



Smart Columbus

Powered by Integrated Data Exchange (IDE)



THE CITY OF
COLUMBUS
ANDREW J. GINTHER, MAYOR

Department of Technology
Shoreh Elhami, Director, GIS/IDE Program Manager



Translational Data Analytics Institute
Christopher Stewart, Faculty-In-Residence

Smart Columbus

Confluence of Civic, Research & Startup Cultures

- Winner \$40M DOT Smart City Challenge
- \$367M investment local businesses & partners
- \$93M for research
(largely from The Ohio State University)
- \$10 M Vulcan Inc.

Paving the Way Through Radical Collaboration

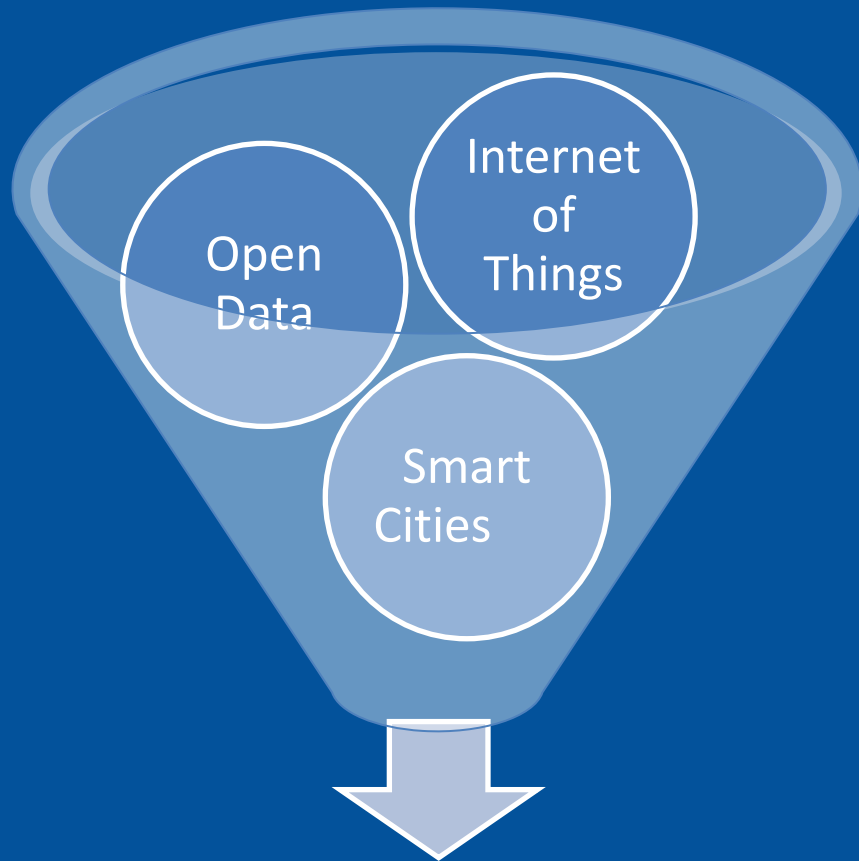


THE CITY OF
COLUMBUS
ANDREW J. GINTHER, MAYOR



“Smart Columbus is just the start. There is a lot to this program no one has ever done before.”
Mayor Andrew Ginther, 2016

Confluence of 3 Disruptive Data Trends



Smart Columbus

Anyone can access, understand, use and share
Open Data

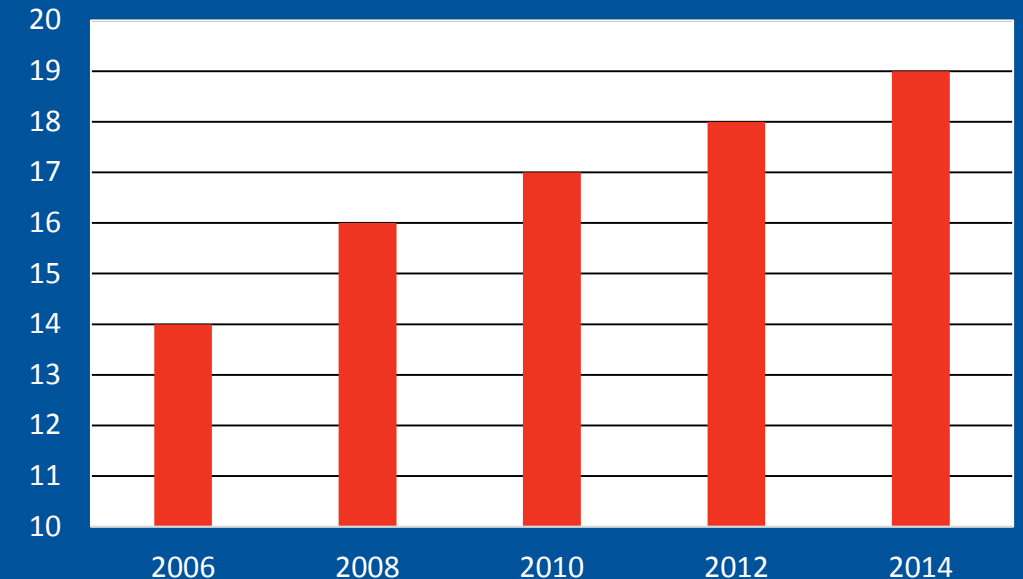
IoT: Devices embedded in the physical world—
e.g., bodies, busses, and businesses

Smart cities actively collect data and adapt
policies and services to make citizenry
successful

Data Flows From and Through Cities



Central Ohio Transit Authority Ridership
(Millions of Rides Per Year)



- **Public-Private Partnerships: COTA is funded by 0.5% sales tax through 2019**
- **Starting 2017, On-board Wi-Fi will produce 4.7 TB per month**
- **How does the city ingest, analyze and use all of this data?**

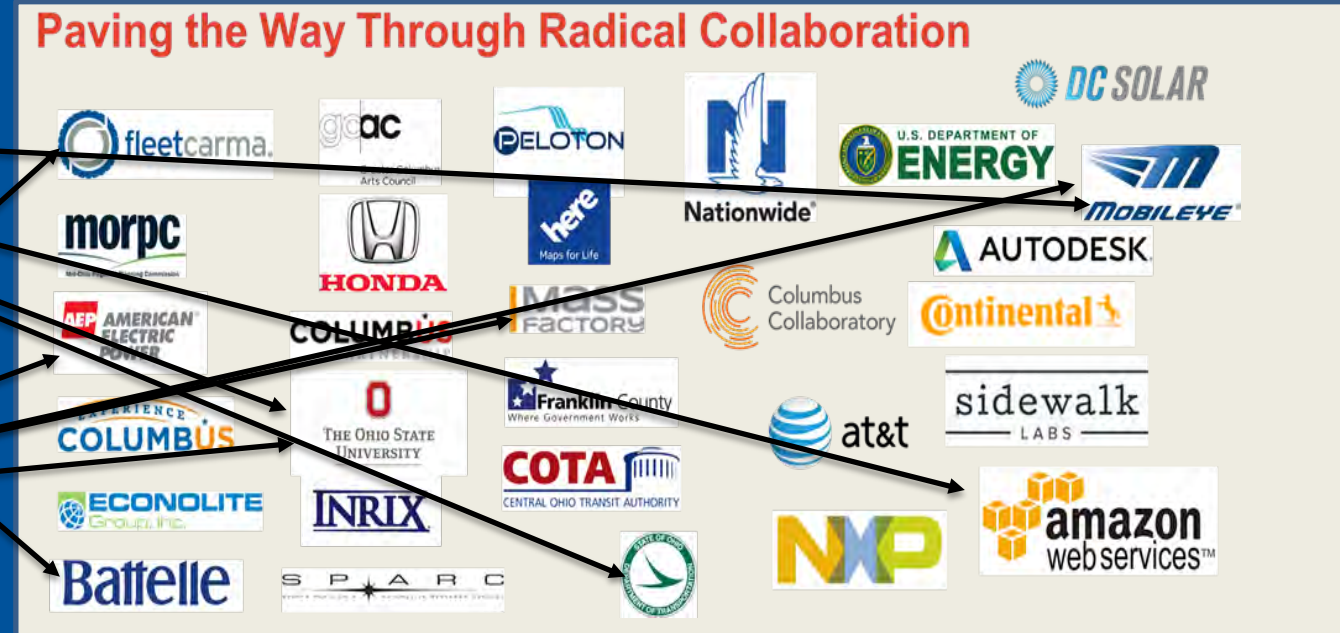
Smart City Applications Abound



- CoGo opens trip data
 - <https://www.cogobikeshare.com/system-data>
 - Discover new bike paths
 - Over-provisioned and under-provisioned paths
 - Activity levels of citizens



Who rises to the challenge? Who makes Smart Columbus?



Challenges: Align For-Profit and Not-For-Profit Incentives, Find people with the right skills, Politics

Any problem in computer science can be solved with another level of indirection.

David Wheeler, 1993

Who rises to the challenge? Who makes Smart Columbus?

- Solution: The city needs a system to (1) manage data resources from multiple sources and (2) provide a common interface for application developers & researchers using data
- **Integrated Data Exchange (IDE)**
 - Collect data from multiple sources (IoT), govern access, ensure privacy and enable analysis (data API)
 - Moving data is a new city service



Integrated Data Exchange Benefits/Challenges

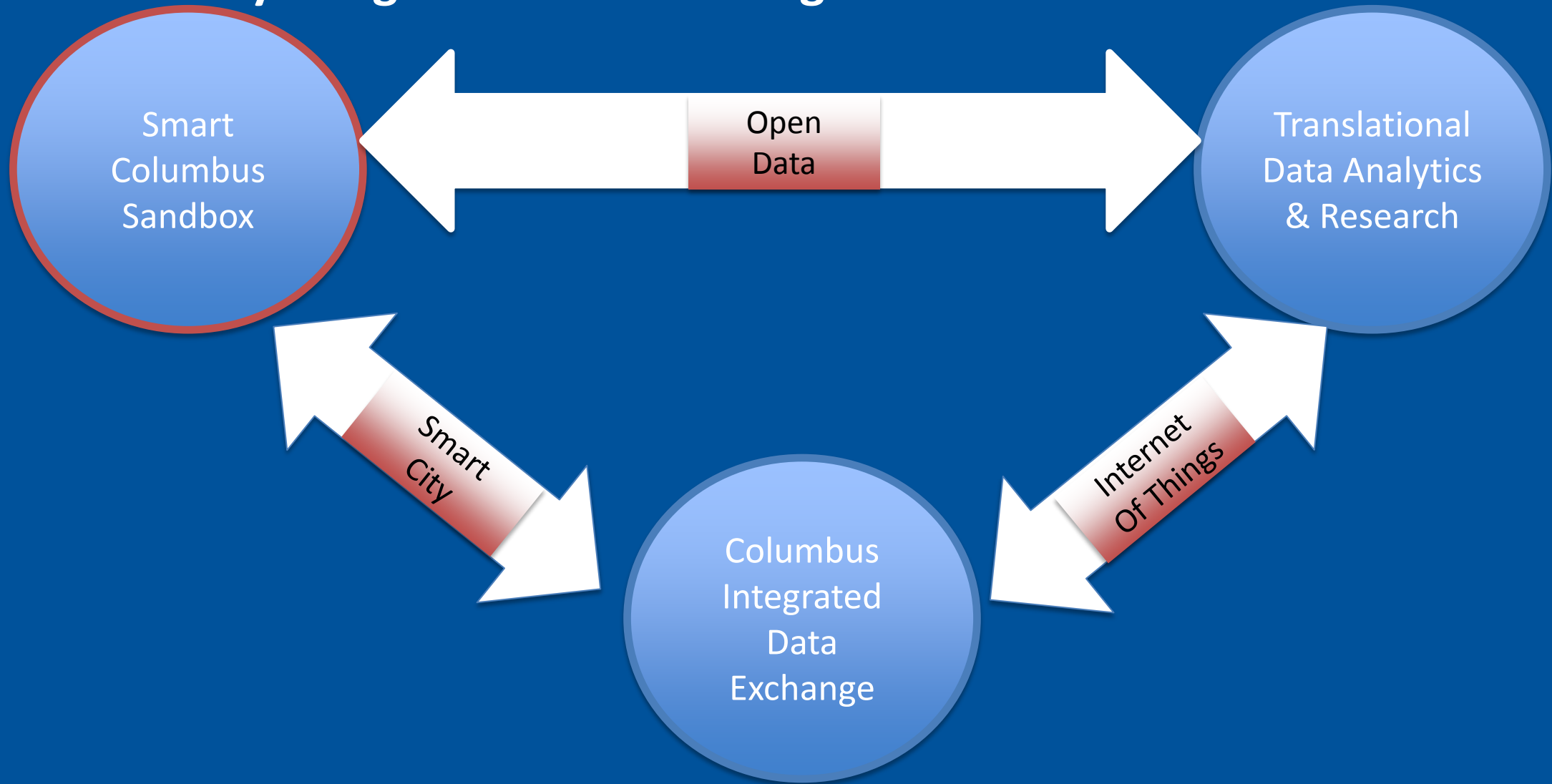
IDE makes application developers and entrepreneurs the bottleneck, **not data access**

IDE makes researchers and IoT builders the bottleneck, **not integration**

- Challenges
 - Provide security
 - Provide fair access to the public
 - Protect the public from dangerous analysis
 - Protect the city from legal problems
 - Scale to support city-scale data ingest
 - Scale to support city-scale IoT

Smart Columbus Partnerships

Powered by Integrated Data Exchange



Giving developers access to Smart City datasets

- Smart Columbus Sandbox brings together entrepreneurs, developers to use existing open data sets



Parking Startup: Easton Mall Pitch



Request Reply Semantics

```
apiKey  
sensor_group  
sensor_zone  
start_time  
end_time
```

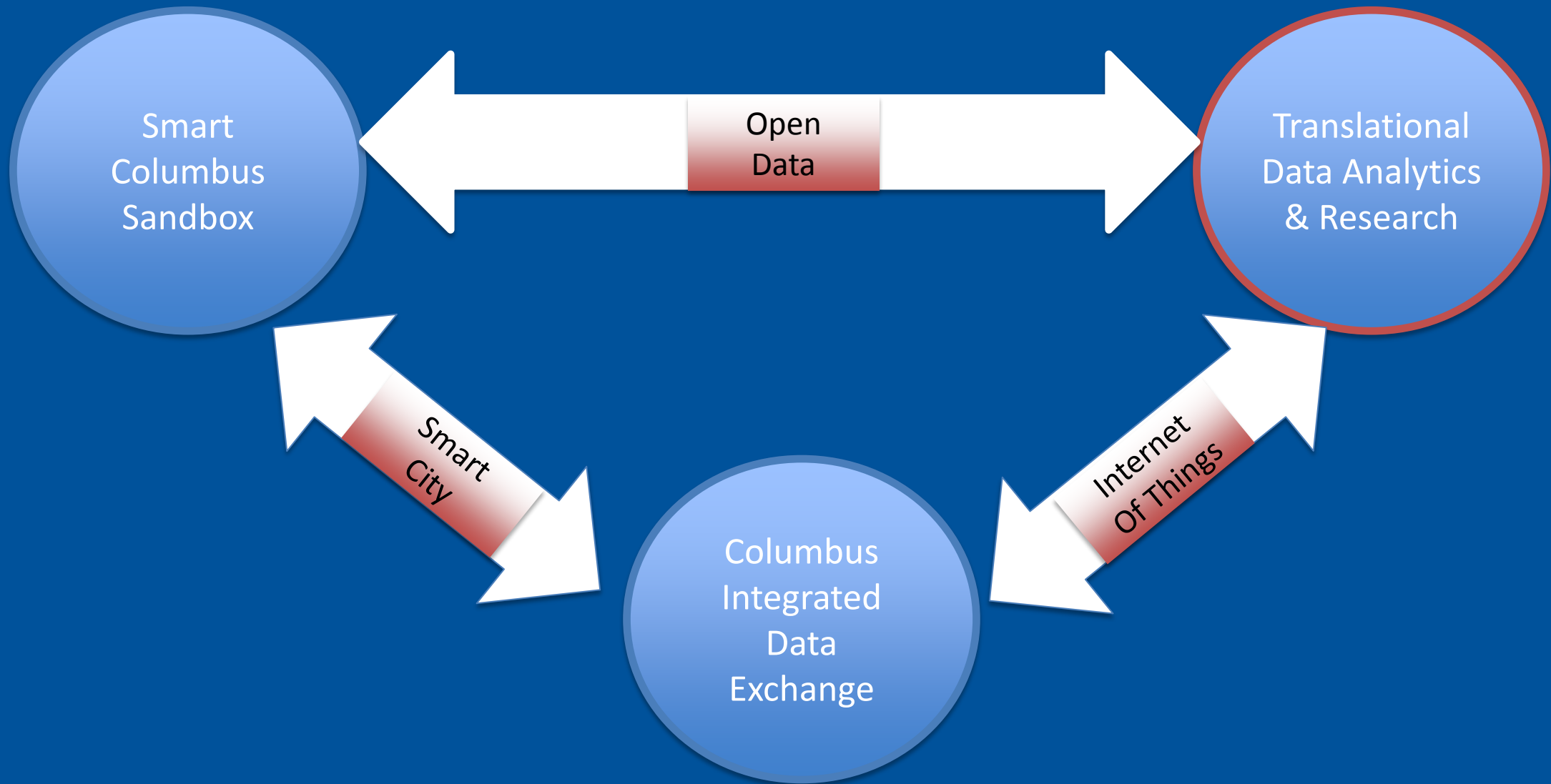
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"result": "success", "trafficCounts": [  
  {  
    "reading_time": "2017-01-01 11:00:00",  
    "occupancy": "2.36", "volume": "65", "median_speed": "0\r"  
  }, {  
    "reading_time": "2017-01-01 12:00:00",  
    "occupancy": "3.38", "volume": "93", "median_speed": "0\r"
```

Early Success: A Hack-A-Thon

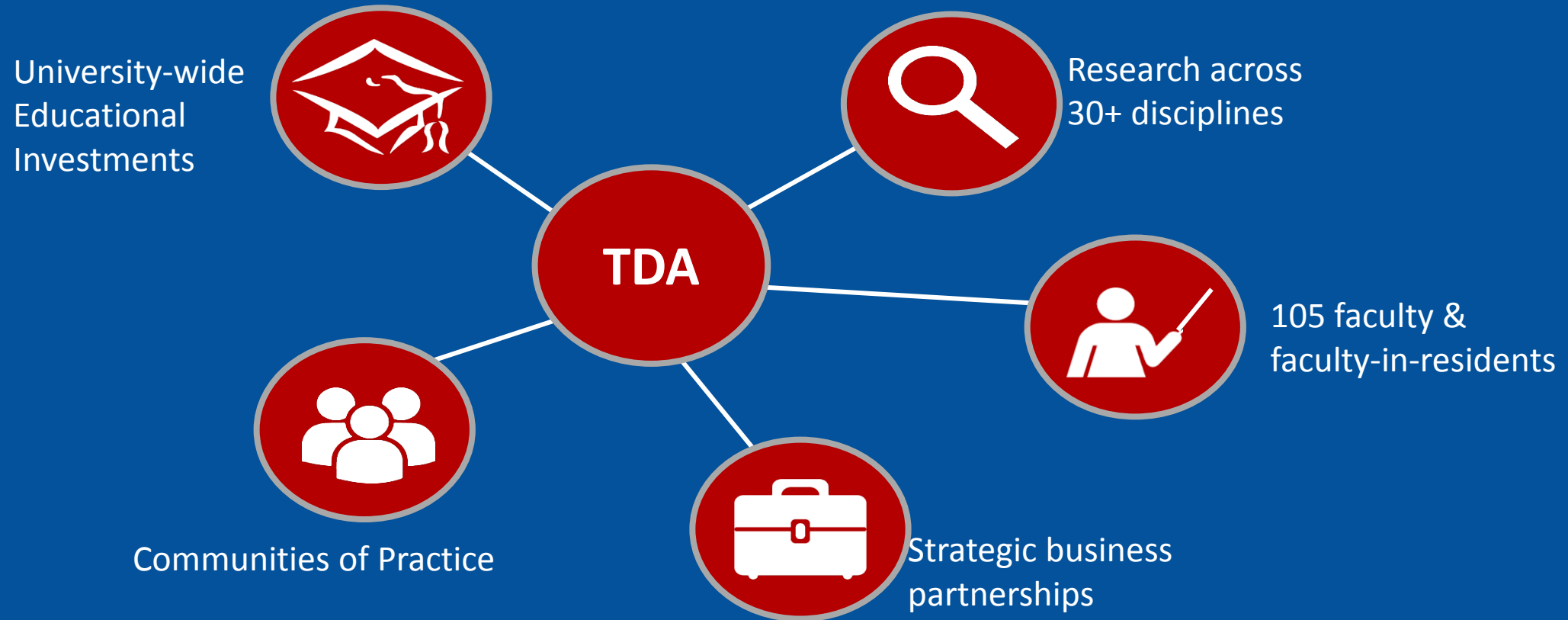
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Smart Columbus Partnerships



Translational Data Analytics Institute (TDAI) is the foundational element of the University's \$500 million investment into Discovery Themes.



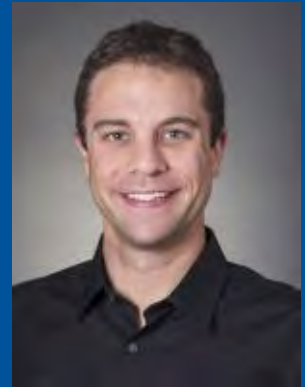
TDAI Community of Practice – Smart Cities



Harmony Bench

What modes, networks, and types of transportation link performers within a city

- (1) Collect GPS and sensor data from IoT embedded in transit vehicles (e.g., phones & wi-fi access points)
- (2) Model and manage demand, using OSU COTS testbed for future deployment in COTA

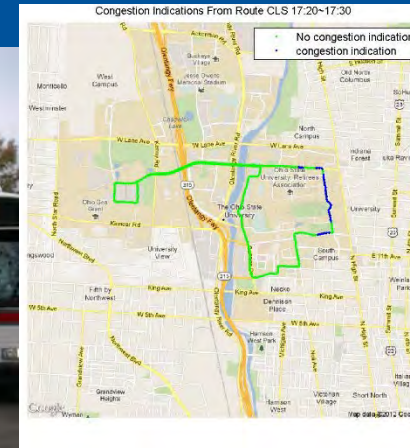


Andre Carrel – Public Transportation



Prof. Anish Arora

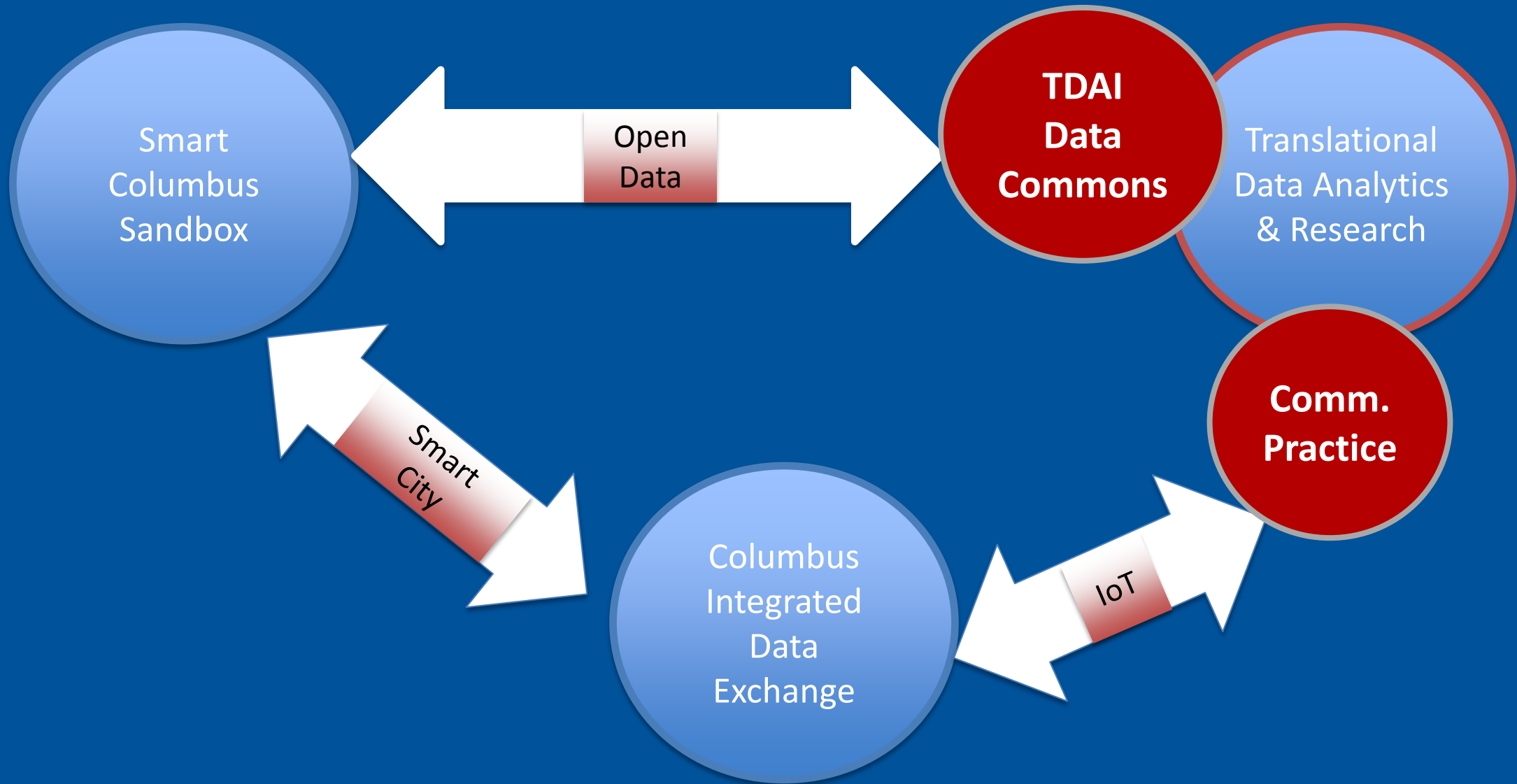
Battery powered radar mesh networks for pedestrian and bicycle identification & wireless, sensor networks to expand Internet access passively & cost effectively



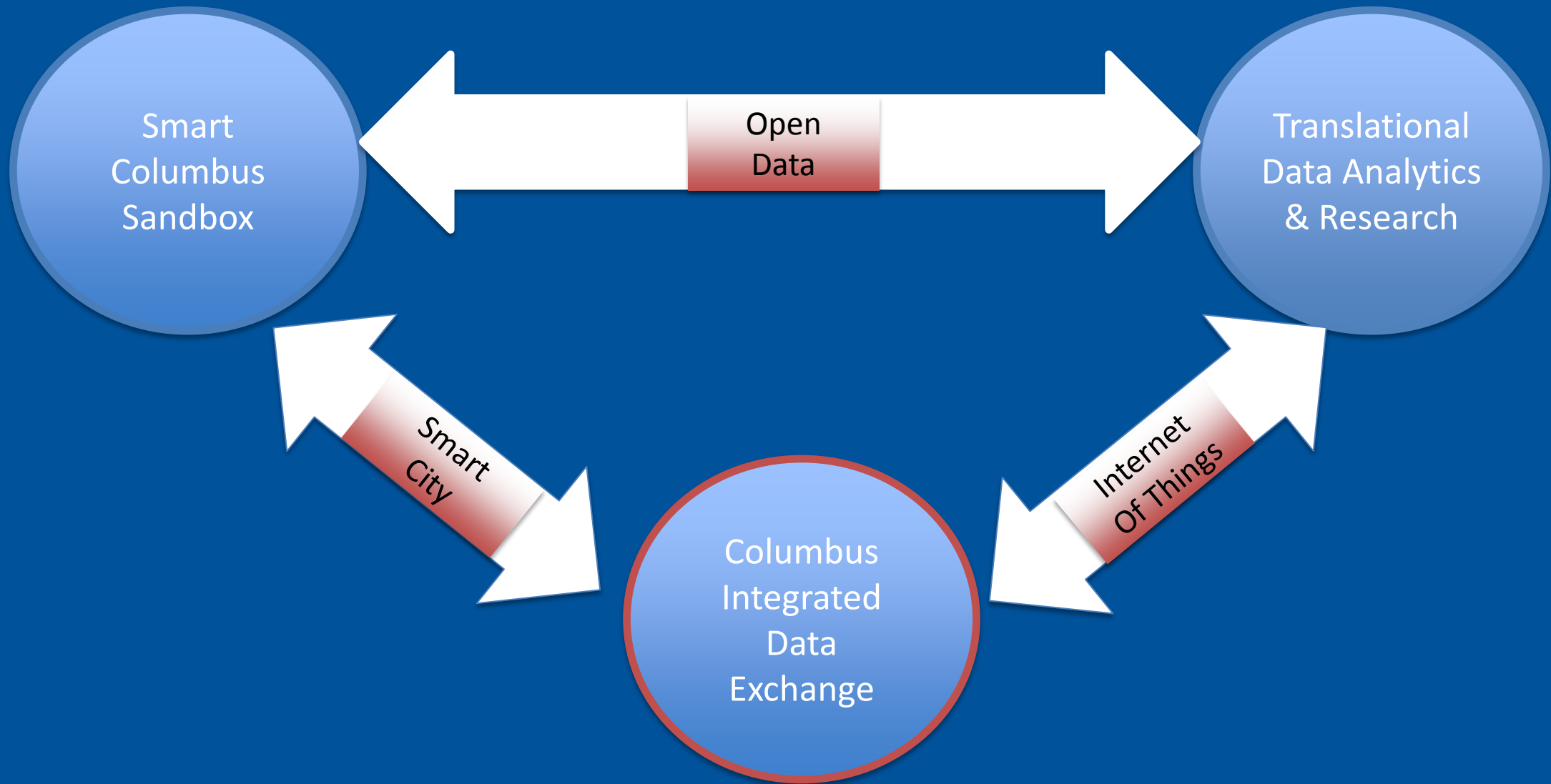
Smart Campus Testbed - Prof. Rabi Mishalani

Route planning and fleet management using video & other sensing and tracking technologies.

Smart Columbus Partnerships



Smart Columbus Partnerships

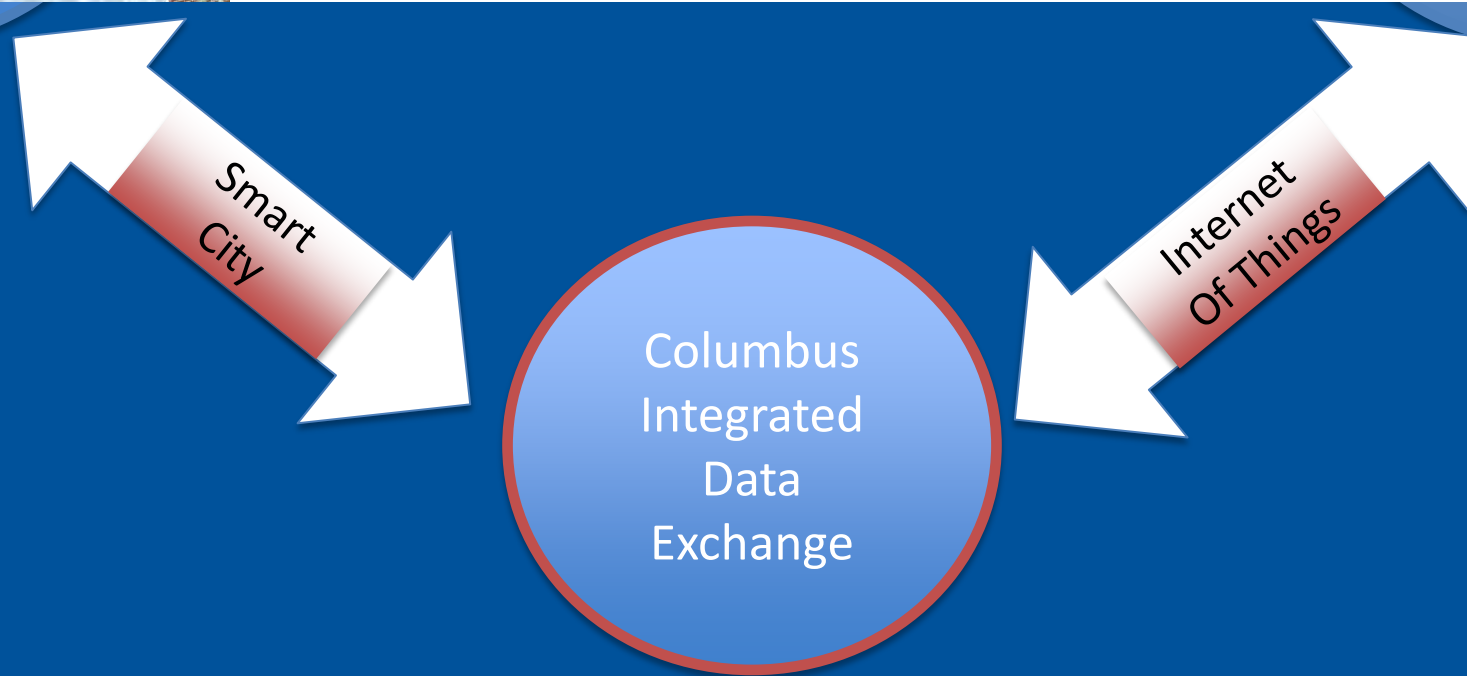


Smart Columbus Partnerships



“The big play and leverage point for us is that internet of things space. But the only way we get there is making sure that we have a secure, sound, accessible integrated data exchange that’s going to stand the test of time.”

Mayor Andrew Ginther, 2017



SMARTCOLUMBUS

OUR VISION



The City of Columbus "Smart Columbus" vision won the **U.S. Department of Transportation \$40 million Smart City Challenge** in June, 2016 after competing against 77 cities nationwide to implement a holistic vision for how technology can help all residents to move easily and to access opportunity. Columbus was also awarded an additional **\$10 million grant from Paul G. Allen's Vulcan Inc.** to reduce greenhouse gas emissions through the decarbonization of the electric supply and transport sectors.

Smart Columbus aspires to:

- Improve **access to jobs** through expanded mobility options in major job centers
- Compete globally through **smart logistics**
- **Connect Columbus residents** to safe, reliable transportation that can be accessed by all
- Better **connect our visitors** to transportation options
- Develop a more environmentally **sustainable transportation** system

THE COLUMBUS WAY

Columbus has built an unprecedented culture of collaboration. By knocking down silos and building partnerships, Columbus has quickly become one of the fastest growing cities in the country, leading the Midwest in job and wage growth. The City of Columbus is matching the USDOT and Vulcan grants with more than **\$360 million in pledges** from public and private sector partners.

OUTCOME: A SAFER, MORE MOBILE AND SUSTAINABLE CITY

Columbus will become the nation's epicenter for intelligent transportation systems (ITS) research to improve safety, enhance mobility, create ladders of opportunity for those who may have been left behind in the past, and reduce emissions.



U.S. Department
of Transportation

[transportation.gov](https://www.transportation.gov)

columbus.gov/smartcolumbus

vulcan.com



SAFETY



MOBILITY



OPPORTUNITY



DECARBONIZATION





VISION

ACCESS
TO JOBS

SMART
LOGISTICS

CONNECTED
RESIDENTS

CONNECTED
VISITORS

SUSTAINABLE
TRANSPORTATION

ENABLING
TECHNOLOGIES



Columbus Connected
Transportation Network
(CCTN)



Integrated Data
Exchange



Enhanced Human
Services



Electric Vehicle
Infrastructure

DEPLOYMENT



RESIDENTIAL
DISTRICT



COMMERCIAL
DISTRICT



DOWNTOWN
DISTRICT



LOGISTICS
DISTRICT



SAFETY



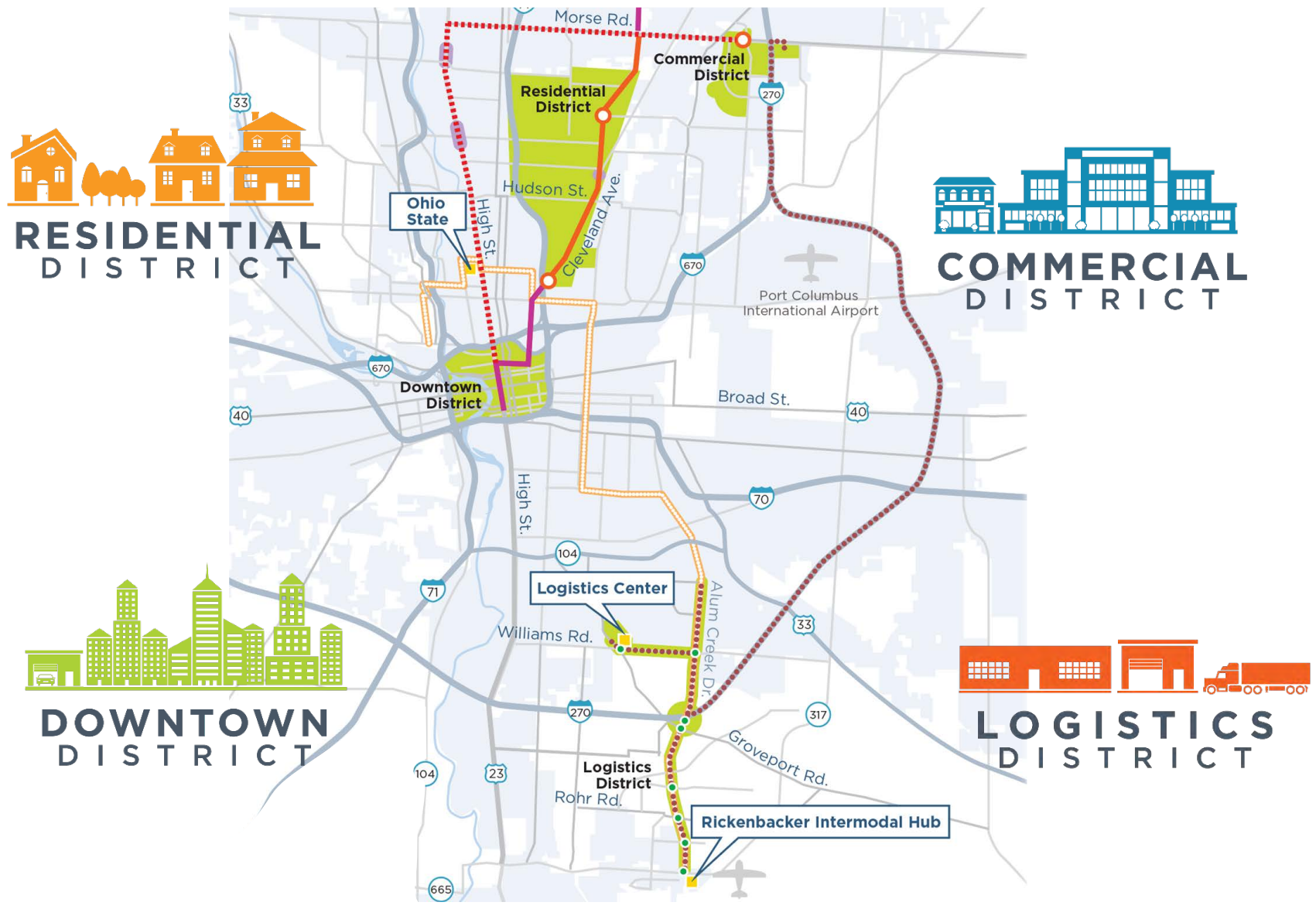
MOBILITY



LADDERS OF
OPPORTUNITY



CLIMATE
CHANGE





Common Payment System



Multi-Modal Trip Planning Application



Smart Mobility Hubs



Mobility Assistance for People with Cognitive Disabilities

Smart Street Lighting

Pedestrian Collision Avoidance



Connected Electric Autonomous Vehicle



- Electric Autonomous Transit Shuttle
- Automated Routes
 - COTA to logistics
 - Transit center to corporate campus
 - Remote parking to retail center



**Delivery Zone
Availability**

**Enhanced Permit
Parking**

**Event Parking
Management**





LOGISTICS
DISTRICT

Truck Platooning

Oversize Vehicle Routing

Interstate Truck Parking Availability





15 Projects (USDOT Grant)

ENABLING SYSTEMS & APPLICATIONS

- CONTROL SYST & APP
- DATA MGT PLATFORM
- PUBLIC APPLICATIONS

CCTN	1 Connected Vehicle Environment	2 Smart Street Lighting	3 Transit Pedestrian Collision Avoidance System	
IDE	4 Integrated Data Exchange (IDE)			

DISTRICTS

RESIDENTIAL	5 Common Payment System	6 Multi-Modal Trip Planning Application	7 Smart Mobility Hubs	8 Mobility Assistance for People with Cognitive Disabilities
COMMERCIAL	9 Connected Electric Automated Vehicle			
DOWNTOWN	10 Delivery Zone Availability	11 Enhanced Permit Parking	12 Event Parking Management	
LOGISTICS	13 Truck Platooning	14 Oversize Vehicle Routing	15 Interstate Truck Parking Availability	

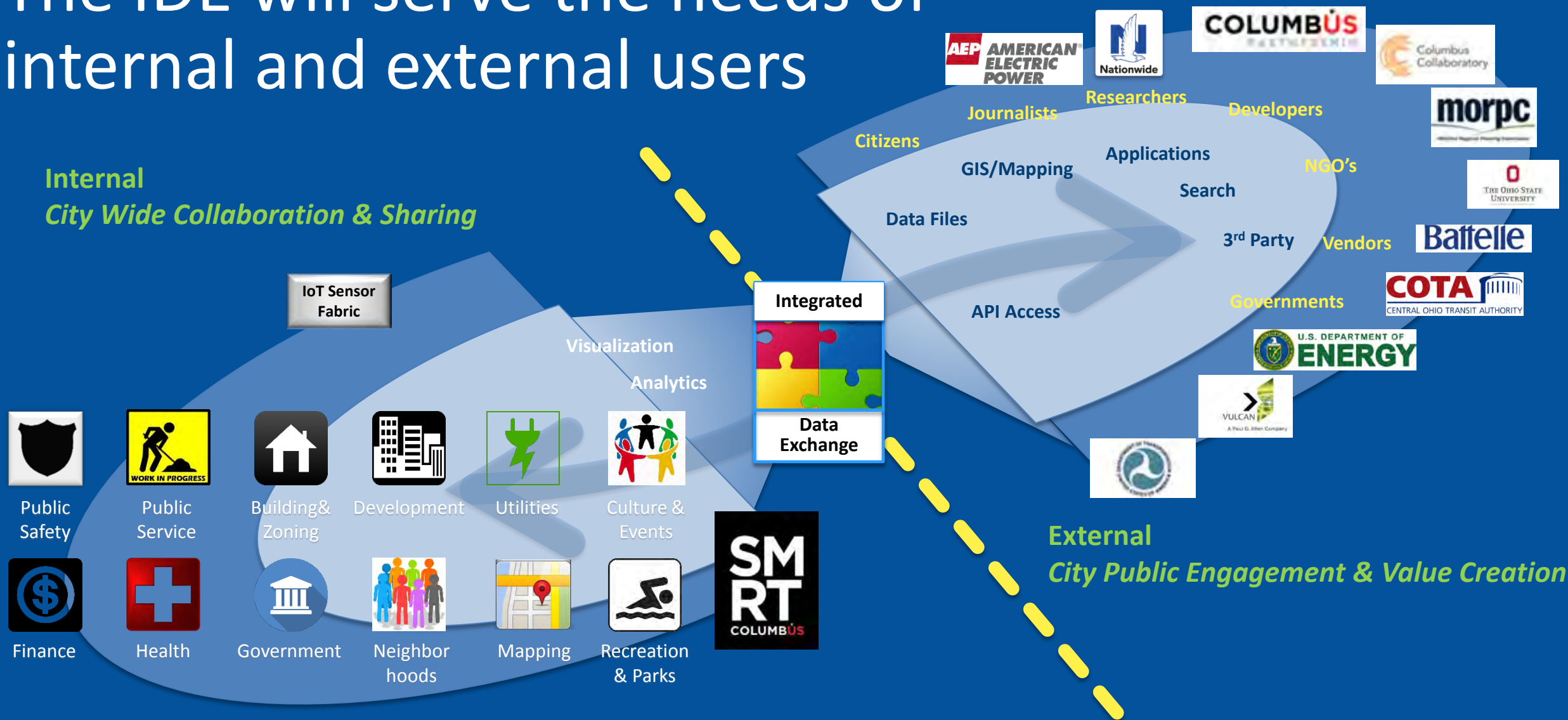


Integrated Data Exchange Vision

*The IDE is a web based dynamic **governed platform** at the heart of the Smart Columbus data environment that integrates data and data services from multiple sources and tenants, including the planned Smart Columbus technologies and traditional transportation data. The IDE embodies an **open-data approach** using best of breed technologies, including both **open-source** and **commercial off the shelf** components to enable better decision-making and problem solving for all users to support a **replicable, extensible, sustainable** platform for data ingestion and dissemination. The IDE drives performance metrics for program monitoring and evaluation.*



The IDE will serve the needs of internal and external users



Integrated Data Exchange: Nascent to Exemplar?

Starting Premise: We don't know what we don't know

BLUF: Other governments are ahead of us, we need to learn from them

Understanding Data Management: Are There Reference Architectures?

BLUF: It isn't just about a place to store data

Seeking Exemplars: What Can We Learn From Other Governments?

BLUF: Data quality and governance matter

Open-Source: What Can We Learn From Proprietary Solutions?

BLUF: Nobody has all the answers, but architectures are similar



Challenge: Current Data Environment



- No Catalog of Data Sources
- Point to Point Integration is Messy
- Data is Not Shared
- No Universal Data Quality Processes
- Data Tethered to Applications
- Change is Risky, Expensive and Time Consuming

Cities As Data Owners

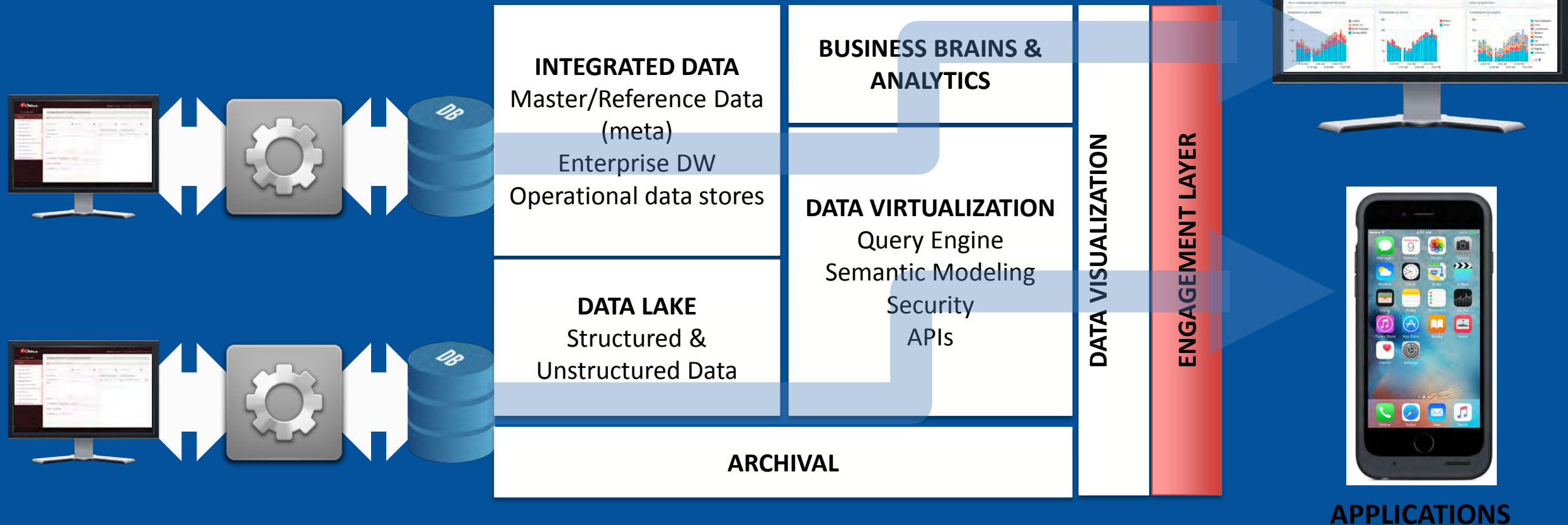
- Information Technology in organizations has evolved primarily as a means to:
 - Automate business processes
 - Enable better decisions
- For most “users” of IT systems, the data is the “application”
- Cities have massive amounts of data within their information technology systems
- City of Columbus has approximately 500 software applications and Terabytes of data





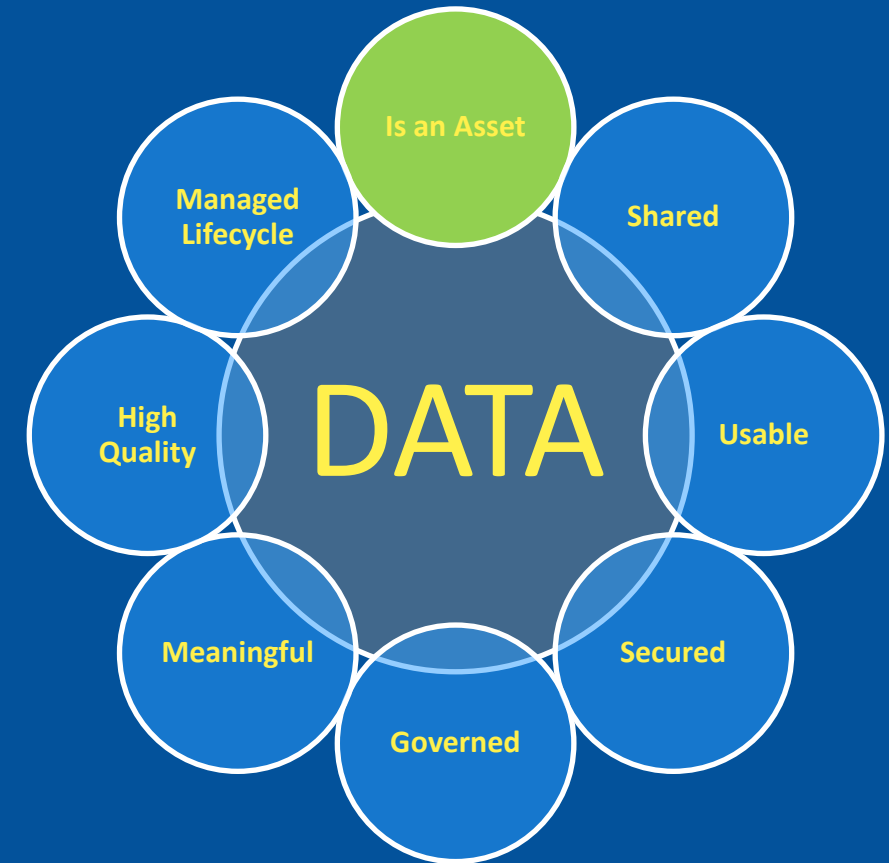
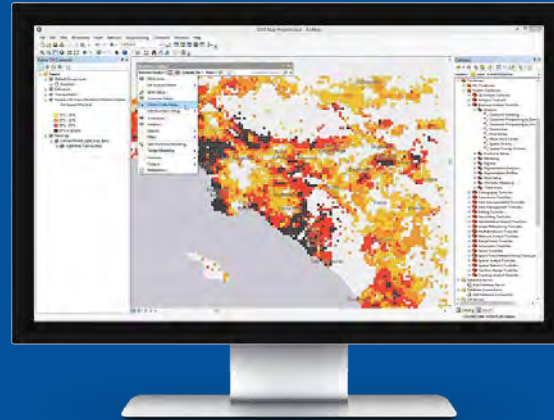
Lessons Learned: Data Management Architecture

RESEARCH



Lessons Learned: Treat Data as an Asset (Governance)

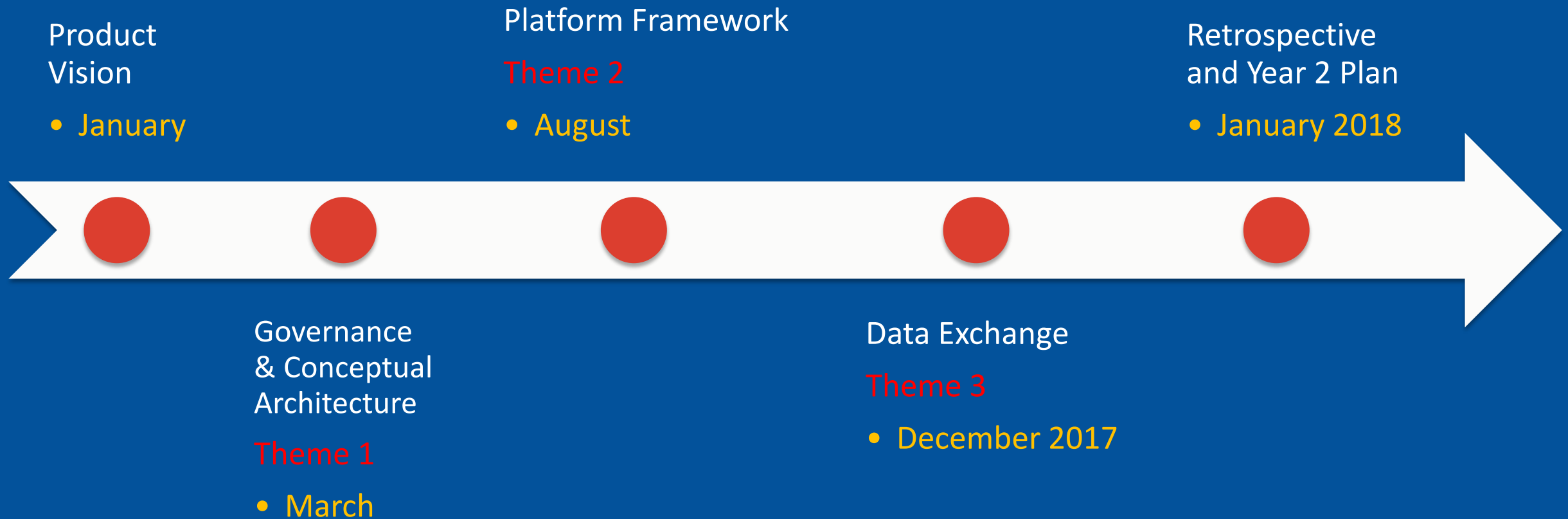
The City's data is an asset. Like any physical asset it must be properly managed and maintained by **people**



ENGAGEMENT LAYER

Road Map: IDE Initial Development Plan

Thematic Targets (2017)



IDE Development (as of June 2017):

Theme 1: Governance & Conceptual Architecture

2-Day Workshops, User Stories: 14, Chores: 4, Artifacts: 32

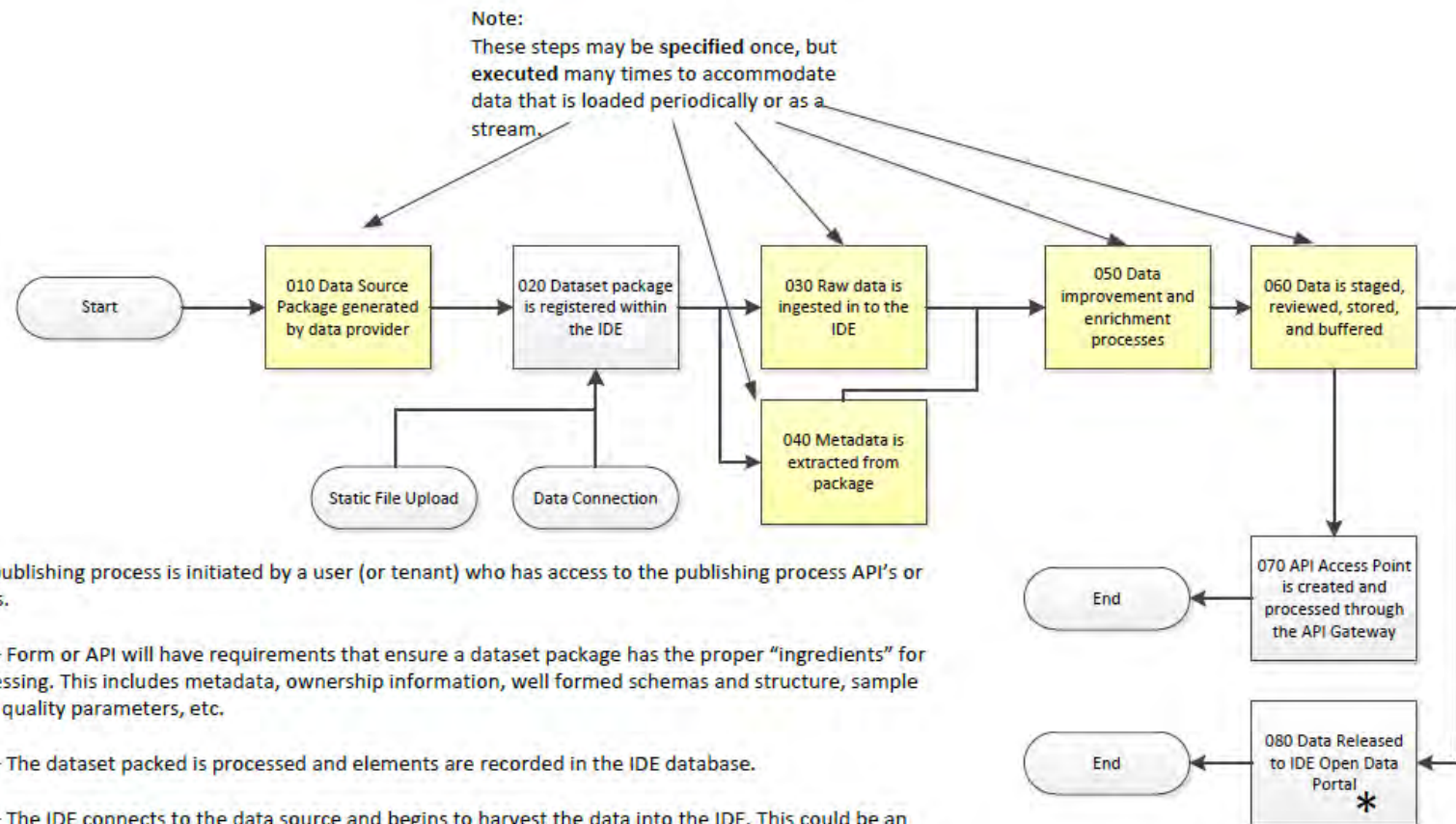
Theme 2: Platform Framework

2-Day Workshops, User Stories: 16, Chores: 10, Artifacts: >20

Theme 3: Digital Exchange

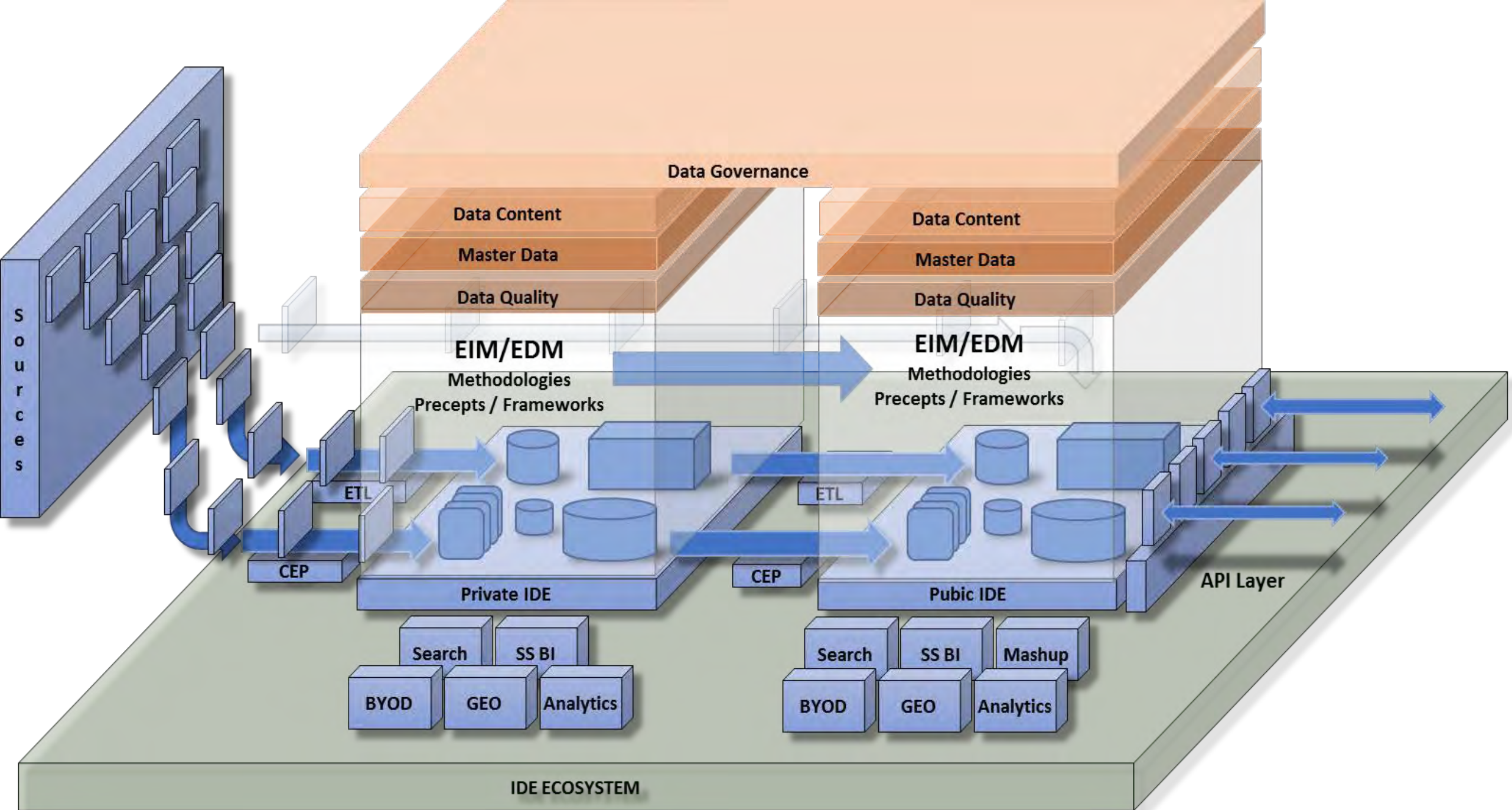
Theme 1 Artifacts

- Architecture Evaluation Criteria - Data Publishing Process



* It is yet to be determined how periodic data set releases will be handled. There are both technical and policy questions involved. There are several basic approaches, including:

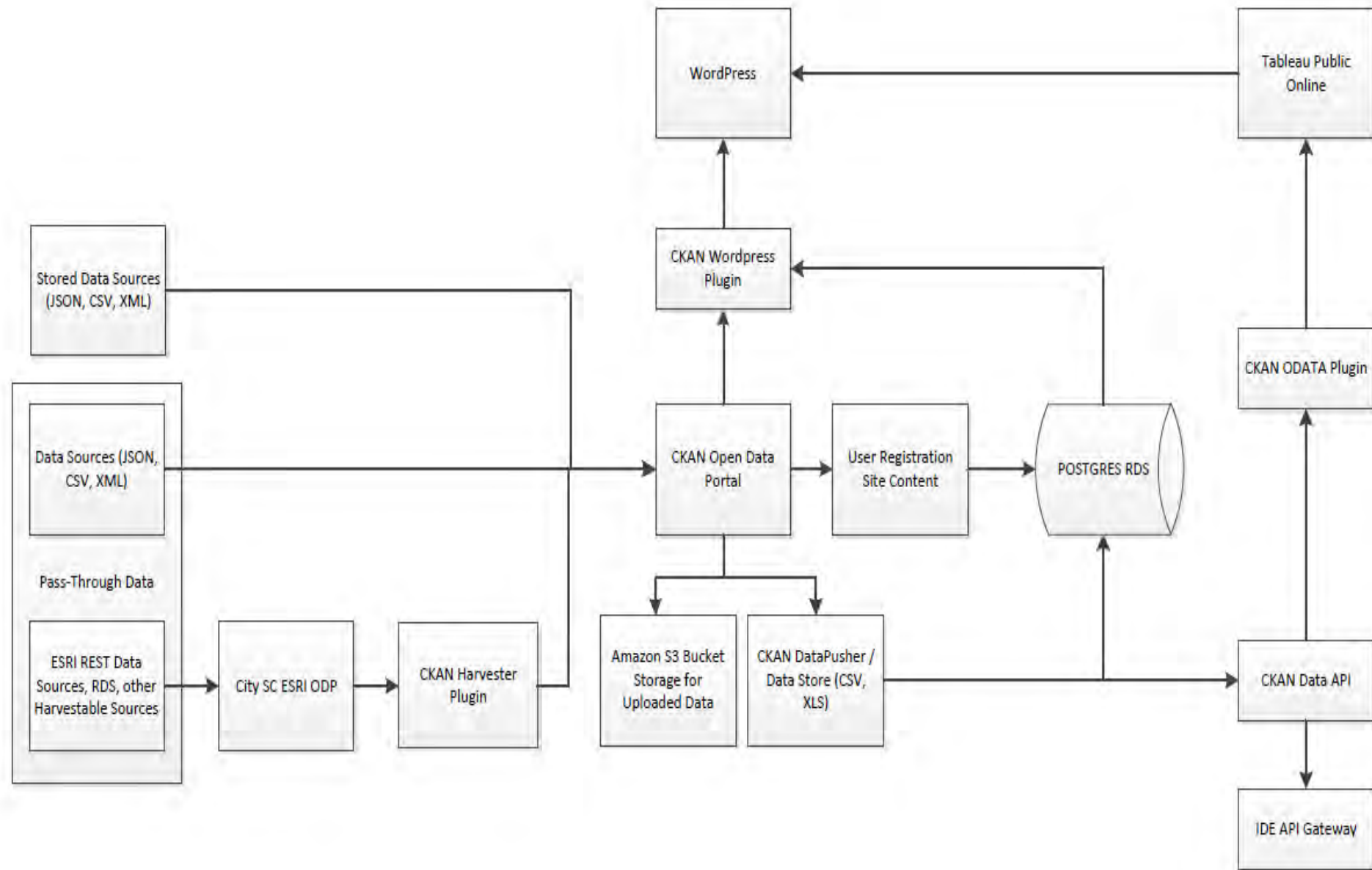
- Replacement
- Appending
- Versioning
- Updating in place



Theme 2 Artifacts:

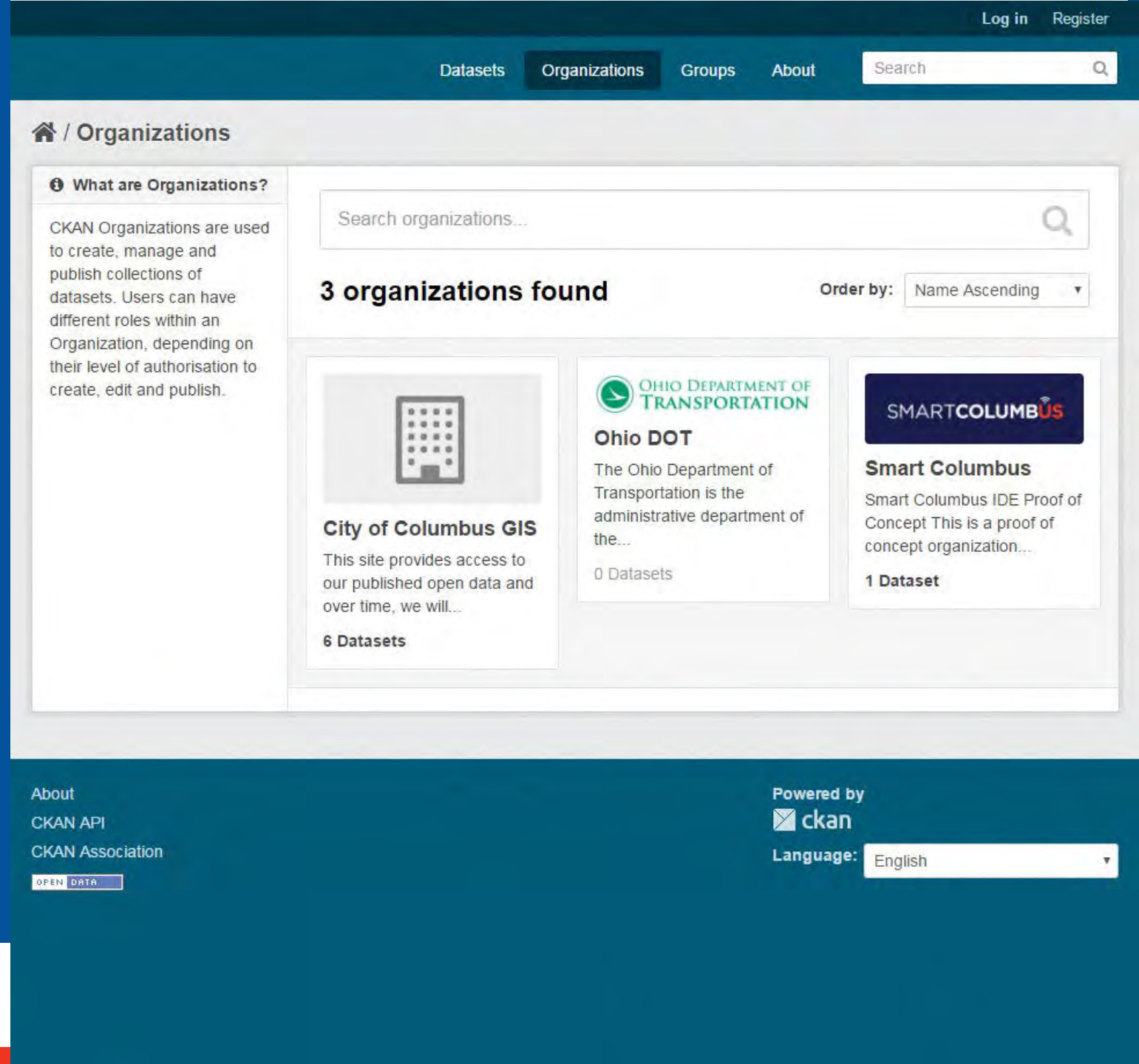
Three Tracks:

- Open Data Portal
 - Subscribed API's
 - Data Management Platform
-
- Deployed Open Data Portal Framework



Theme 2 Artifacts

- Open Data Portal (CKAN)
- Data available in different formats
- Multiple tenants



Extending Engagement: Work Group Matrix

- Data Governance
- Data Architecture
- Data Asset Development
- Data Quality
- Data Analytics
- Cyber Security & Privacy
- Infrastructure
- Business Management
- Resource Dev & Education
- Community Engagement
- Data Sharing Policy & Laws
- User Experience

Plan			Build			Run		
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
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City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners
City	Vendor	Partners	City	Vendor	Partners	City	Vendor	Partners

Question & Answer

Chris Stewart: cstewart@cse.ohio-state.edu

Shoreh Elhami: shelhami@Columbus.gov

Sam Orth: hsorth@Columbus.gov

If you want to change outcomes, you need to realize that outcomes are the result of systems. Not the computer systems, but the way people work and interact. And these systems are the product of how people think and behave. So, if you want to change outcomes, you have to change your systems, and to do that, you have to change your thinking.

John Morgan