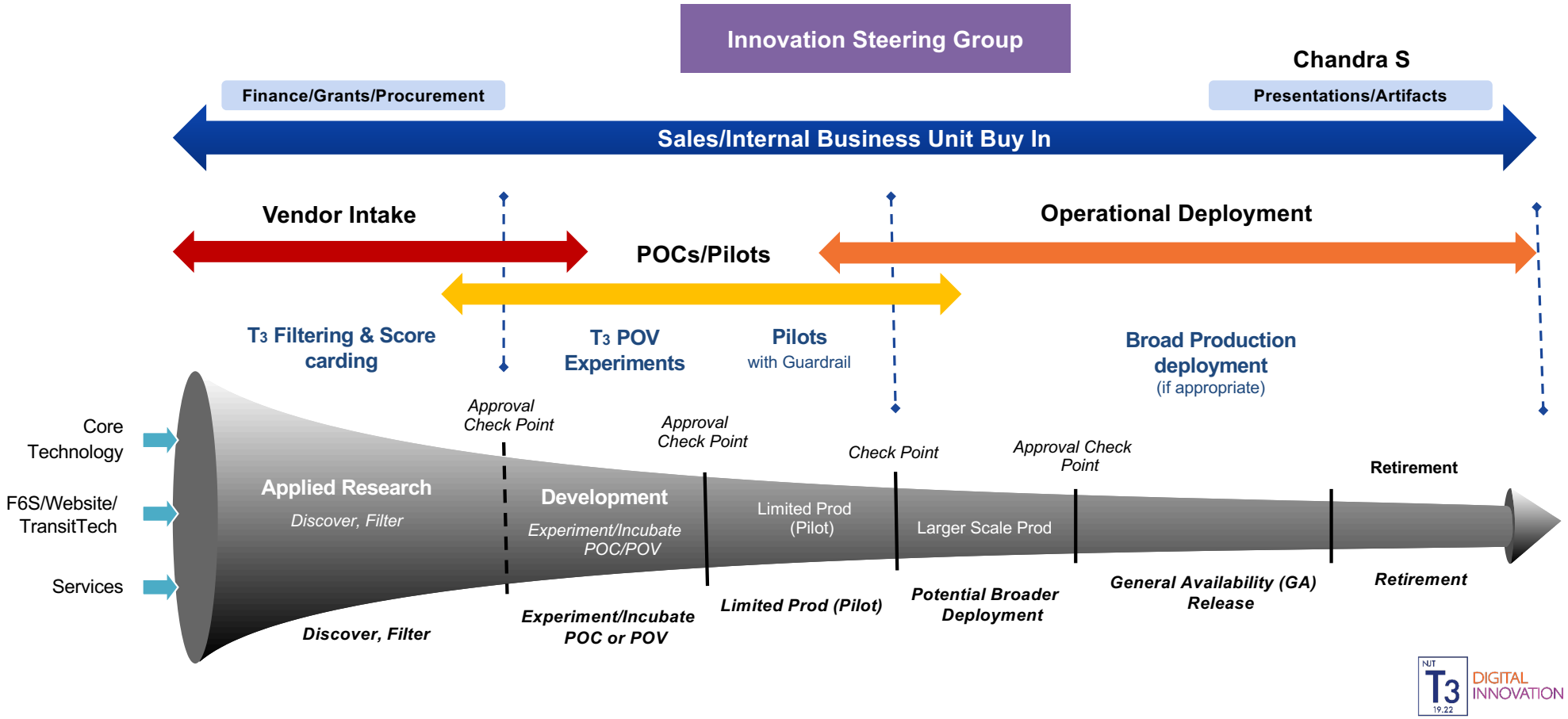
NJTRANSIT
The Way To Go.

NJTransit Innovation Infrastructure for CAVs

6/28/21

NJTRANSIT Innovation Funnel



Key Mobility Innovation Areas

Multi-mode Trip Planner	Smart Train & Bus	Video Analytics	Micropositioning/AVs
Combine all statewide transportation resources	Resilient communications - Multi-carriers	Make use of vast camera networks at stations and on vehicles	Indoor IoT positioning for garages, yards, and stations
Single App to plan, book and pay for a trip	Integrate all systems onboard	Real-time edge processing onboard	10cm accuracy real-time locations
Door to door trip plans	Expanded functionality for operations and WiFi for Passengers	Cloud portal for vendor analytics	Many new cell phone applications

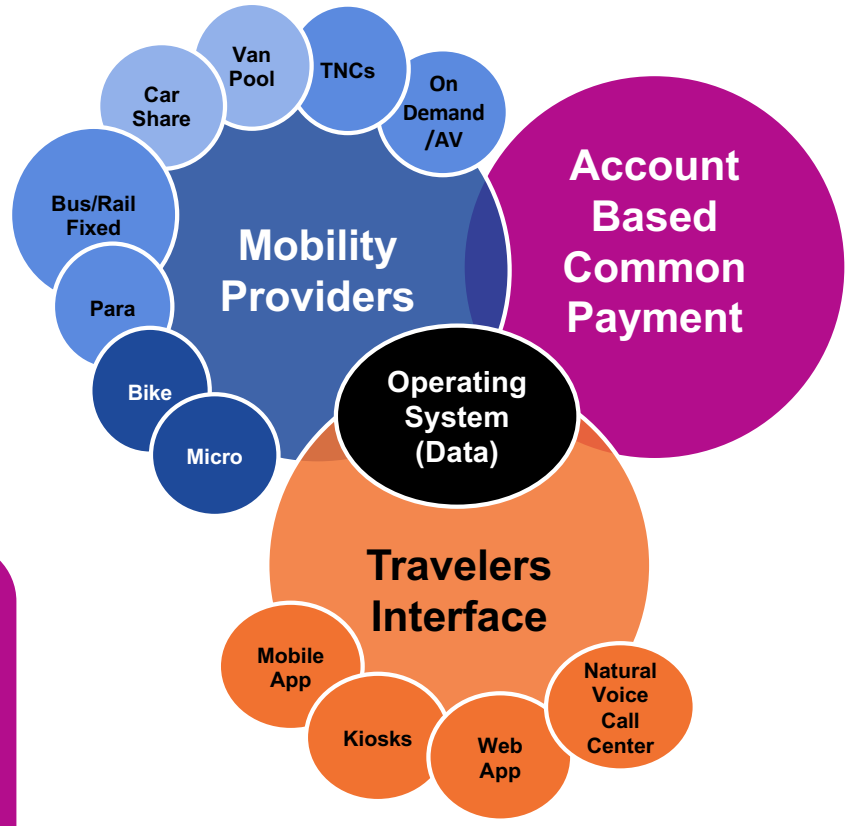
NJT T3 19.22 DIGITAL INNOVATION

Multi-mode Trip Planner/Common Payment System

- The future of transit is multimodal and on-demand
- A shift away from personally-owned vehicles
- One-stop shop to plan, book, and pay
- ATIS Replacement
- State legislation for a statewide trip planner

Assistant Administrator of FTA, Vincent Valdes said:

"Regional Transit agencies should become the multi-modal mobility managers for the region."



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Existing NJ Mobility Options

TOO MANY OPTIONS FROM POINT A TO POINT B

USER GROUPS

Wheelchair Customers

Scheduled trip requests

ADA AccessLink (Trapeze)

Fleet Management

MDT

Ambulatory Customers

Scheduled trip requests

40+ Community Service Partners

Daily Schedule

Real-time trip requests

Ridesource Providers

Uber

Lyft

App

General Public

GTFS-/GTFS-RT

megabus.com

Greyhound

Coach USA

Coach Company

RideWise

Trailways

TransOptions

GLOUCESTER COUNTY NJ

goHunterdon

SEPTA

AMTRAK

PATCO

ezride

NJTPA

LINK

PATH

OceanRide

ACM Corporation

TRANS-BRIDGE LINES

SCUCS

Academy

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MCAT

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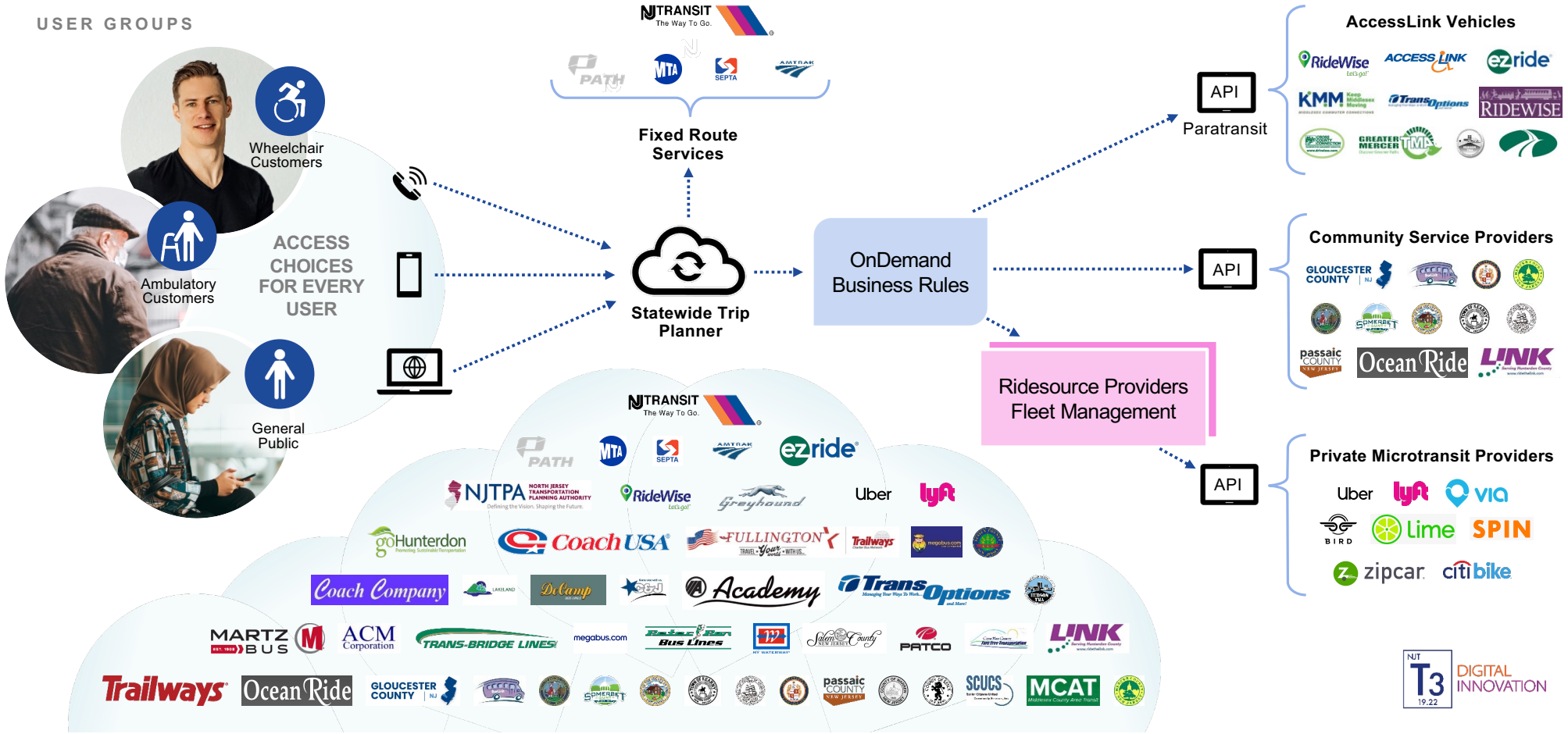
Final State-wide Multi-mode System



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Smart Train/Lt Rail Technology

Nielsen's Law of Internet Bandwidth – Users' bandwidth grows by 50% per year

LEGEND

Business Use Cases | New Equipment

PTC Backup communications

Passenger WiFi

Improved reliability w/ redundant cellular carriers

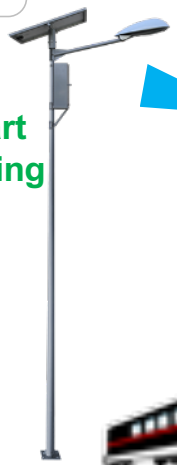
Improve cellular coverage

Cellular Suite Smart Train WiFi Router

Micropositioning

Asset/yard management

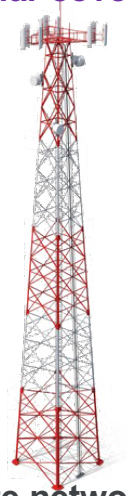
Smart Lighting



Track worker protection

WiFi Onboard sensors

Vehicle health monitoring



Conductor Mobile Validation Device (MVD) Communications

Real-time video processing

Video Graphics Processing Unit

Existing Video Recorder

Existing Bombardier equipment

Existing Displays & PA

Consistent customer messaging

Private network over public cell providers (NJTRANSIT contributed towers and access at garages & terminals, 5G support)

NJT T3 DIGITAL INNOVATION 19.22

Smart Bus Technology

LEGEND

Business Use Cases | New Equipment

Asset/garage management

Smart Lighting

Worker protection

Precision docking

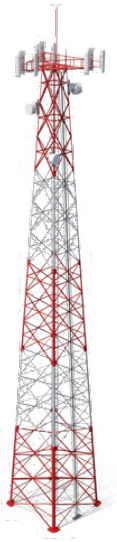
UWB Micropositioning

Passenger WiFi

Cellular Suite SmartBus WiFi Router

Improved reliability w/ redundant cellular carriers

Improve cellular coverage



Private network over public cell providers (NJTRANSIT contributed towers and access at garages & terminals, 5G support)

Real-time video processing

Video Graphics Processing Unit

Existing Apollo DVR & Cameras

Existing DigiRouter WR54 – Clever Interface

J1939 to Wi-Fi Adapter

Bus health monitoring

NJT T3 19.22 DIGITAL INNOVATION

Video Analytics/ Machine Vision

Initial Analytics

Rail Business Challenges

Bus Business Challenges

General

- Passenger count
- Social distancing/Mask Compliance
- Standup and sitdown
- Incident Alert
- Empty Cars

Security

- Access Control – Restricted Areas, Bridges / Tunnels, Rail Tracks / Crossings, Others
- People – Intrusion, Suspicious Activity, Loitering, Afterhours Activity
- Efficiency - Absence of Security, Absence of Staff
- Facilities – Removed Objects, Abandoned Objects, Camera Tampering, Vandalism
- Summary – Video Synopsis, Video Wall, Others
- Search – Object Detection, Perpetrator Detection, Gun Detection, Others

Health & Safety

- Hazards - Trip, Fall, Slip Events, Fire, Smoke Events

Operations & Planning

- Pedestrian Flows – to identify choke points in passageways and stairwells and plan for capital improvements or space clearing needs to prevent overcrowding
- Parking Management – Car, Bike, Available Spaces, Occupancy rates, License Plates, Wrong / Illegal / No parking
- Enforcements – Fare Evasion, Realtime Law Enforcements & Notifications, Asset Surveying
- Incident Management – Situational Awareness, Compliance & Notifications

Customer Intelligence & Communications

- Real time Crowding Data – Gather data and transmit to app and web site

Passenger revenue generation

- Demographic – Age, Gender, Single, Family, Student / Professional, Visually / Physically Challenged
- Behavioral – Dwell Time, Directional of gaze, Emotions, Activities
- Location & Time – People Count / Density, Type

NJT T3 19.22 DIGITAL INNOVATION

Video Analytics/ Machine Vision

Initial Analytics

Rail Business Challenges

Bus Business Challenges

External Rail vehicle use cases

- Engineer trackworker/trespasser warning alerts
- Stopped vehicle, location/track verification – Location inside NY Penn
- Tunnel inspection
- Rail vehicle/track/catenary defect detection
- Passenger counts at station approach
- Railroad crossing
- Camera quality monitoring
- Drone inspection cameras

Inside Rail vehicle use cases

- Match consist to TMAC trainID
- NDT counting onboard & at station
  - Count boardings and alighting at each station or occupancy between stations
- Conductor MVD driven police alerts
- Engineer attention monitoring
- Ticketing queues
- Camera quality monitoring
- Remote augmented reality applications

NJT T3 19.22 DIGITAL INNOVATION

Video Analytics/ Machine Vision

Initial Analytics

Rail Business Challenges

Bus Business Challenges

Onboard Bus use cases

- Expand functionality on existing hardware
- Provide location information inside garages and PABT
- Backup/validation of automatic passenger counting
- Driver warning alerts or training alert logs
  - Forward collision warning
  - Left turn assist warnings
  - Pedestrian warnings
- Bus Automation
- Road defect detection
- Traffic conditions along routes
- Stop passenger queues
- Camera quality monitoring

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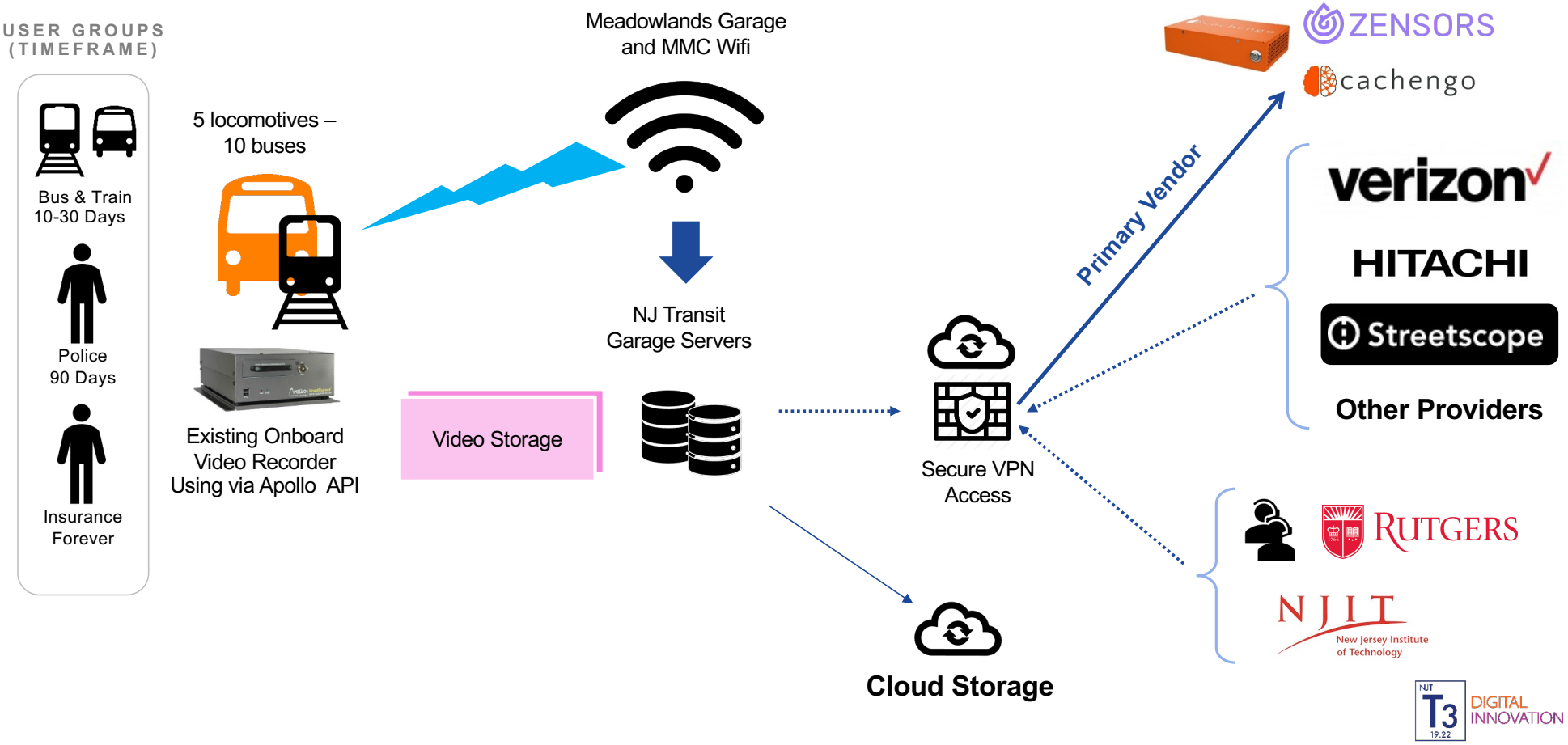
Initial POC – Video Storage & Analytics Development Portal



IoT Micropositioning Revolution with Ultrawideband (UWB)

UWB Provides...

High precision location accuracy (10cm) and security for IoT solutions is critical

Higher accuracy in tunnels, urban canyons, and indoor facilities, which can confound GPS signals and other sensors

A proven solution to support location accuracy

Consumer Smart Devices Featuring UWB:

Samsung Galaxy Note 20 Ultra

Apple iPhone 11

Apple iPhone 12s

Rumored: Google Pixel 6

UWB adoption is expanding!

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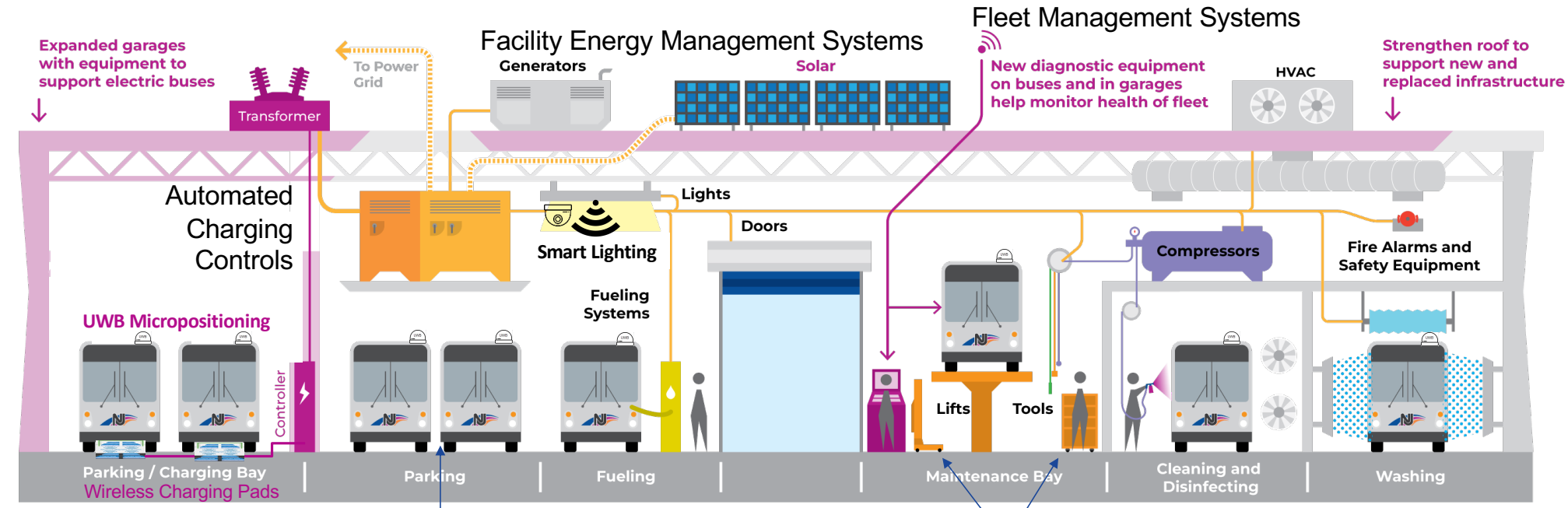
Bus Garage Management w/Micropositioning

Wayne, Hilton, Greenville, Hamilton & Newton Garages



Automated parking/positioning

Digital Dispatch information and Vehicle Awareness

Digital Logistics & Maintenance tech For equipment & storage.

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Microlocation Applications

Accessible Wayfinding

Asset Management

Police Officer Emergency Locate

Secure Access Control

UWB

Trackworker Protection

Time & Attendance Systems
- Duty Manager - Rail
- Teledriver – Bus Ops
- Kronos – HQ/Bus Maintenance

Rail Micropositioning
- Consist/Yard Management
- Passenger tracking/payment
- Communication based train control

Bus Micropositioning
- Electric charging
- Garage Management
- Precision docking
- Pedestrian detection

Bus Single Sign-on
- Farebox
- Headsign/AVL
- Radio

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Automated Vehicles


PC Control Computer


Vehicle to Vehicle
Communication System:
(With Accelerometer & Gyro)


Vision/Lidar/Radar

SAE Level 2
Steering Actuator


Mobileye System
in the cab

OnGuard Active
Throttle & Braking Actuator

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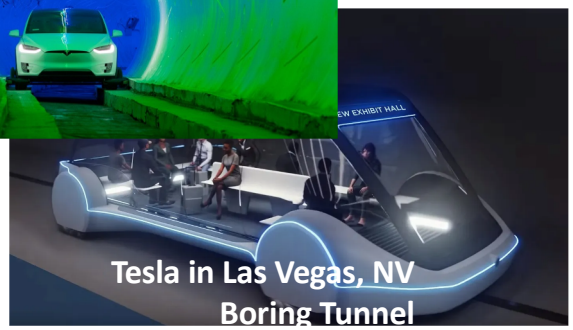
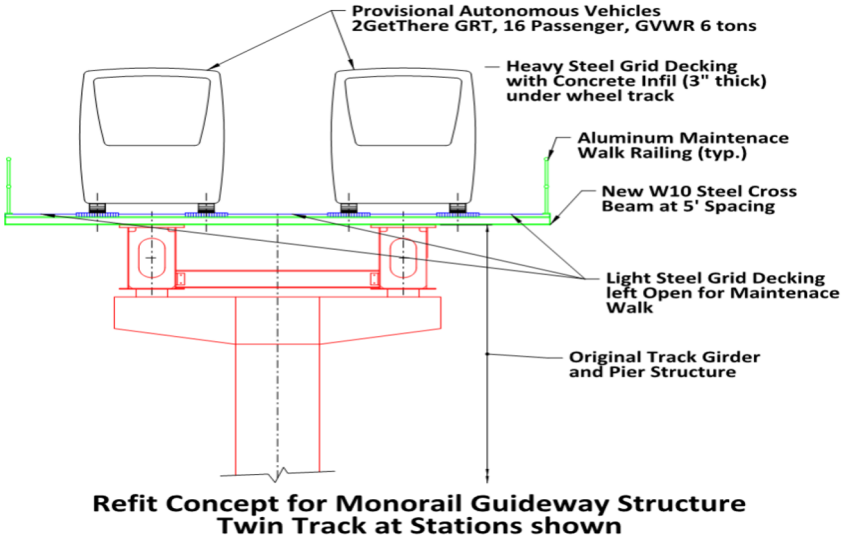
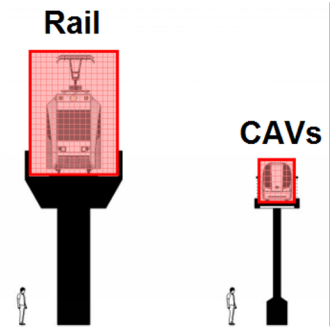
Dedicated Automated Guideways



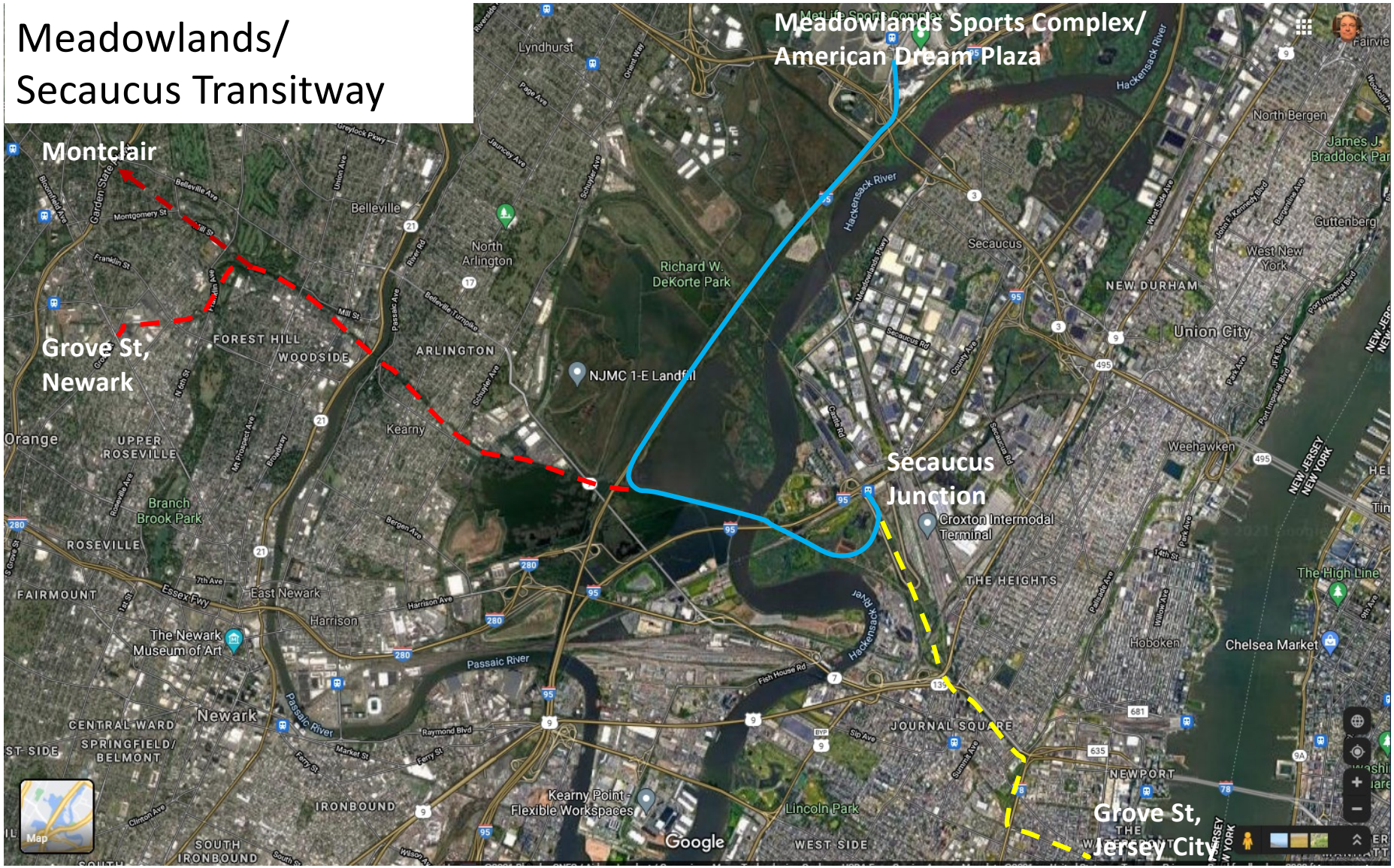


Refit Concept for Monorail Guideway Structure
Twin Track at Stations shown

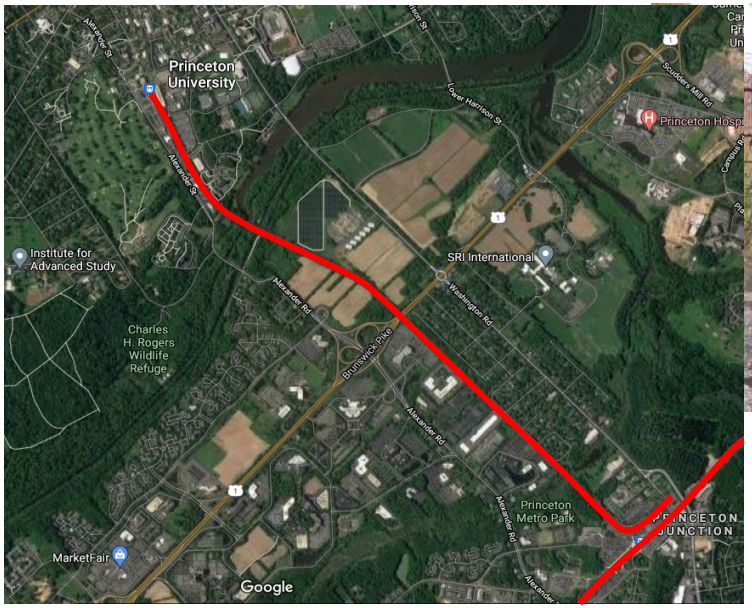


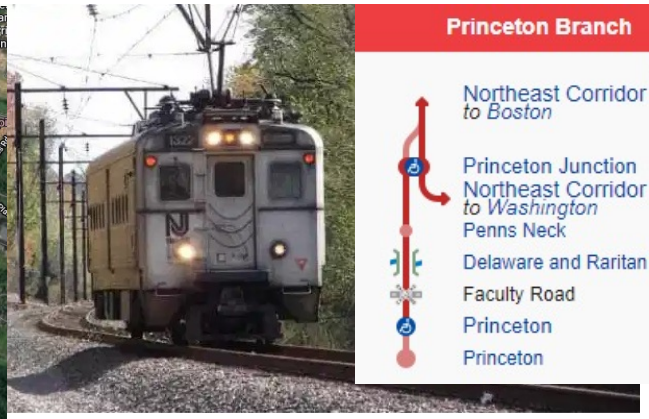
Lightweight narrow roadway type guideways

Meadowlands/ Secaucus Transitway



Princeton Dinky Alternatives Study





A planning firm, Stantec, was hired to serve as the consultant for the transitway study. The study is expected to take about a year to complete and is expected to be finished by the end of 2021. Following is the timeline for the study:

- January 2021 – March 2021: Data collection and an assessment of existing conditions
- April 2021 – May 2021: Sharing of initial findings and stakeholder/community outreach
- June 2021 – August 2021: Develop and evaluate concept alternatives
- September 2021 – October 2021: Share alternatives and obtain stakeholder/community feedback
- November 2021 – December 2021: Finalize analysis of alternatives and select preferred alternative

Need

Interagency CAV Regional Planning

Automated Vehicle Regional Planning

- Princeton Dinky
- Meadowlands/Secaucus Transitway
- Bus Garage Modernization
- XBL PANYNJ Project
- Newark Airport Airtrain Replacement
- LaGuardia Airport Connector