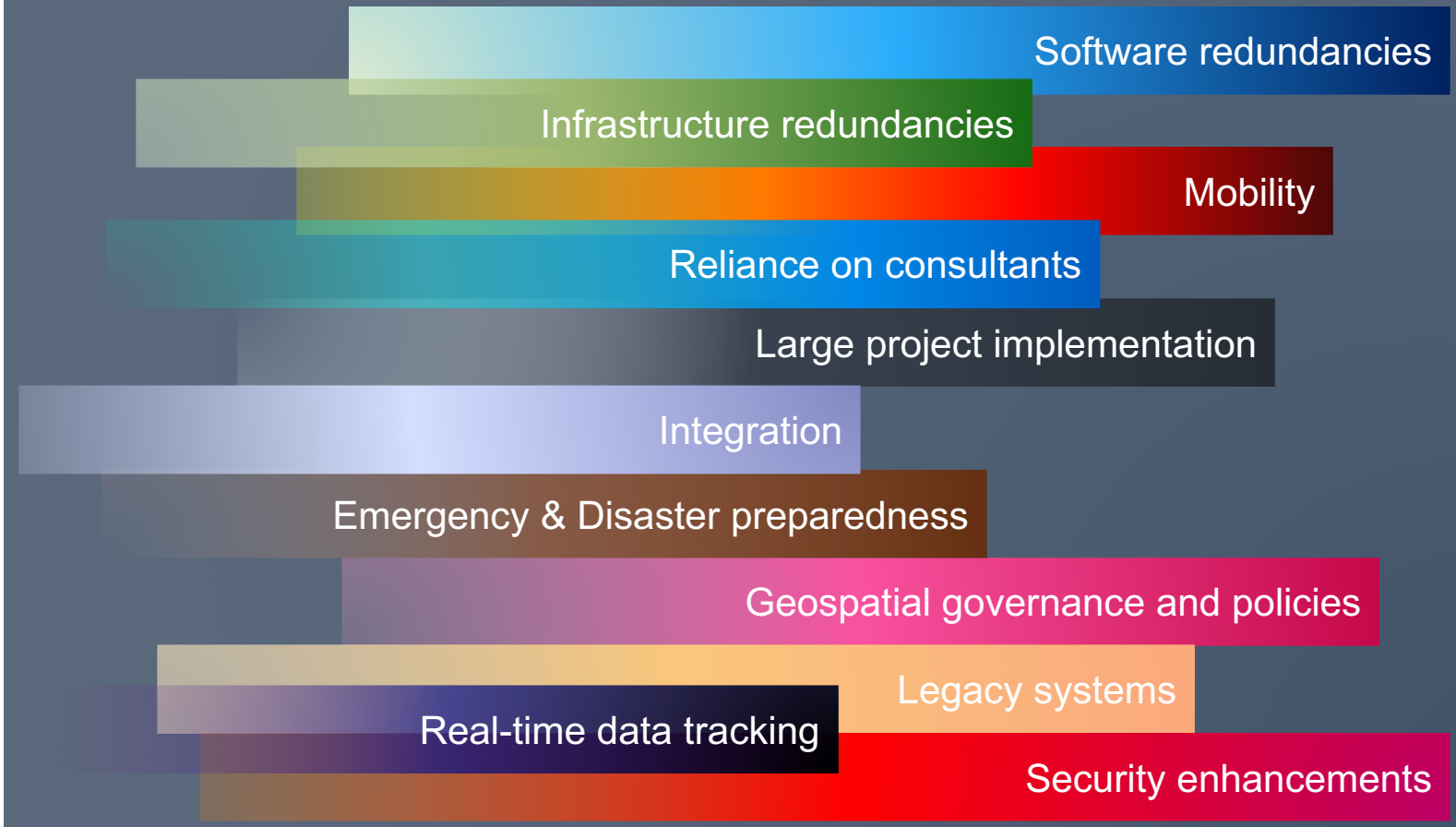
Integrating Organizations and People

Breaking Down the Barriers



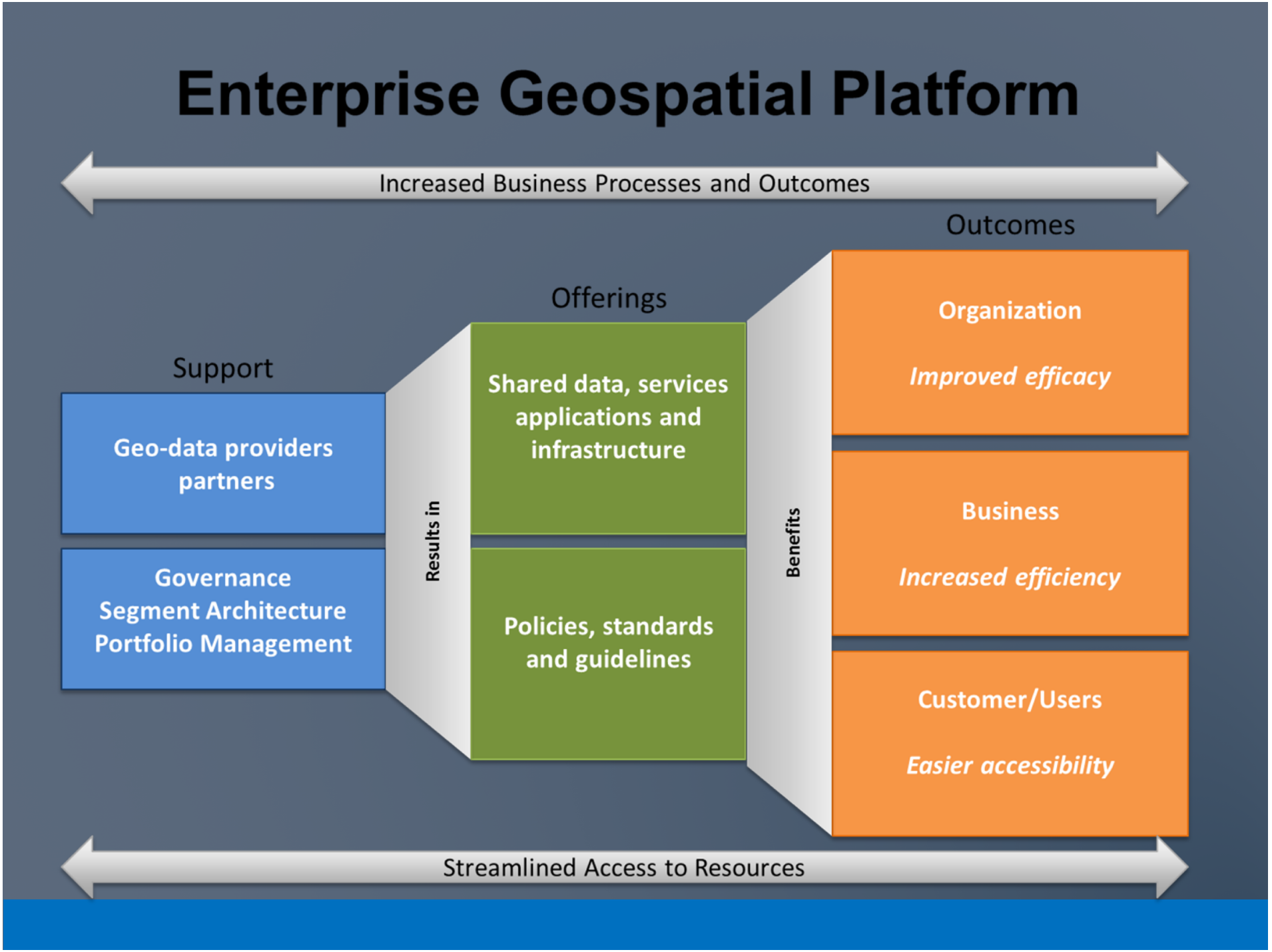
…Sharing Resources

Consolidation

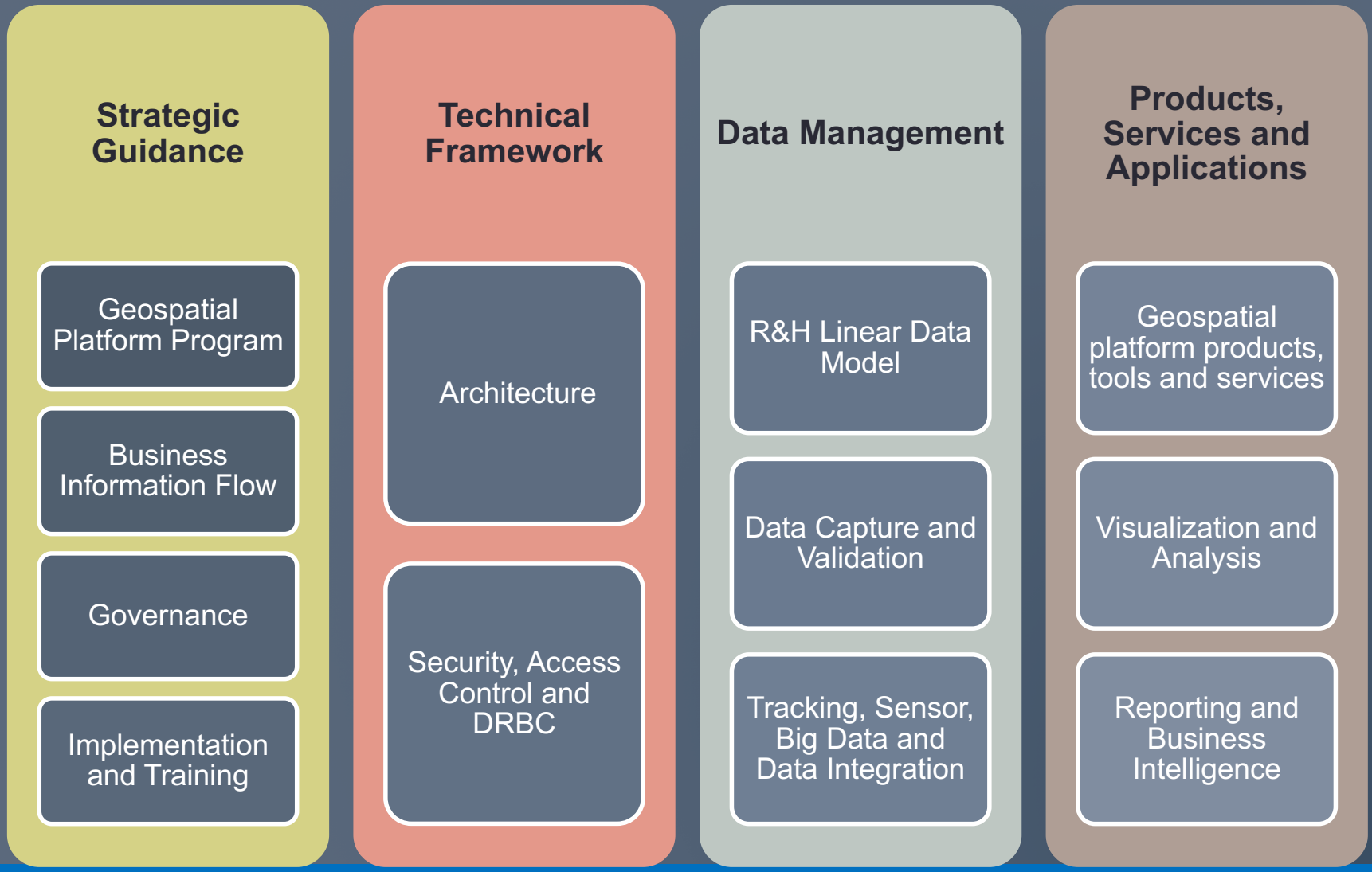


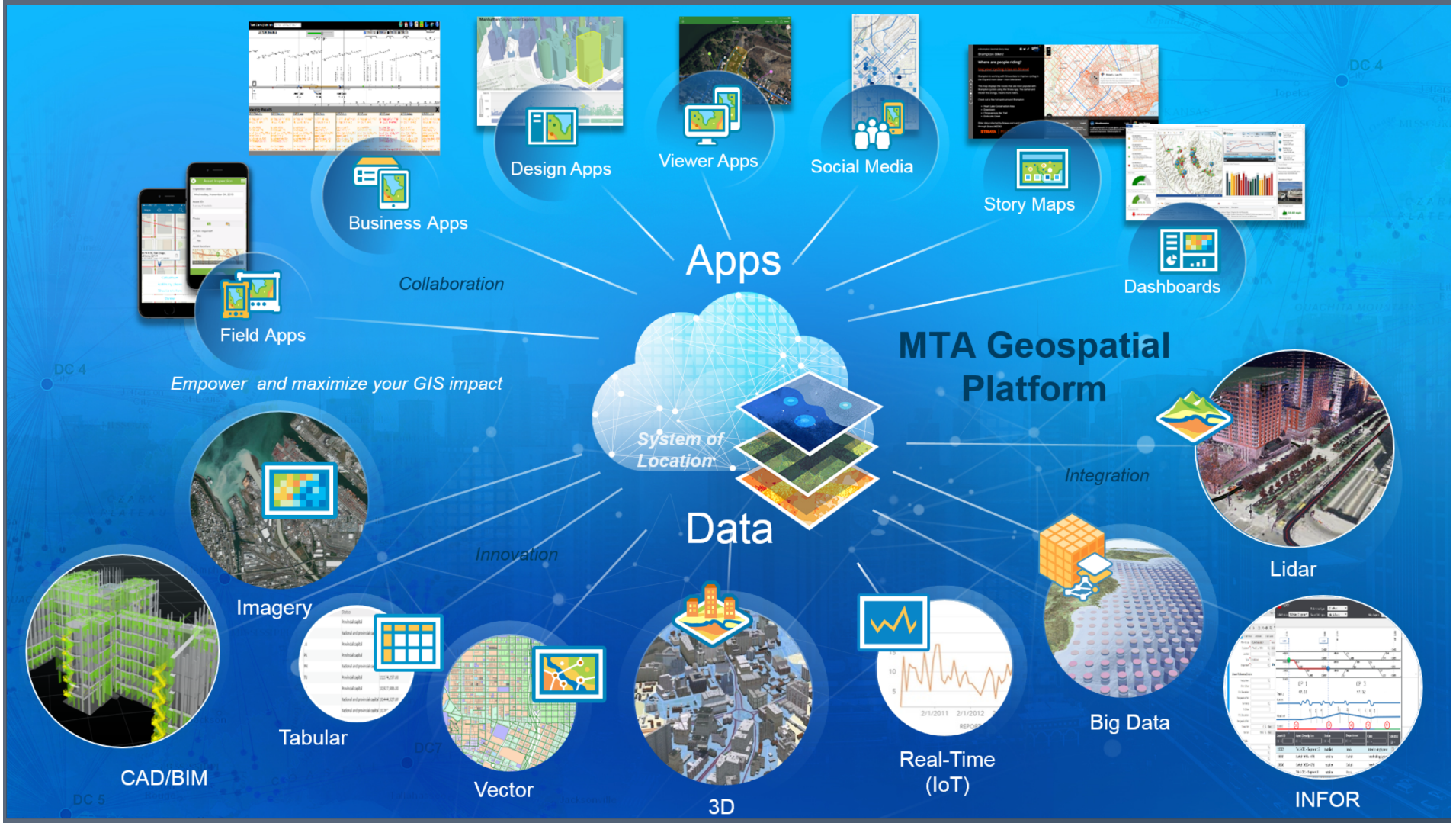
…Drive business value

MTA Geospatial Platform enables every employee to easily discover, use, make and share maps from any device, anywhere, anytime.


Enterprise Geospatial Platform
Increased Business Processes and Outcomes
Outcomes
Offerings
Support
Organization
Improved efficacy
Shared data, services applications and infrastructure
Geo-data providers partners
Results in
Benefits
Business
Increased efficiency
Governance
Segment Architecture
Portfolio Management
Policies, standards and guidelines
Customer/Users
Easier accessibility
Streamlined Access to Resources

MTA EGP Program – Work Streams




Apps
Business Apps
Design Apps
Viewer Apps
Social Media
Story Maps
Dashboards
Field Apps
Collaboration
Empower and maximize your GIS impact
MTA Geospatial Platform
System of Location
Data
Integration
Innovation
Imagery
Lidar
CAD/BIM
Tabular
Vector
3D
Real-Time (IoT)
Big Data
INFOR

GIS and EAM

- System of record for geographic location referencing
- System of record for Linear Asset Management
- Evolve Location referencing to depend on GPS and GIS to greatly improve accuracy

- Whole life asset management
- Planning & design, procurement & inventory, installation, maintenance & work management, decommissioning & disposal
- EAM manages asset information including asset attributes & specifications, work management, cost, etc.

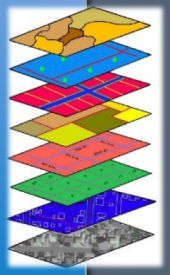
EAM and GIS are linked by a common "GIS" ID that represents the geolocation NOT the asset

Relationship between GIS and EAM

Geographic Information System

Asset GeoLocation Management

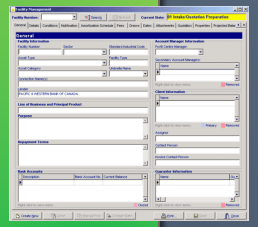
- Geospatial location
- Geographic visualization
- Spatial hierarchy
- Spatial query
- Spatial analytics
- Spatial cost tracking
- Discrete and linear assets



Asset Management Information System

Asset Life Cycle Management

- Material stock/inventory
- Installation
- PM
- Repair
- Decommission
- Replace
- Asset hierarchy
- Cost tracking
- Discrete and linear assets



Stores the assets that reside at a geographic location

Stores the geographic locations at which assets reside

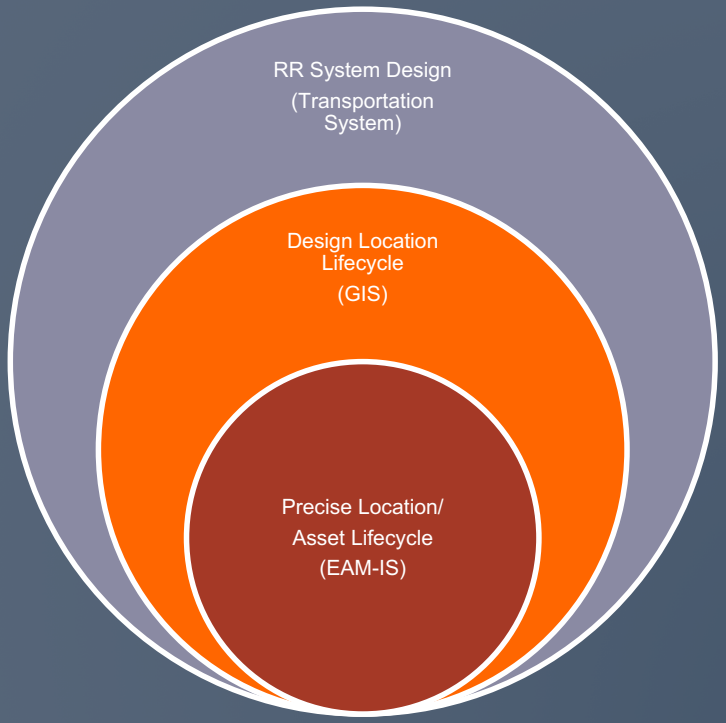
GIS Data

- **ASSET LOCATION REGISTRY**
- Location attributes
- Linear reference

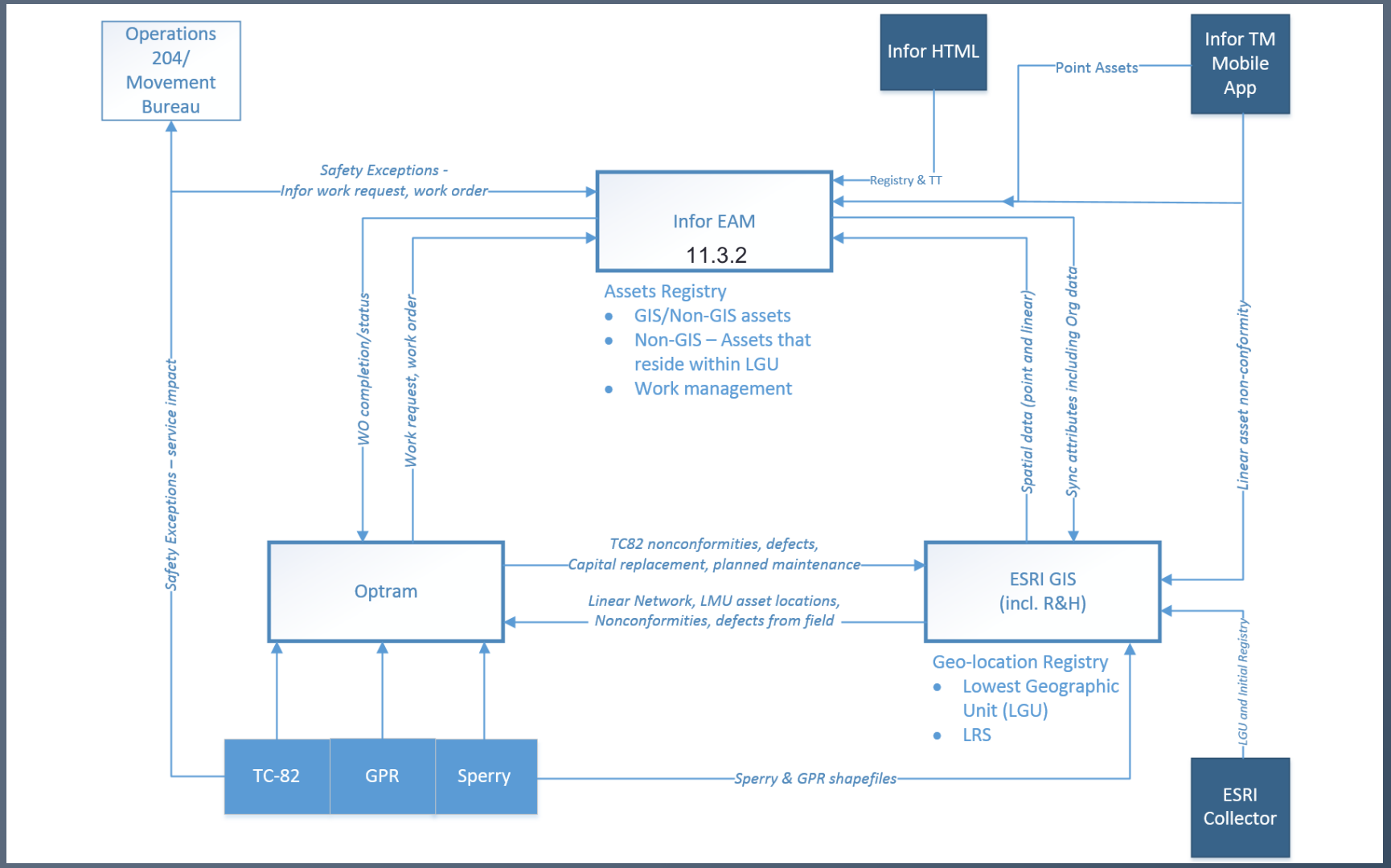
Asset Management Data

- **ASSET REGISTRY**
- Attributes
- Specifications
- Condition

Location Lifecycle and Asset Lifecycle



GIS Integration – Other Systems



Why Linear Referencing?

- Critical for MTA operations
- Varying asset infrastructure – above ground, underground, tunnels, bridges, etc
- EAM Linear requirements
- Emergency Preparedness: real time web services for FDNY, NYPD, etc.

Benefits

- Coordinated, all agency approach to develop a linear data model that fits the MTA's needs
- Improved Business
- Support the MAP-21 requirements
- Support data driven decision making and better analytical capabilities
- Integration with other systems
- Standardization
- Data Governance
- Qualitative benefits

Challenges

- No comprehensive rail data model
- Business information remains in silo and maintained in different referencing systems (Mile Post, Stationing, Chaining etc)
- Challenging or expensive integration between different systems
- Latency in propagation of updates to the system

MTA Linear Use Cases (very incomplete list)

- 1. Non-zero starting point (Segments which start at either a positive number or a negative number)
- 2. Miles which are not a mile (Short and long miles)
- 3. Gaps (Gaps in the numbering sequence)
- 4. Jumps (Jumps in the numbering sequence)
- 5. Tracks which join or separate (Track 1 becomes track 2, which then becomes track 1 again)
- 6. Lines which become another line (Harlem becoming the New Haven)
- 7. Reversals (numbering sequence reverses on itself)
- 8. Positive sequence in both directions around a zero point – Brooklyn Bridge which is a zero location and both directions head out as positives.
- 9. Chaining
- 10. Stationing
- 11. Mile Marker Positions
- 12. Changes to the physical location of a mile marker/s
- 13. Transposing Track (High side to low side of a curve)
- 14. Re-using Track (Moving to a branch line, or less used line)
- 15. Multiple Mile markers of the same value (Mile markers increase to 71, then go back to 68 and increase again – on same line)
- 16. Must accommodate ladders
- 17. Must accommodate any asset as a starting point
- 18. Must be able to create a physical route, but that physical route cannot be identified in the asset list of Infor

Criteria of Linear (very incomplete list)

1. Beginning (non-zero) measurement/stationing
2. Ending measurement/stationing
3. Stationing in feet is the fundamental measurement unit?
4. Allow base measurement relative to/from a non-”asset” reference line
5. Direction of increasing stationing (may/might be implied by ending being smaller than beginning)
6. Some way to have the segment related to other segments and reference points
7. Accommodate complex relationships like ladders, yards, interlockings, etc.
8. Allow for GAPS/Jumps in stationing
9. Short/Long milepost calculations
10. Allow for multiple mileposts with the same value.
11. Allow for measurements relative to other reference points and linear segments (signals, platforms, etc.)
12. Allow for conversion between measurement systems (stationing to/from mileposts, feet from signal to absolute stationing, etc.) – “Universal Translator”
13. Additional attribution like division, line, track, etc.

QESTIONS ?