



Modeling and Mapping Metro's Rail Stations

Minhua Wang
GIS Enterprise Architect
mwang@wmata.com

Voliya Arakkal
Sr. GIS Analyst
varakkal@wmata.com

Andrew Oldham
Sr. GIS Analyst
aoldham@wmata.com

GIS in Transit Conference 2013
October 16-17, 2013



Modeling and Mapping Metro's Rail Stations

- Project Goals & Scope
- The Challenges of Mapping Metro's Rail Stations
- Modeling of Rail Station Spaces
- Digitizing Rail Station Spaces
- Presenting Rail Station Mapping Data
- Next Step
- Conclusions



Project Goals

- Who will benefit from the rail station mapping
 - Metro Customers: navigate through a station
 - Police and First Responders: quickly and accurately locate an incidence or a crime location
 - Emergency Management Officer: define emergency evacuation plan
 - Maintenance Crew:
 - Find where is an asset or where is a work site and how to get there
 - Find where is the closest storeroom with the required equipment and parts
 - Maintenance Manager:
 - Dispatch crews based on crew locations and work site locations
 - Calculate work load and required materials based on area, length measurements: e.g., square footage for landscape maintenance



Project Scope

- Two dimensional Floor Plan Space Mapping, including station interior, exterior and parking garages
- Space object definition is based on space usage
- The relationships between space objects include spatial relationship (hierarchy, association, etc.), as well as topological relationship such as connectivity (or adjacency)
- Deliverables
 - A model of Metro rail station spaces
 - 40 different ArcGIS feature classes for total of 91 station
 - Taxonomy of standard rail station locations



Challenges

- How to define rail station spaces
 - Rail station structure is so complex: multiple levels serving multiple purposes with different structures
 - Each station is unique in space configuration and level structure
 - Station interior, exterior and parking garage are so different in terms of structure and usage
- Data sources
 - Old design as-built drawings may not reflect the current usages
 - Most as-built drawings are scanned images, not digital CAD drawings, not georeferenced, many are “cartoon” drawings (not to scale, and not to true measurement)
 - The as-built drawings were delivered by multiple contractors with different design standard
 - No design drawings for exterior spaces for most stations
- Knowledge and skill requirements
 - Knowledge of floor plan design
 - Understanding of as-built drawings
 - Skills in converting engineering drawings to GIS features



Modeling of Rail Station Spaces

- Facility Spatial Data Model
 - ESRI Facility GIS Model
 - BIM model
- WMATA Rail Station Space Data Model
 - Station Interior
 - Station Exterior
 - Parking Garage
 - Rail Station Domain
 - Space-Asset relationships
- Rail Station Location Taxonomy
 - Space object relationships
 - Standard codes and names
 - Location Hierarchy



WMATA Rail Station Mapping Data Model

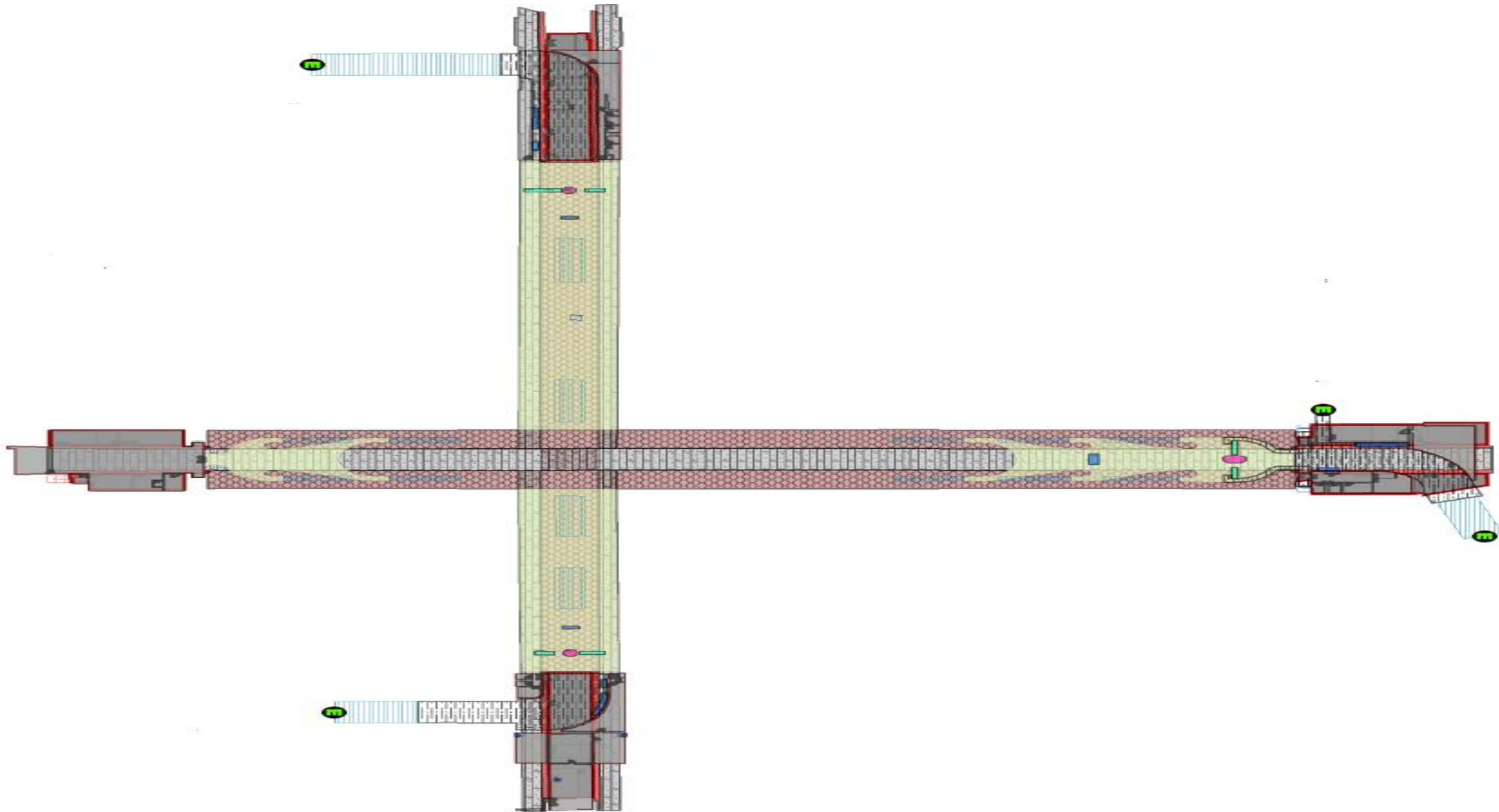
- Rail Station Interior

- Mezzanine
- MezzanineZones
 - Kiosk
 - FareGateArea
 - FareCardVendingMachineArea
 - PaidArea
 - OpenAccessArea
- Rooms
- RoomDoor
- Passageway
- Platform
- PlatformEndGate
- ElevatorBank
- EscalatorBank
- SafetyWlak
- ServiceRoomFloor
- Stairways
- Trackbed

- Rail Station Exterior

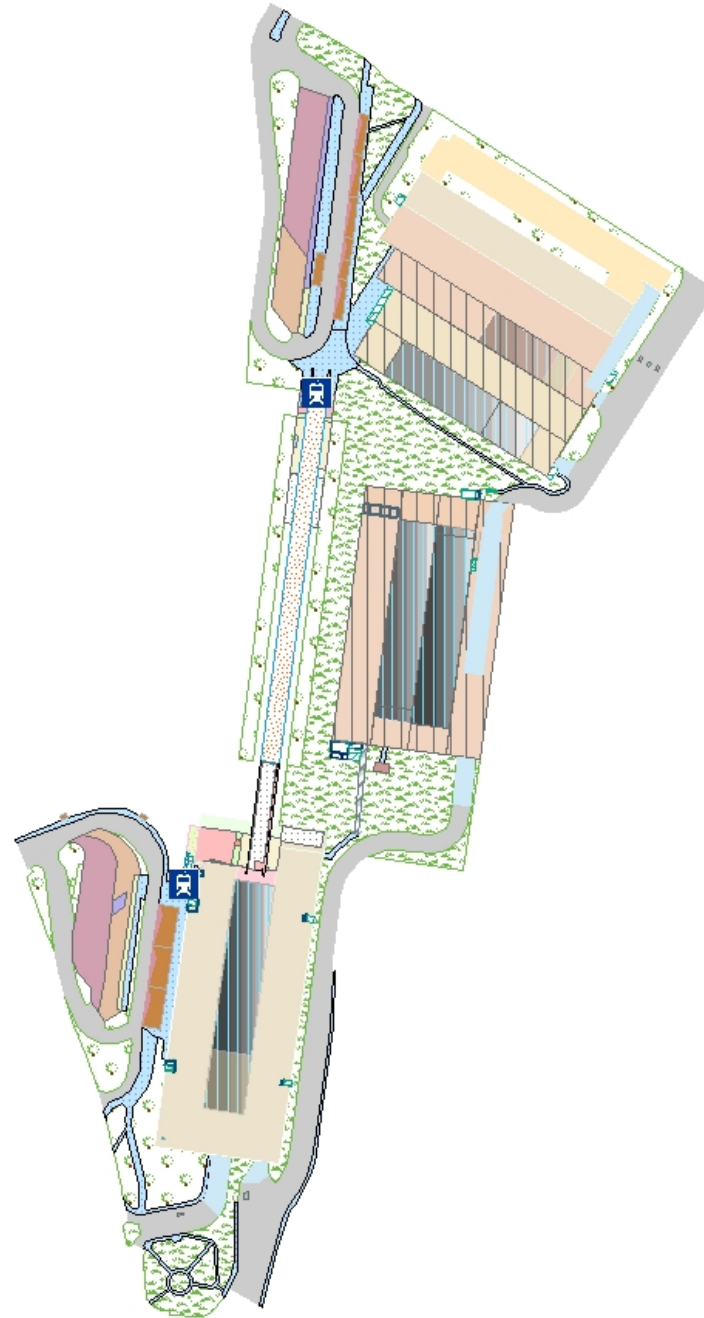
- StationEntrance
 - Pavilion
 - Busbay
 - PassengerWaiting Area
 - KissRide
 - PedestrianBridge
 - PedestrianWalkway
 - SideWalk
 - ParkingLot
 - EntranceGate
 - Landscape
 - Lawn
 - Roadbed
 - OutstationStructure
 - OffsiteFacility
- Parking Garage
 - GarageRamp
 - ParkingGarage
 - ParkingGarageLevel

Rail Station Interior Spaces





Rail Station Exterior Spaces





Digitizing Rail Station Spaces

- Standard definitions
 - Feature definition
 - Feature attribute list and definitions
 - Standard code and naming conventions
- Workflow management
 - Source data collection: as-built drawings
 - Feature markup
 - Field verification
 - Georeferencing
 - Feature capture
 - Attribute population
- Field Verification
 - Feature definition
 - Feature relationships
 - Feature attributes
- QA/QC process



Presenting Rail Station Mapping Data

- 2-D Map Display
 - Layer Structure representing multiple levels
- 3-D Model for Rail Station
 - 3-D Floor Plan Display
- Taxonomy Search
 - Location hierarchy search
 - Single code search

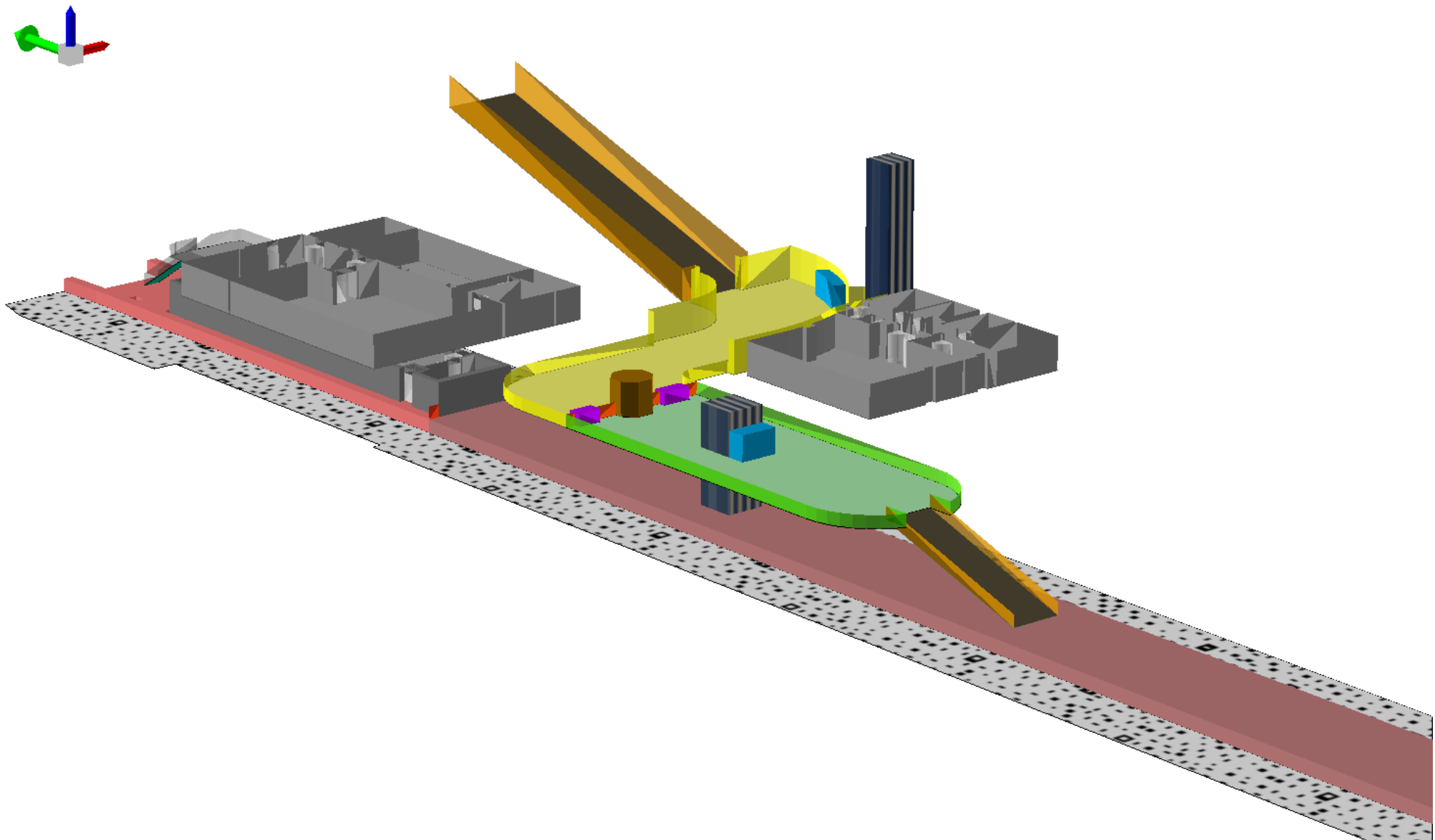


2-D Map Display





3-D Map Display





What's Next?

- Emergency Exits and Rescue Areas
- Rail Station Asset Mapping: e.g., camera, detection device, emergency equipment, etc.
- 3-D Access Paths and 3-D Rail Station Mapping
- 3-D Routing
- Rail Station Evacuation Modeling



GIS-Based Rail Line Asset Viewer

DEMO



Conclusion

- The purpose of this project is to map 2-D space usages of the Metro stations for location references
- Due to the complexity of station structure and space configuration, an 2-D station mapping data model has been developed to capture features at different levels of structures in both interior and exterior of a station
- The outcome of this project has significant benefits for police and first responders, maintenance crews, as well as customers to locate assets, incidents on a station and navigate through a station



GIS-Based Rail Line Asset Viewer

Questions?

Thank You!