

An aerial photograph of an airport is shown, with a large blue rectangular overlay on the upper half. The overlay contains the title and date in white text. The background image shows a runway with a green-painted taxiway, a large parking lot filled with cars, and various airport buildings and infrastructure.

# Enhancing the Airport Experience with Wayfinding

May 23, 2024

# Today's Learning Objectives

- (1) Enhance airport terminal and groundside operational performance through better passenger guidance and information techniques**
- (2) Explore the potential to use modern personal communication devices to optimize flows and reduce passenger stress**

# American Association of Airport Executives (AAAE)

**1.0 Continuing Education Units (CEUs)  
are available to Accredited Airport  
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# American Institute of Certified Planners (AICP)

## 1.5 Certification Maintenance Credits

**You must attend the entire webinar to be eligible for credits**

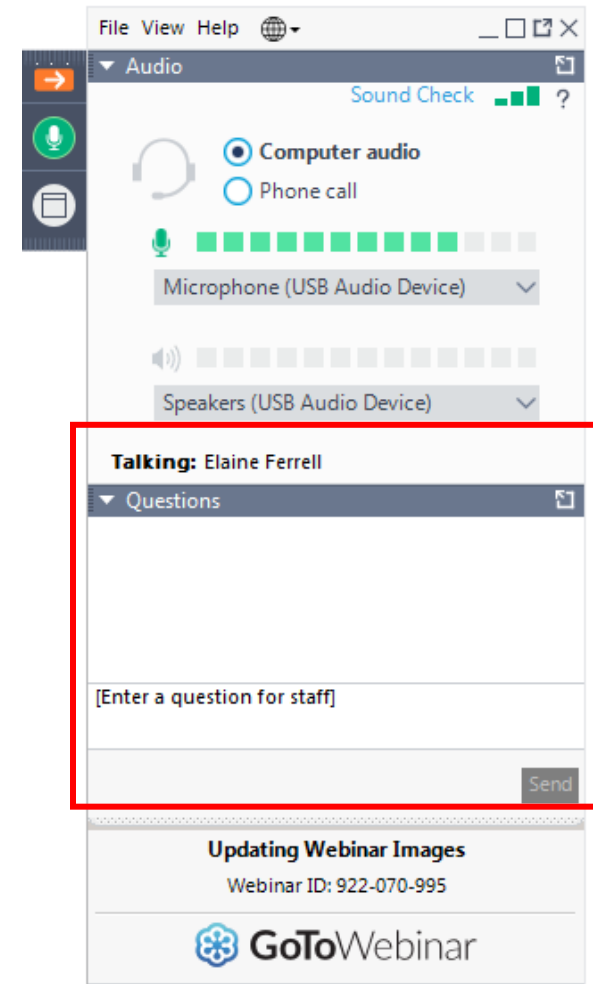
**Log into the American Planning Association website to claim your credits**

# Questions and Answers

Please type your questions into  
your webinar control panel

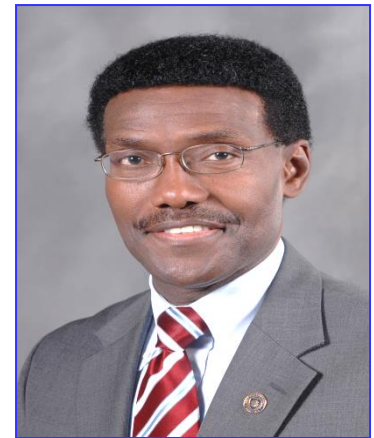
We will read your questions out  
loud, and answer as many as  
time allows

**#TRBwebinar**



# Dr. Nettey, Kent State Univ.

- I. Richmond Nettey
- Ph.D., M.B.A. and B.S. (Aviation)
- Assoc. Dean (2007-19) & Professor of Aeronautics, College of Aeronautics and Engineering, Kent State University, Kent, OH, 44242.
- Chairman, Transportation Research Board Standing Committee on Airport Terminals and Ground Access (AV050), National Academy of Science, Washington, DC
- President, Safety Division, Association of Technology, Management & Applied Engineering (ATMAE)
- President, University Aviation Association (1997-1998)
- Trustee, Aviation Accreditation Board International (AABI) (2003-2007)





# Today's Speakers



Gideon D'Arcangelo

[Gideon.darcangelo@arup.com](mailto:Gideon.darcangelo@arup.com)

Americas Digital Services leader for Arup



Bonnie Powell

[bonnie.powell@nrel.gov](mailto:bonnie.powell@nrel.gov)

National Renewable Energy Laboratory



Michael Erhart

[merhart@apple-designs.com](mailto:merhart@apple-designs.com)

Apple Designs

## An Overview of Wayfinding: Techniques for Enhancing Landside and Airside Operations and Experience

Gideon D'Arcangelo  
Principal | Experience Design  
Arup



# Gideon D'Arcangelo

## Principal, Arup

- Leads Experience Design Practice for Arup in the Americas
- Digital Services Leader for Arup for the Americas
- Leading Art, Branding and Digital Experience Program for JFK New Terminal One



# Always Start with the End User

## Take the Human-Centered Approach

Magda, 34

The Value Seeker



### Persona characteristics

A holiday maker in Croatia.

Magda is not a frequent traveller and seeks simplicity throughout her journey. Travelling for her is an escape from everyday life and she plans her spending very sensibly. This passenger aims to get from point A to point B with minimal inconvenience (prioritizing direct flights rather than transfers). She expects predictability and reliability of the transportation mode. Magda values familiar context and efficient experience through check-in and security. She usually chooses cheap flights, likes promotions and she pays less attention on design and digital solutions.

Magda doesn't cope well with planning alternatives and deciding on new solutions. She gets frustrated by the additional fees she has to pay to fulfil her needs (water, toilet, WIFI). She feels stressed when her previously planned journey becomes unavailable. If she has to reschedule, she would be looking for alternatives at a similar price, even if it means that she would be waiting for a longer time.

Status



Local



International

Transport mode of access



Car



Taxi



Train



Public transport

Special journey requirements

### Persona journey

Journey Purpose

Business

Leisure

Journey Situation

Departing

Arriving

This persona highly values these moments\*:

1. Efficiency and simplicity of the processes
2. Predictable journey with no surprises
3. Access to promotional retail offers

Top CX metrics important for premises development:



Ambience



Natural Wayfinding



Cleanliness & Maintenance



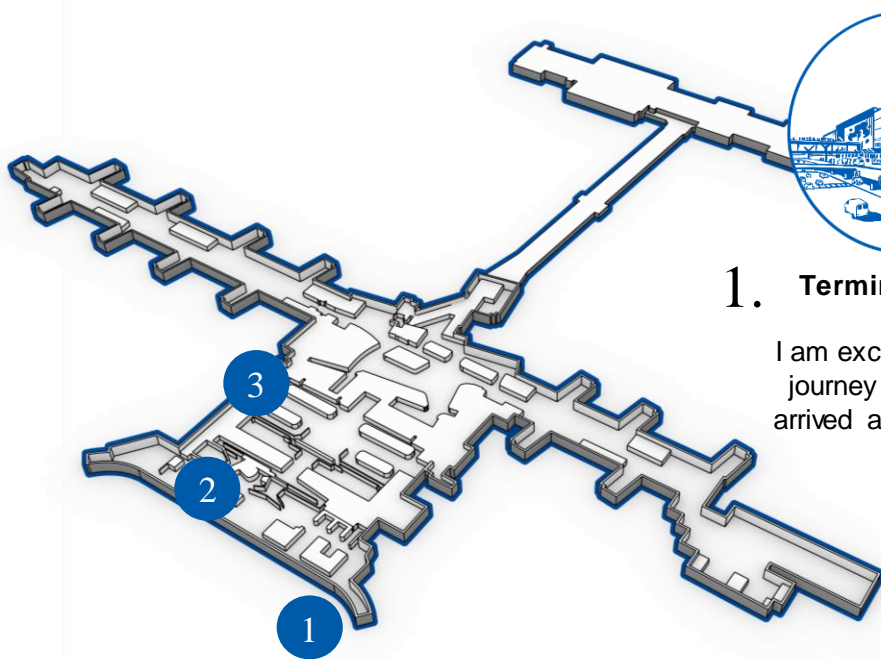
Walking Distances



Airport Access

# Take the Human-Centered Approach

## Desired Experiences - Departure



### 1. Terminal Approach

I am excited to begin my journey and I know I've arrived at the right place.



### 2. Departures Threshold

I am greeted with a big welcome and I am clearly oriented toward where I need to go.

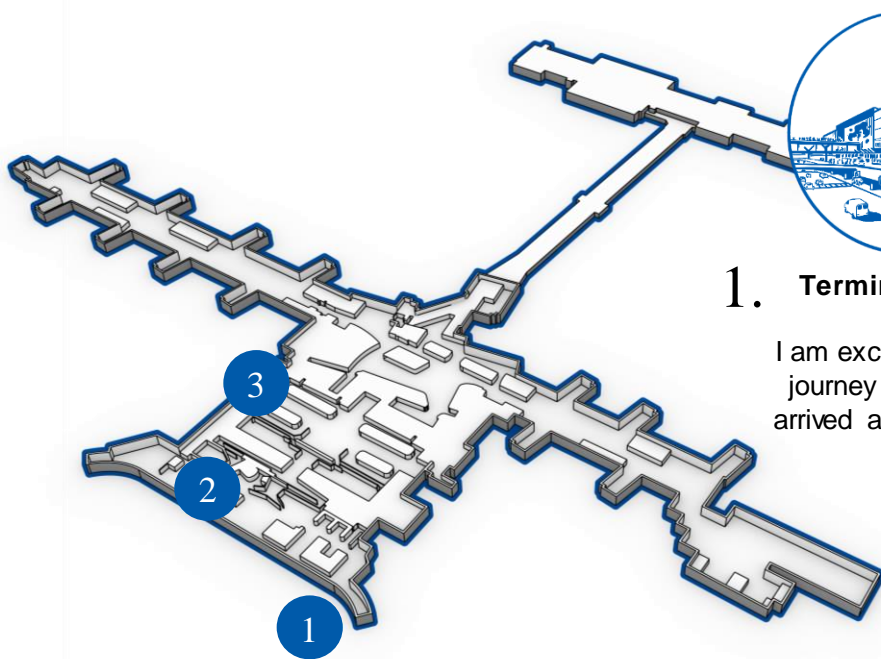


### 3. Departures Hall

I am drawn into a wonderful experience as I make my way through ticketing and security.

# Take the Human-Centered Approach

## Desired Experiences - Departure



### 1. Terminal Approach

I am excited to begin my journey and I know I've arrived at the right place.



### 2. Departures Threshold

I am greeted with a big welcome and I am clearly oriented toward where I need to go.



### 3. Departures Hall

I am drawn into a wonderful experience as I make my way through ticketing and security.

#### NAVIGATION to PASSENGER SATISFACTION

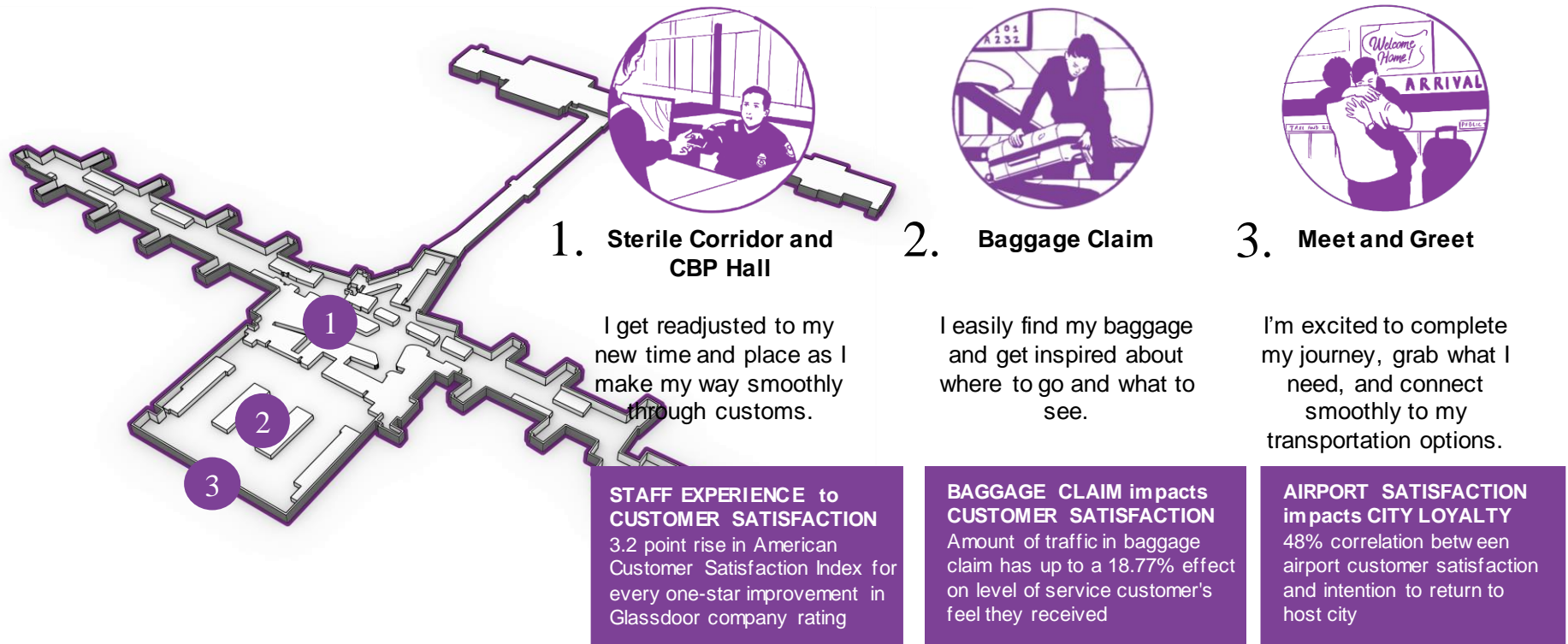
49% positive correlation between ease of navigation and overall airport sentiment

#### QUEUE ENGAGEMENT to PASSENGER SATISFACTION

Entertainment in the queue and frequent updates increase willingness to wait in line

# Take the Human-Centered Approach

## Desired Experiences - Arrivals



# Wayfinding Examples

## Passenger Journey

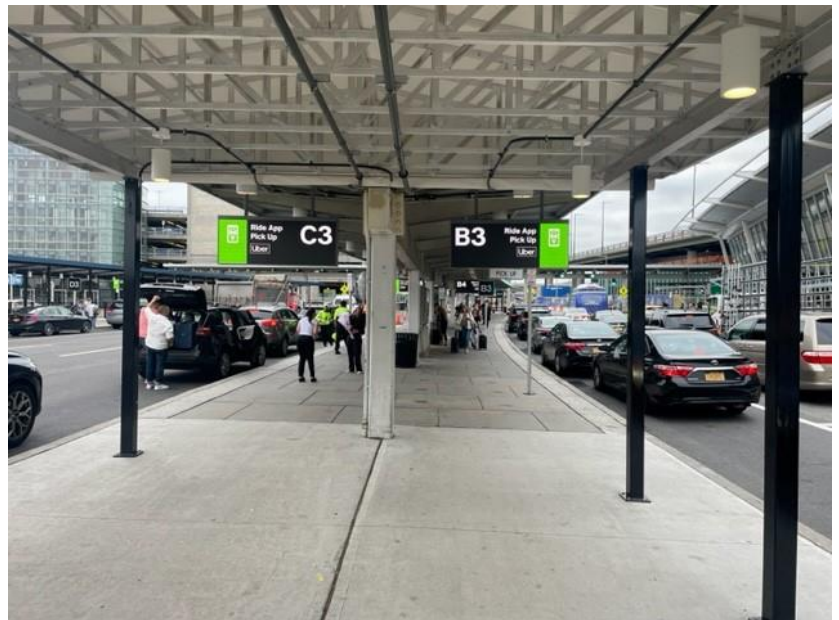
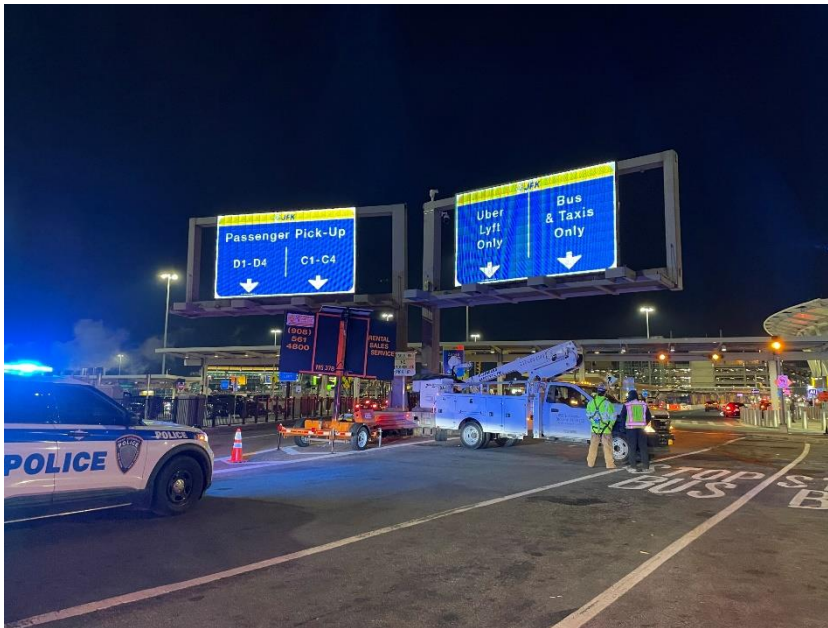
- Groundside (JFK Terminal 4)
- Curb-to-Security (JFK Terminal 4)
- Security-to-Gate (LGA Terminal C)
  - Emphasis on data-driven dynamic wayfinding



# Groundside

## Dynamic Curb Utilization

→ JFK Terminal 4

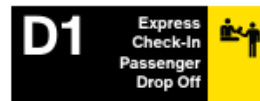




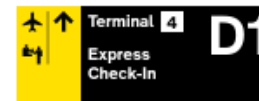
# Groundside

## Dynamic Curb Utilization

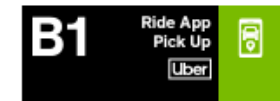
→ JFK Terminal 4



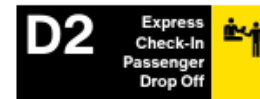
Ped-1A



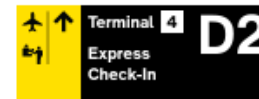
Ped-1B



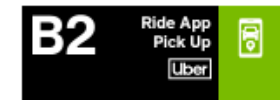
Ped-9A



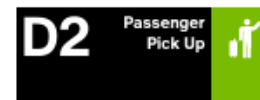
Ped-2A



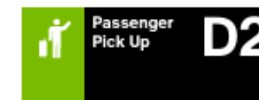
Ped-2B



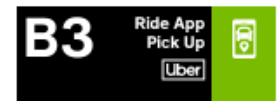
Ped-10A



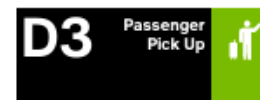
Ped-3A



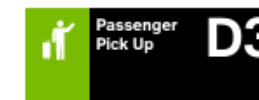
Ped-3B



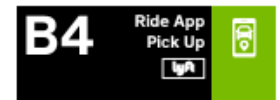
Ped-11A



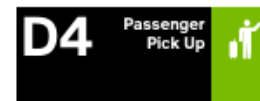
Ped-4A



Ped-4B



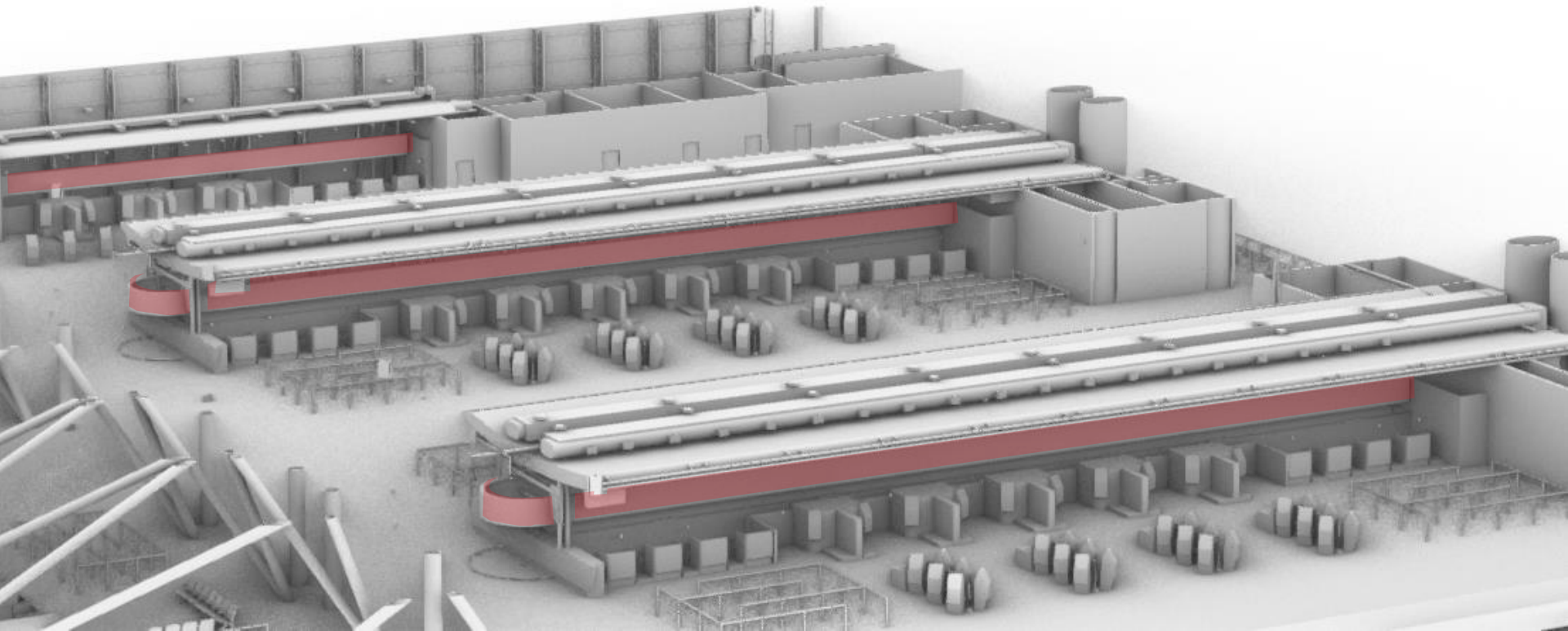
Ped-12A



# Curb-to-Security

## Curb-to-Security Optimization

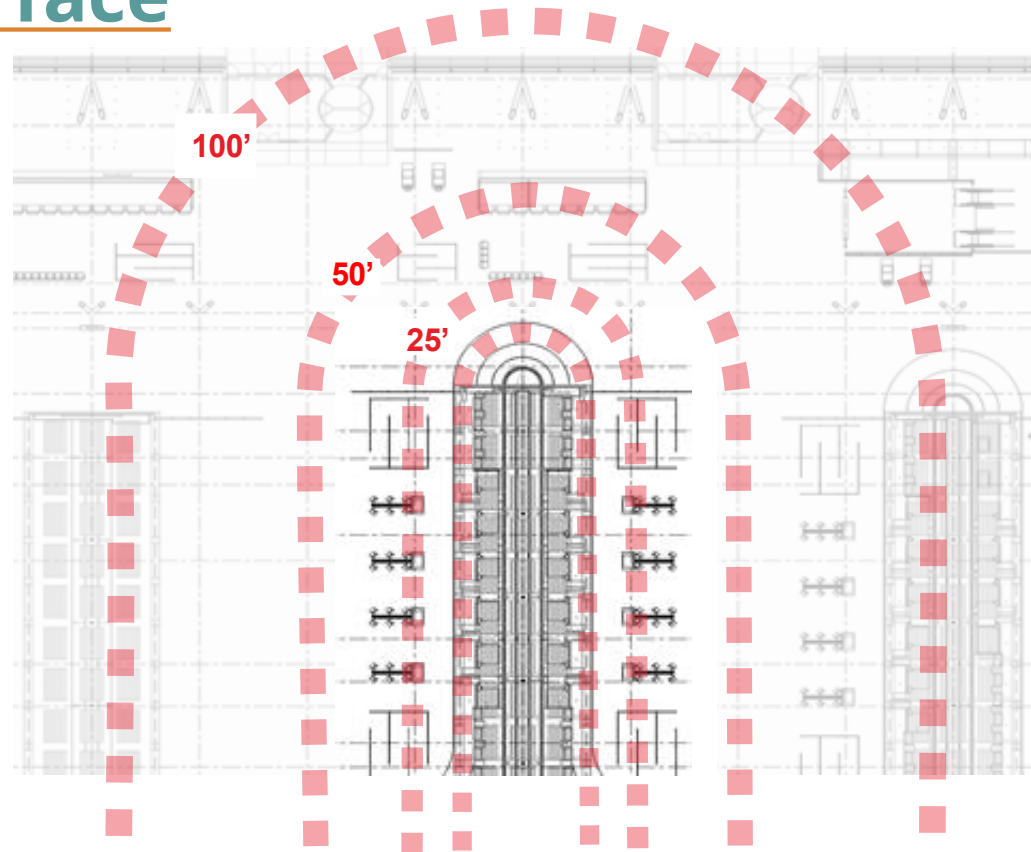
➔ JFK Terminal 4



# Curb-to-Security

## Multi-Distance Interface

→ JFK Terminal 4









6

6

6

Star Alliance Gold Member

Avianca

Airlines

Bag Drop

3-1-1 for Your Carry-Ons  
Play Your Part

- 3 "3-1-1" or less with containers of liquid or gel.  
"More Than 3 ounces permitted in checked baggage"
- 1 quart-size, clear plastic, zip-top bag holding 3 ounce or smaller containers.  
"Bag must be taken out of carry-on at security"
- 1 bag per transfer placed in the security bin.  
"Transfer baggage must be placed in the security bin"

Wait Time for General is 40 mins.

5

Bag Drop

Check-in Row

5



Check-in Row  
8

8

# WHERE DO I CHECK IN?

5:45am

DESTINATION	FLIGHT	TIME	STATUS	ROW
Bogota	AV 021	07:25am	On Time	6
London LHR	VS 0026	08:00am	On Time	5
Mexico City	AM 0405	08:01am	On Time	3
Panama City	CM 0803	09:07am	On Time	7
Port of Spain	BW 0423	07:30am	On Time	5

Copa Airlines

Security

Wait Time for General is 39 mins.

Security



7

7



SAFE TRAVELS FROM YOUR FRIENDS AT T4

7



# Security-to-Gate

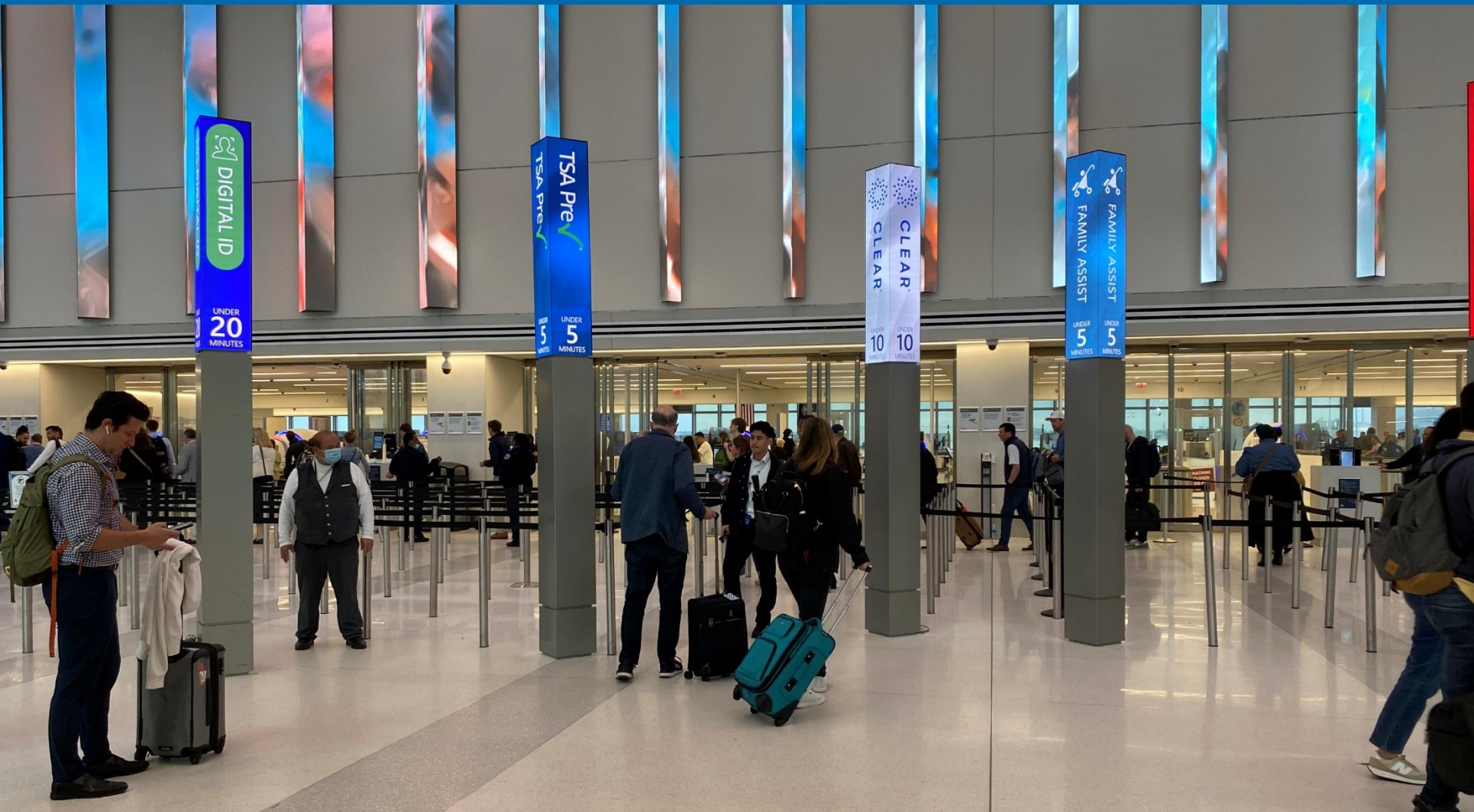
## Data-driven Wayfinding

→ Delta LGA Terminal C

- Line ID Totems with Line Weights
- Dynamic Wayfinding
- Data-Driven Maps (fixed and mobile)



# Security-to-Gate: Dynamic Queue Totem



# Security-to-Gate: Dynamic Wayfinding

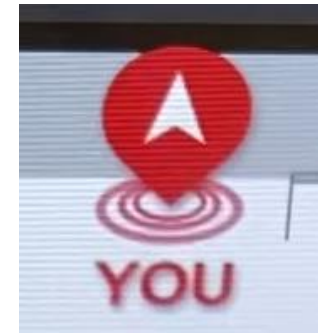
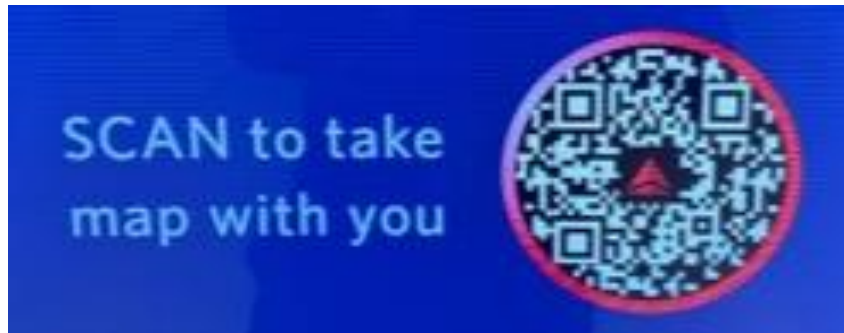




# Security-to-Gate: Interactive Maps

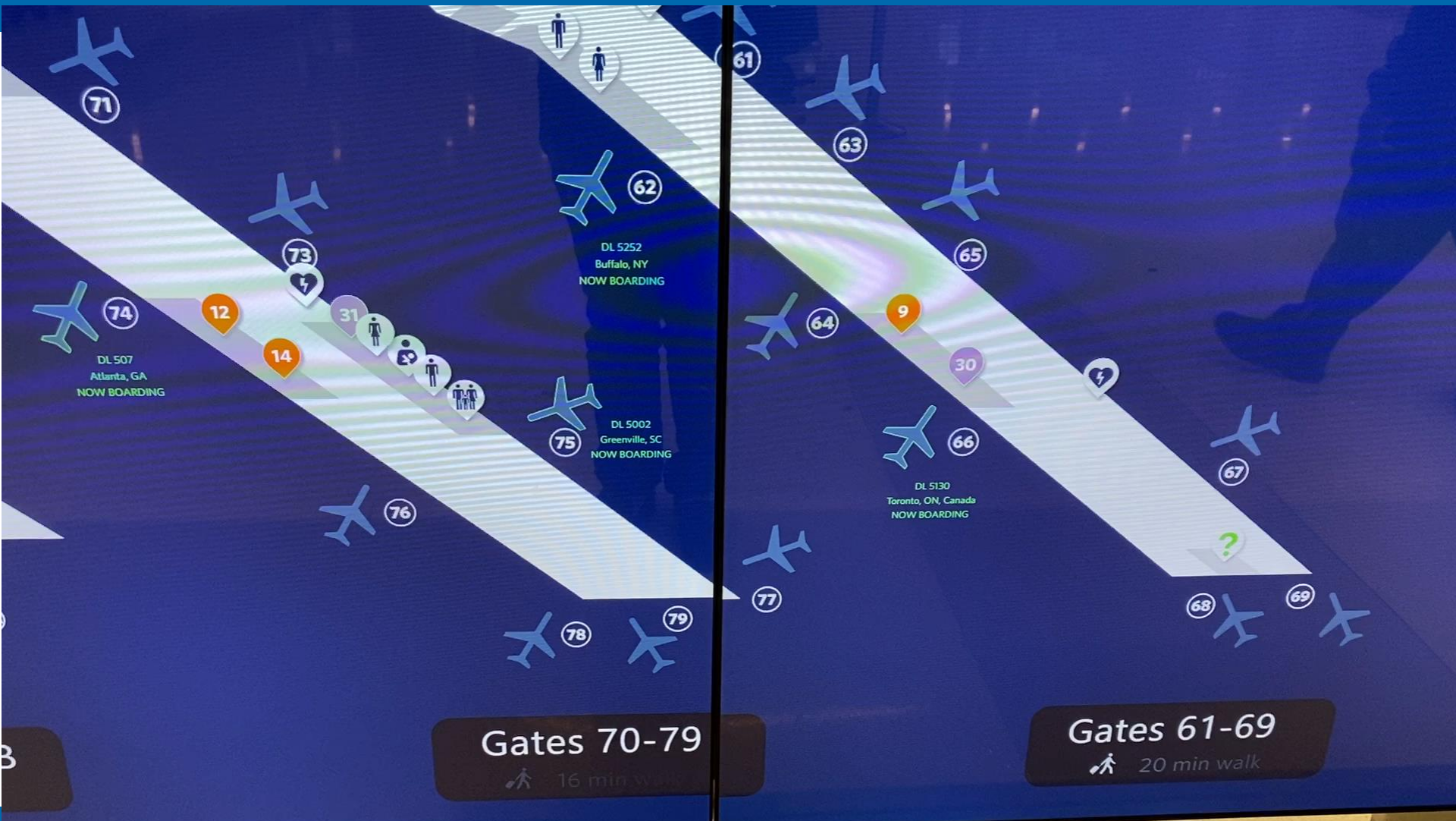


# Security-to-Gate: Interactive Maps





# Security-to-Gate: Interactive Maps



# Security-to-Gate

Cincinnati, OH	DL 5285	WESTJET	7275	1:15p	ON TIME	94
Cleveland, OH	DL 3912	WESTJET	8472	1:10p	ON TIME	93
Columbia, SC	DL 5407	WESTJET	7192	1:05p	ON TIME	67
Columbus, OH	DL 5714	WESTJET	8494	10:55a	DEPARTED	62

BOARDING ENDS 15 MINUTES BEFORE DEPARTURE.

**NEW YORK-LAGUARDIA** 59°F

**2** Post-Security

You are located on Level 2

**FACILITIES & SERVICES**

- AED Defibrillator
- ATM
- Delta Help Center
- Delta Sky Club
- Restroom - Family
- Restroom - Men
- Restroom - Women
- High Traffic Restroom

**EAT & DRINK** Post-Security

<ul style="list-style-type: none"> <li>Bubba's</li> <li>Firebird</li> <li>Portobello's</li> <li>Starbucks</li> <li>Starbucks - Near Security</li> <li>Sunday Supper Trattoria</li> <li>Torrey Bar</li> <li>Wendy's</li> </ul>	<ul style="list-style-type: none"> <li>Cotto</li> <li>Starbucks</li> </ul>	<ul style="list-style-type: none"> <li>Chick Ramen</li> <li>Loose Burger</li> <li>Starbucks</li> </ul>
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**RETAIL** Post-Security

<ul style="list-style-type: none"> <li>Bookman 9022</li> <li>Briggs &amp; Riley</li> <li>Bookend</li> <li>CBD Express</li> <li>CBD Express</li> <li>La Loba</li> <li>MAC</li> <li>Patricia Nash</li> <li>Shoe to New York City</li> </ul>	<ul style="list-style-type: none"> <li>CBD Express</li> <li>Cotto Market</li> </ul>	<ul style="list-style-type: none"> <li>Butterfield</li> <li>Flavio Market</li> <li>Pharo</li> </ul>
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SCAN to take map with you

**KEY MAP**

LEVEL

3 Security Checkpoint & Parking Garage

2 All Gates

1 Bag Claim & Ground Transportation

Gates 92-98 You are here

Gates 81-89B 8 min walk

Gates 70-79 14 min walk

**WITH US**

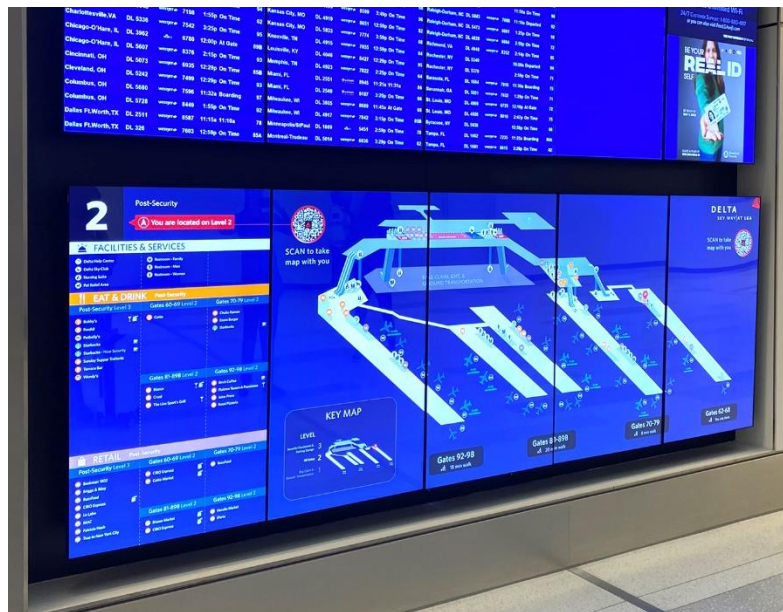
# Conclusion

## Take the Human-Centered Approach

- Map out the Passenger and Staff Journeys
- Look for Pain Points
- Develop Wayfinding Interventions
- Consider Data-Driven Dynamic Wayfinding Techniques



# FOR ADDITIONAL INFORMATION



Gideon  
D'Arcangelo  
[gideon.darcangelo@arup.com](mailto:gideon.darcangelo@arup.com)

## The Evolution of Airport Terminal Wayfinding Technologies

**Bonnie Powell**  
**National Renewable Energy Laboratory (NREL)**

*Webinar: Enhancing the Airport  
Experience with Wayfinding*

May 23, 2024

# Bonnie Powell

- Researcher / energy engineer
- Collaborates with the Energy Security & Resilience Center and the Center for Integrated Mobility Sciences within NREL

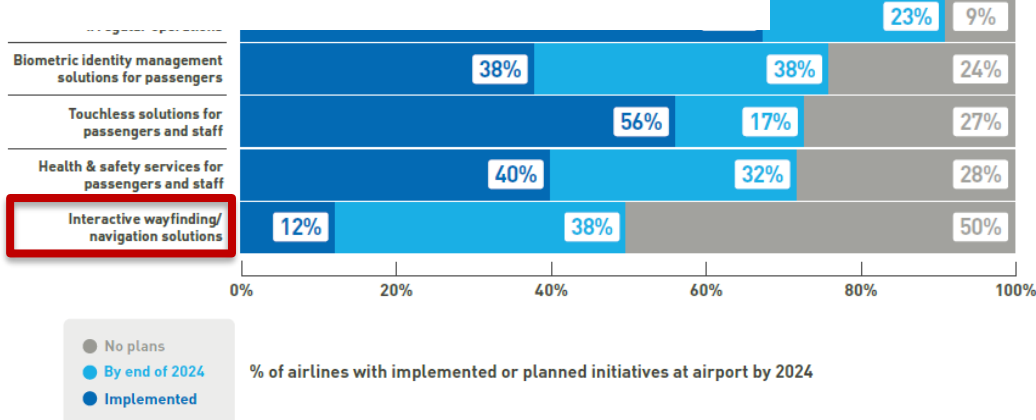


*Photo by Werner Slocum, NREL*

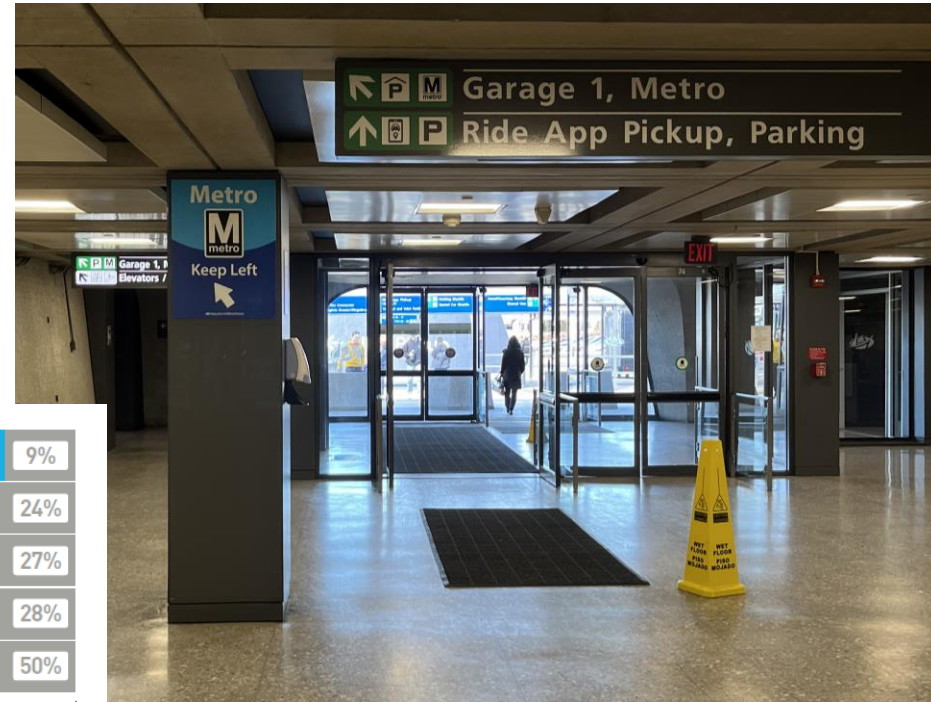
# Wayfinding Motivation

- Improve passenger experience
- Reduce congestion
- Reduce energy consumption (e.g., through making public transit easier to locate)

## AIRLINE INVESTMENT PRIORITIES AT AIRPORT



Source: SITA. 2021. [Air Transport IT Insights 2021](#).



Washington Dulles International Airport: Metro wayfinding signs

Photo by Bonnie Powell, NREL

# Wayfinding Technology Timeline



Photo from [Getty Images](#) 515236823



Photo from [Getty Images](#) 1336123688



Photo by Stan Young, NREL

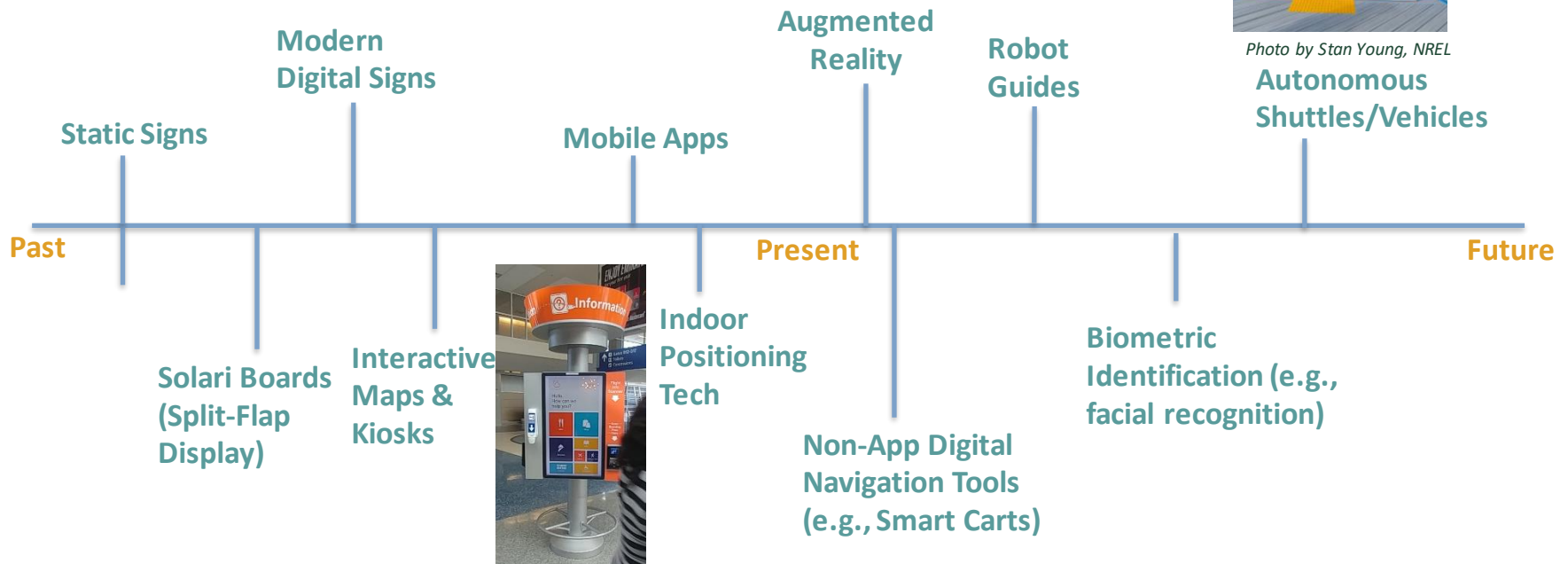


Photo by Stan Young, NREL

## Considerations:

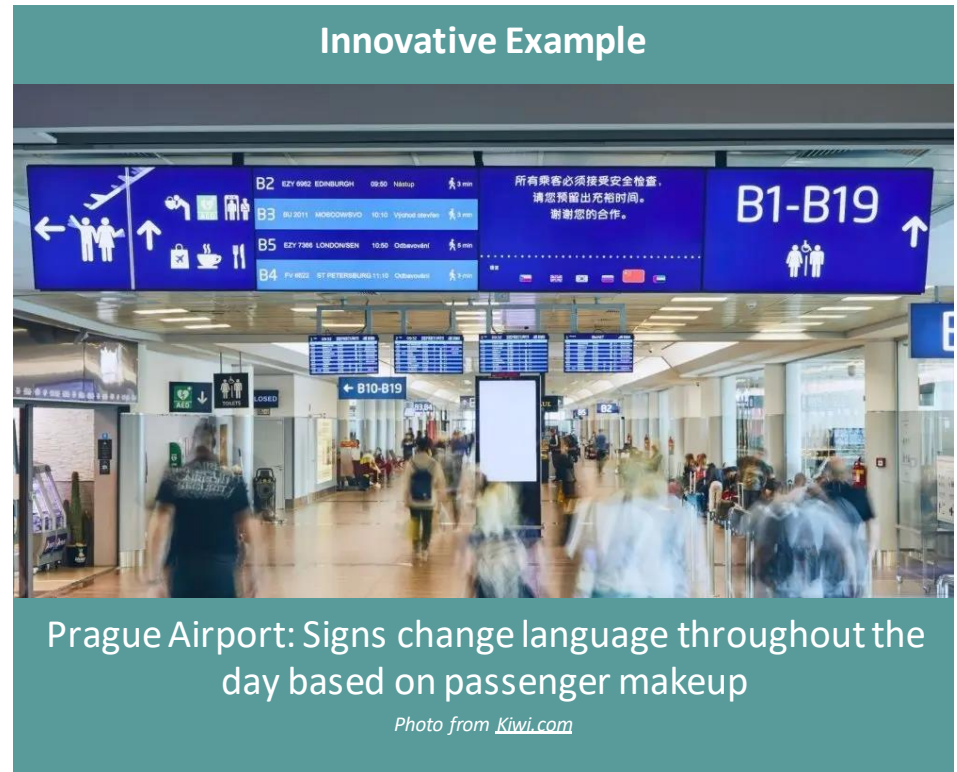
- **Integration** of numerous technologies
- Many wayfinding technologies do not disappear; additional technologies are added

# Wayfinding Technologies

## 1. Static and digital signs:

- Key long-term fixtures
- Digital signs prevalent for dynamic information
- Can have multiple purposes (e.g., advertising + directions)
- U.S. Federal Aviation Administration has design guidelines for signage in terminals
- Languages displayed are a key consideration

### Innovative Example



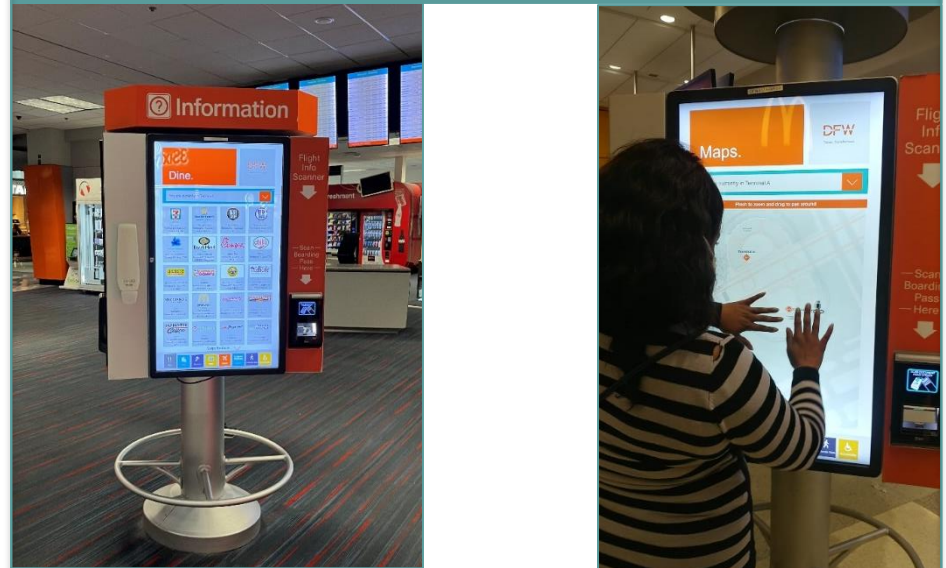


# Wayfinding Technologies

## 2. Interactive displays:

- User input
- Allow for more personalized information
- However, only one person can use a display at a time

### Innovative Example



### Dallas Fort Worth International Airport (DFW): Interactive information kiosks

The user scans their boarding pass to get personalized directions.

*Photos by Bonnie Powell, NREL, May 2023 (left), and Stan Young, NREL, Nov. 2021 (right)*



# Wayfinding Technologies

## 3. Floor-based navigation:

- Painted lines or arrows
- Sign projection systems:
  - Can change placement or language based on the passenger makeup, time of day
- Can be useful for certain groups (e.g., wheelchair users with a lower field of vision)
- May catch the attention of travelers looking at their smartphones while walking

### Innovative Example



Rotterdam The Hague Airport (Netherlands):  
Projection directing travelers toward the exit

The color contrast between the ground and the digital projection and animating the projection were key considerations.

*Photo from a field study conducted by Tezcan and Hiemstra-van Mastrigt (2019)*

# Wayfinding Technologies

## 4. Employee-provided guidance:

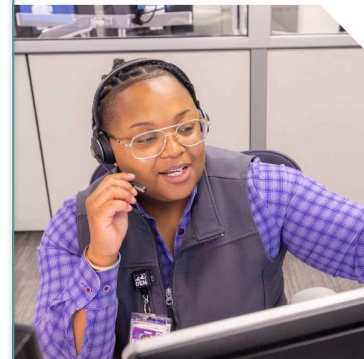
- Information desks have become less staffed over time, sometimes replaced with help chats and mobile apps
- Volunteer airport ambassadors are often still prevalent
- Digital and employee guidance can be combined



Ronald Reagan Washington National Airport:  
Information desk

*Photo by Bonnie Powell, NREL*

## Innovative Example



Our Customer Service Team is Ready to Assist you!

Call, text or video chat with a Customer Service Agent 6 a.m.-10:30 p.m. daily.

Our customer service team is knowledgeable about all things DEN. They can even help you navigate the airport! Phone: 720-730-IFLY (4359). Text chat: 720-902-9351 or video chat through the button below.

Open Chat

Open Video Chat

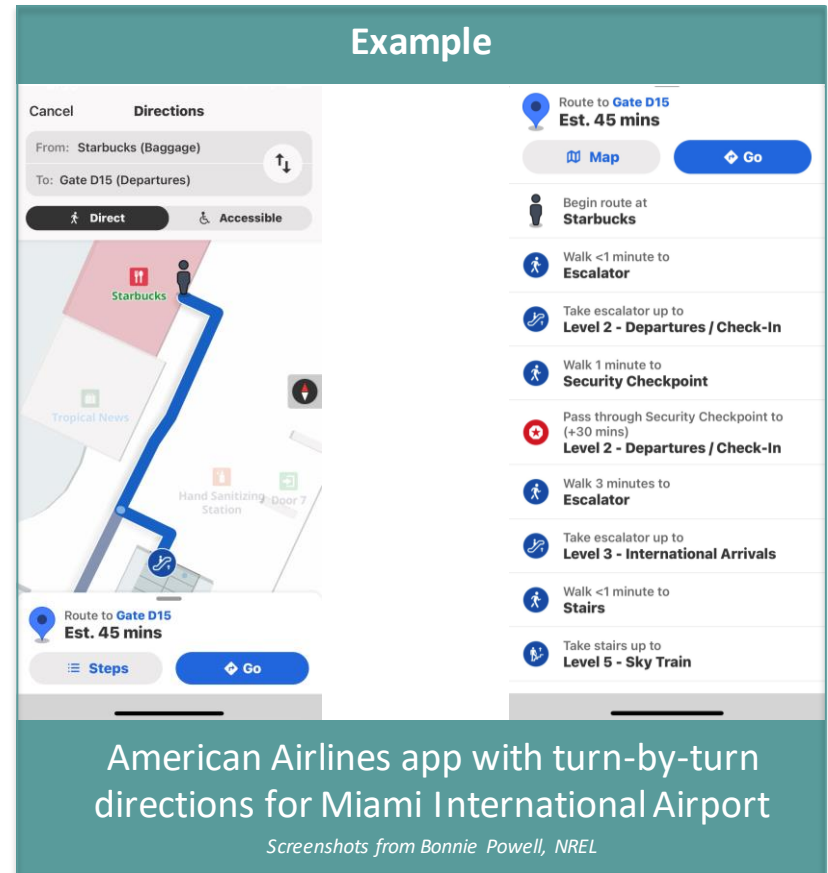
Denver International Airport: Live video or chat help

Screenshot from [flydenver.com](https://flydenver.com)

# Wayfinding Technologies

## 5. Mobile apps: Airlines & Airports

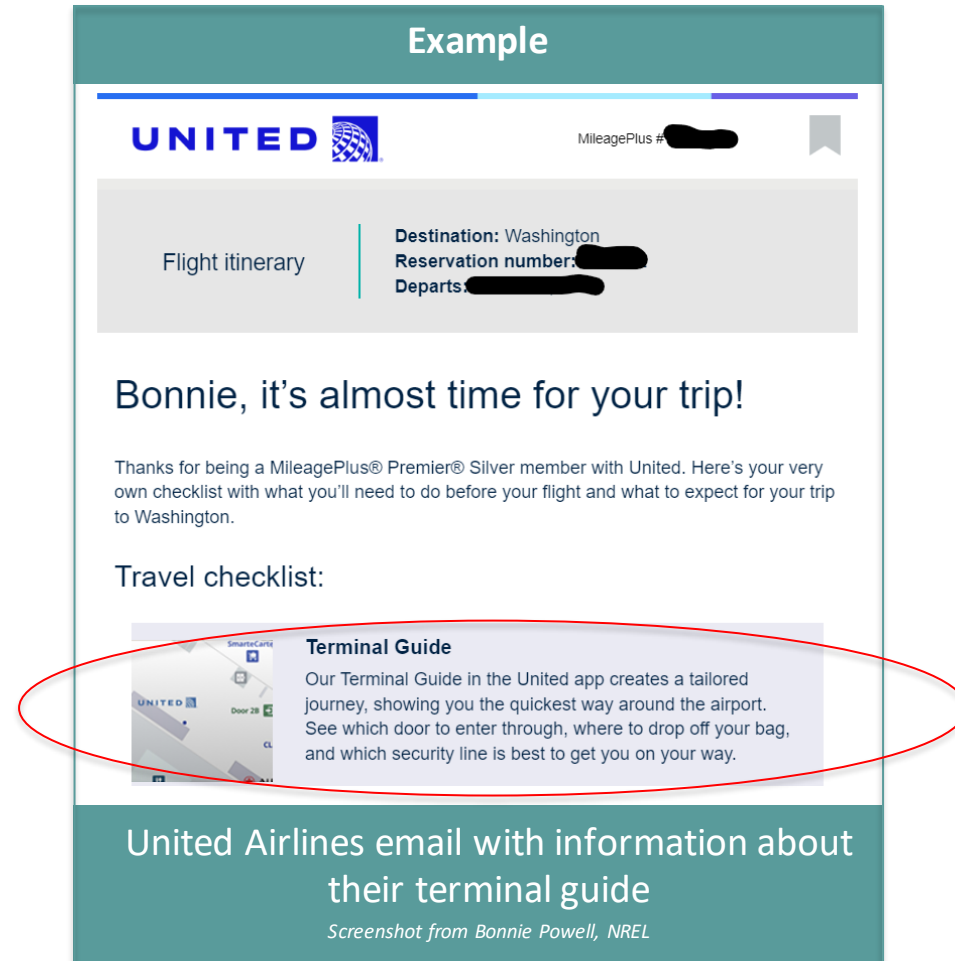
- Major non-budget airlines have airport maps integrated into their apps for the airports they service



# Wayfinding Technologies

## 5. Mobile apps: Airlines & Airports (cont.)

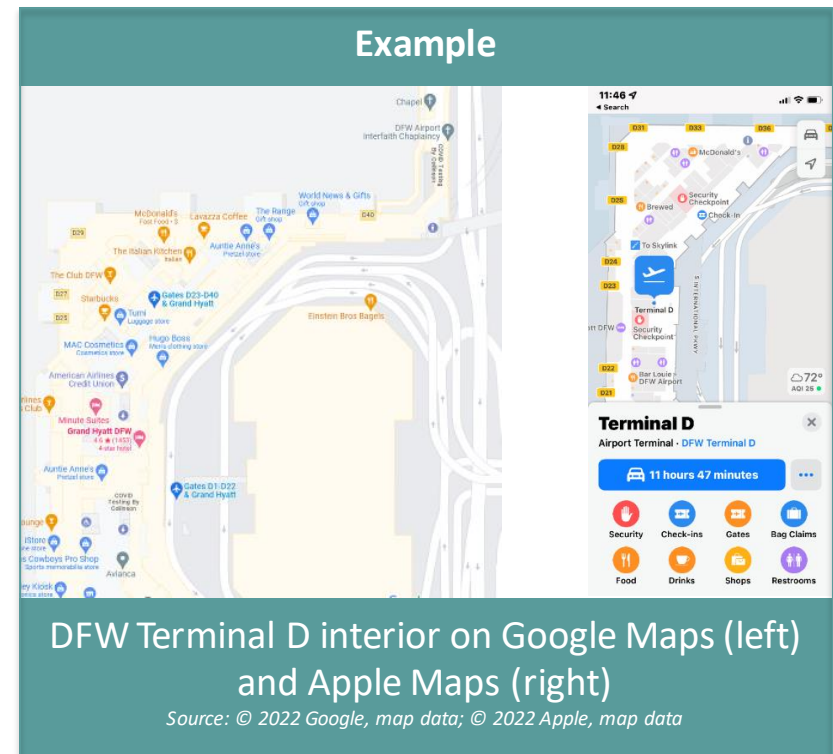
- Some airports have apps that include terminal maps
- Maps are just one feature of the app



# Wayfinding Technologies

## 5. Mobile apps: Third-parties

- E.g., Google, Apple
- Some airports and airlines have private partnerships to develop apps
- Apps are moving toward one-stop shops for multiple customer needs during travel
  - But many apps still focus only on a few parts of the travel experience

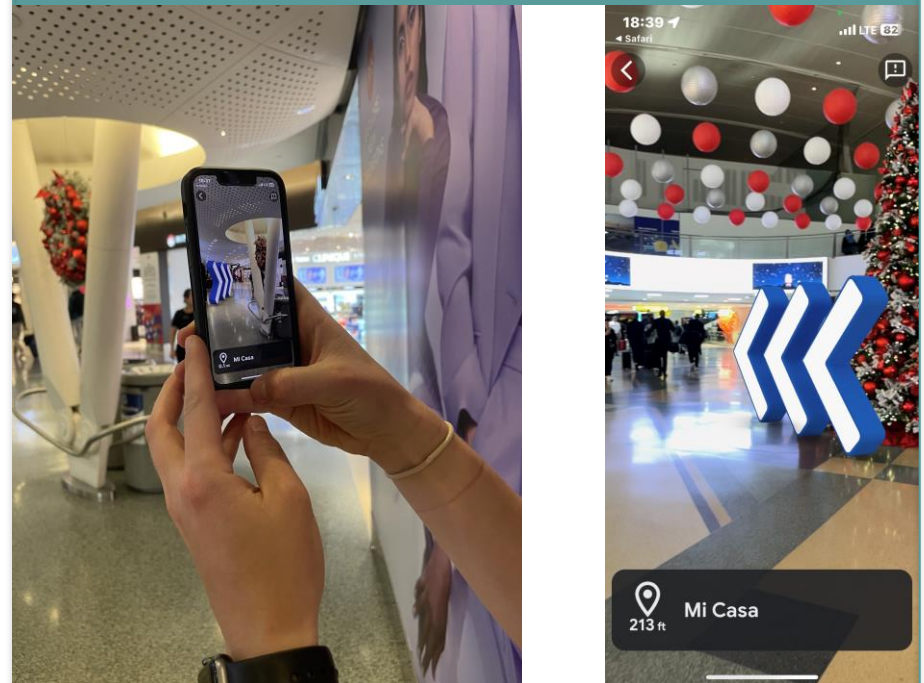


# Wayfinding Technologies

## 5. Mobile apps: Third-parties (cont.)

- Indoor Google Maps (live view) launched in March 2021:
  - Uses a smartphone's camera to scan location, then shows directions on the screen (augmented reality)
  - Compares images to a database of facility images to determine the traveler's orientation
  - Displays directions superimposed on the camera image

### Innovative Example



Indoor Google Maps live view augmented reality directions in John F. Kennedy International Airport Terminal 4

*Photo and screenshot from Bonnie Powell, NREL*



# Wayfinding Technologies

## 5. Mobile apps (cont.):

### — Challenges:

- **Balancing holding a phone** and other items while moving
- Not all travelers **have or can easily operate** a smartphone
- Potential for **conflicting information** between the app and the built environment
- Potential for **conflicting interests** (e.g., commercial interests and traveler interests)



Photo from [Getty Images](#) 1502942937

# Wayfinding Technologies

## 6. Indoor positioning technology:

- GPS technology revolutionized outdoor navigation
- No comparable solution for indoor navigation yet

### Examples

- Comparing smartphone digital camera image to a database of building photos (e.g., Google)
- **Bluetooth Low Energy (BLE)** and **Ultra-Wideband (UWB)** beacons:
  - Common-Use Beacon Registry (set up by SITA), aids app developers.

### Considerations:

- **Customer experience**—risk of notification fatigue
- Customer and employee **privacy**
- **Competition** among airport, airlines, and third parties for data.

# Wayfinding Technologies

## 7. Biometric technology:

- Facial recognition can be used for purposes beyond security
- Concerns about privacy and increased inaccuracies among certain groups (e.g., those with darker skin, women, and older adults)
- Example:
  - Delta Air Lines' Parallel Reality technology displays personalized information on a screen to multiple passengers at the same time

### Innovative Example



Delta Air Lines' Parallel Reality experience at the Detroit Metropolitan Airport

*Photo provided by Bonnie Powell, NREL*

# Wayfinding Technologies

## 8. Robot guides:

### Example



Incheon International Airport

*Photo from [Korea JoongAng Daily](#)*

## 9. Miscellaneous digital navigation tools:

### Examples

- Cairo International Airport, Chicago O'Hare International Airport, Cincinnati/Northern Kentucky International Airport (and more): Self-guided **online virtual tours** to familiarize travelers with an airport prior to arrival
- San Diego International Airport: **Airport carts** with screens displaying personalized information and directions
- Cincinnati/Northern Kentucky International Airport: **3D hologram** planned to guide travelers in the correct direction when exiting an escalator



# Other Key Considerations

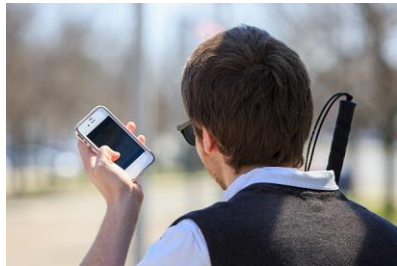


Photo from [Getty Images](#) 586892139

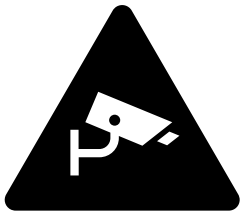
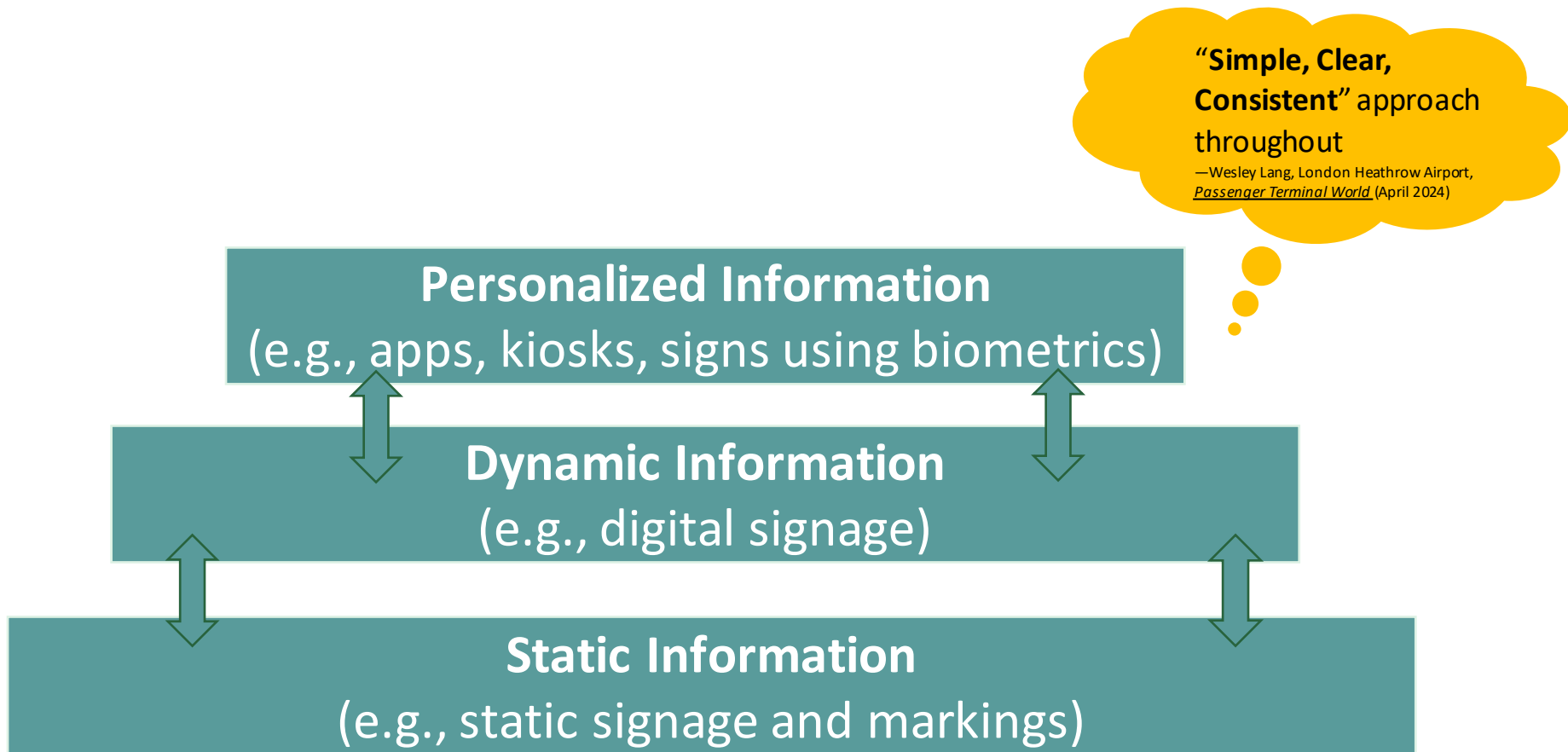


Photo from [Getty Images](#) 2081480435

- **How technologies impact different groups of travelers** (such as those who are disabled, visually impaired, elderly, traveling with small children, etc.)
  - Tailoring wayfinding technologies so they work for more groups of people
  - Developing targeted wayfinding technologies for certain groups (e.g., San Francisco airport deployed a navigation app for visually impaired travelers)
- **Legal considerations related to privacy and sharing data in modern wayfinding:**
  - Compliance with privacy laws
  - Public opinion related to collecting and sharing data
  - Potential tensions among airlines, airports, and third-party app developers vying to cater to the same customer market
- **Human behavior and human-technology interactions:**
  - Passenger surveys and studies are crucial
  - Feedback should be incorporated into technology choices and systems
  - Ideally, this should be an iterative process

# Framework



# Conclusion



**Rapidly changing** area



**Smartphone apps** and push notifications are the anticipated path forward, but they have challenges:

- Notification fatigue: Apps can overload travelers
- Difficult to balance smartphone navigation in dynamic situations
- Must overcome “local positioning problem” for widespread adoption



**Electronic wayfinding** does not replace but rather **augments traditional methods**:

- Well-designed, easy to navigate airport is the foundation
- Effective, concise, up-to-date static signage remains essential
- Electronic bridges to interactive and customized wayfinding capabilities



**Powerful partnership opportunities** moving forward



**Human behavior** studies are critical to any plan or investment—they could prevent the deployment of costly and ineffective technologies and improve existing strategies

# FOR ADDITIONAL INFORMATION



## The Evolution of Wayfinding Within Airports

Bonnie Powell, Stanley E. Young, and Andrew Duvall

*National Renewable Energy Laboratory*

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Bonnie Powell  
[Bonnie.Powell@nrel.gov](mailto:Bonnie.Powell@nrel.gov)

Stan Young  
[Stanley.Young@nrel.gov](mailto:Stanley.Young@nrel.gov)

Andy Duvall  
[Andrew.Duvall@nrel.gov](mailto:Andrew.Duvall@nrel.gov)

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# TRB Webinar: Enhancing the Airport Experience with Wayfinding

## Wayfinding: Lessons Learned and Looking Ahead

Michael Erhart  
Apple Designs

# Michael Erhart

## Vice President

- VP and Senior Project Manager, Apple Designs
- 20 years wayfinding and signage design
- Led custom wayfinding design and programming for numerous airport and large transportation facilities
- Technical innovation lead



# Wayfinding: Lessons Learned and Looking Ahead

The traditional wayfinding experience and how it is changing.

- The purpose: Navigation and efficient passenger movement
- User groups and destinations
- Static signs, maps, and human assistance
- Digital signage and interactive kiosks
- Mobile wayfinding apps and beacon technology

# Wayfinding: Lessons Learned and Looking Ahead

The future (is now) wayfinding experience.

- The purpose: Navigation and efficient passenger movement...and dwell time
- More user groups and destinations
- A relaxing experience: Airport lounges
- A family experience: Visitor pass
- A customized experience: Augmented reality



# The Traditional Wayfinding Experience

The purpose: Navigation and Efficient passenger movement.

- A seamless passenger journey for arriving and departing passengers
- Limited space = hierarchy of information and focused messaging for navigation



# The Traditional Wayfinding Experience

## The challenges of traditional wayfinding

- ➔ Static Nature: Signs and maps cannot dynamically update to reflect real-time changes such as gate alterations or delays.
- ➔ Language Barriers: Travelers from different parts of the world may struggle with signs in foreign languages.
- ➔ Overcrowding: Large crowds can obscure signs and make it difficult for passengers to navigate efficiently.
- ➔ Stress and confusion: The sheer size and complexity of modern airports can overwhelm passengers, particularly those unfamiliar with the layout.

# The Traditional Wayfinding Experience



Columbus Airport

# The Traditional Wayfinding Experience

## Digital Signage and Interactive Kiosks

- ➔ Real-Time Updates: Digital signs can display real-time information about flights, gate changes, and delays.
- ➔ Multilingual Support: They can easily switch between languages, catering to a diverse international audience.
- ➔ Interactivity: Kiosks allow passengers to search for specific locations, amenities, and services, providing personalized directions and information.



# The Traditional Wayfinding Experience



Winnipeg James Armstrong Richardson Int'l Airport



# The Traditional Wayfinding Experience

## Mobile Wayfinding Apps and Beacon Technology

- ➔ Turn-by-Turn Navigation: Similar to GPS for driving, these apps provide step-by-step directions within the airport.
- ➔ Push Notifications: Passengers receive updates about gate changes, boarding times, and other critical information directly on their smartphones.
- ➔ Providing Precise Location Information: Beacons can pinpoint a passenger's location within the airport, allowing for highly accurate navigation.
- ➔ Contextual Information: As passengers move through the airport, beacons can trigger notifications about nearby amenities, shops, and services.

# The Traditional Wayfinding Experience



# The Future Wayfinding Experience

**The purpose: Navigation and efficient passenger movement  
...and dwell time.**

- ➔ An increase of 1% in global passenger satisfaction generates a 1.5% growth of non-aeronautical revenue.  
Solution: Ease of navigation and boutique experiences
- ➔ More user groups and destinations: kids play, adult changing, sensory room, lactation room, airport club, non-ticketed public  
Solution: Dynamic signage and mobile
- ➔ One hour more at an airport is around \$7 more spent per passenger. Conversely, an extra 10 minutes in security reduces an average passenger retail spend by 30%.  
Solution: Biometrics and AR

# The Future Wayfinding Experience

## A Relaxing Experience: Airport Lounges

- ➔ Travelers are increasingly looking to spend on better dining, more lounge access, and new experiences such as sleep suites and pods.
- ➔ Following the trend of seeking out and paying for a better airport experience, increasingly travelers demonstrate their willingness to pay directly to access a lounge.
- ➔ In a recent study, 70 percent of travelers said more options to lounge access would improve their time at the airport.

# The Future Wayfinding Experience

## A Family Experience: Visitor Pass

- ➔ Airports are slowly starting to experiment with day passes and places for those without a flight to hang out and spend more time with their family and friends or shop and dine at the airport.
- ➔ Seattle-Tacoma International Airport (SEA) was the first airport on the West Coast to implement a post-security visitor program in 2018.
- ➔ The ONT+ Visitor Pass Program allows the non-traveling public to visit ONT and enjoy the amenities on the post-security side of the passenger terminal (launched Oct 2022).
- ➔ PHL Wingmate Pass: 1-day pass that permits non-ticketed passengers security, terminal entry (launched Nov 23)



# The Future Wayfinding Experience

## A Customized Experience: Augmented Reality

- ➔ Augmented Reality (AR): Some apps use AR to overlay directions onto the real world through the phone's camera, making it easier for passengers to follow directions.
- ➔ Artificial Intelligence (AI): AI could further personalize the travel experience by learning individual preferences and predicting needs.

# The Future Wayfinding Experience



The convergence of static and digital signs.



# The Future Wayfinding Experience



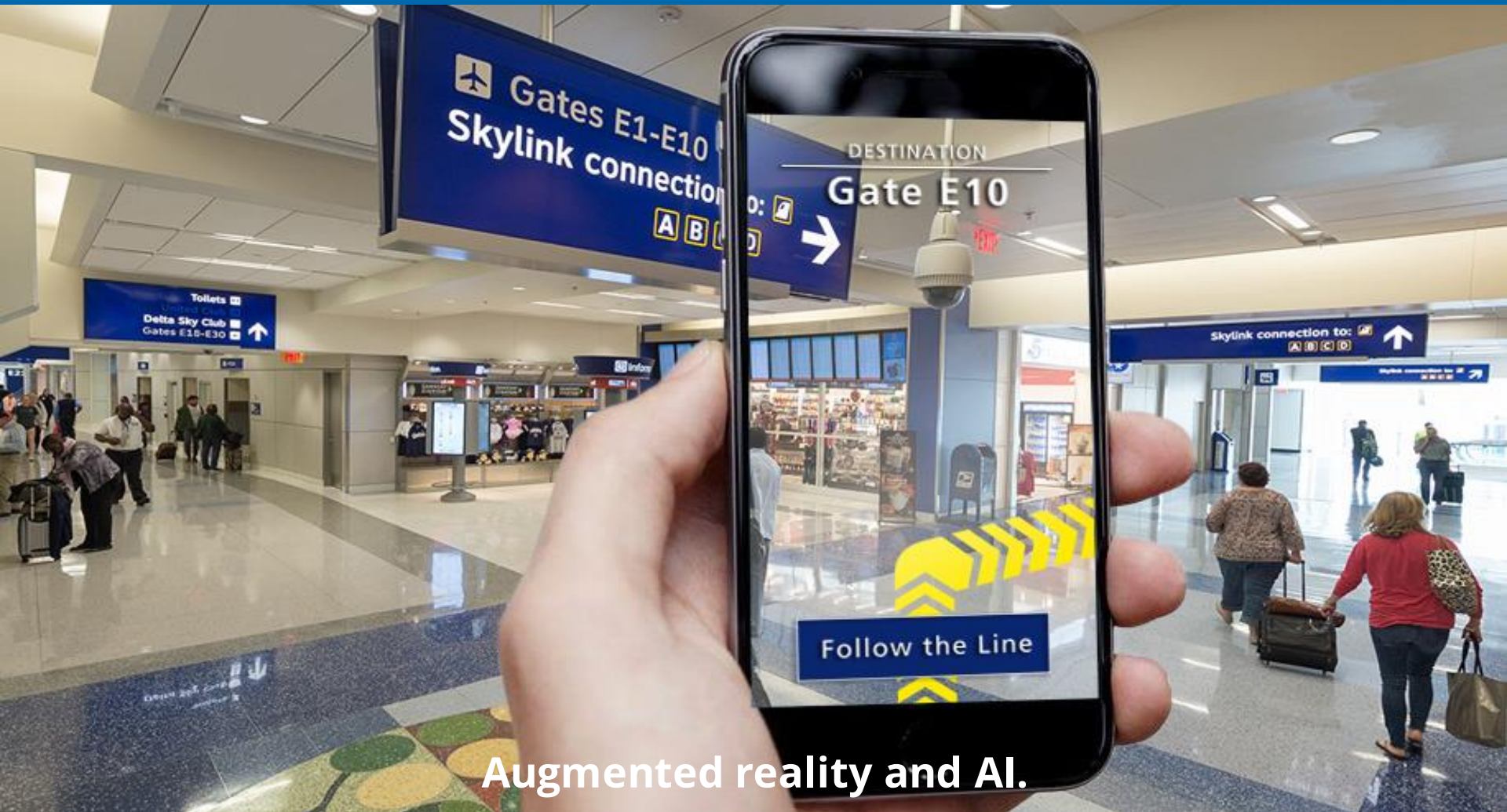
Chicago O'Hare Int'l Airport, Terminal 5 - CBP

# The Future Wayfinding Experience





# The Future Wayfinding Experience



Augmented reality and AI.

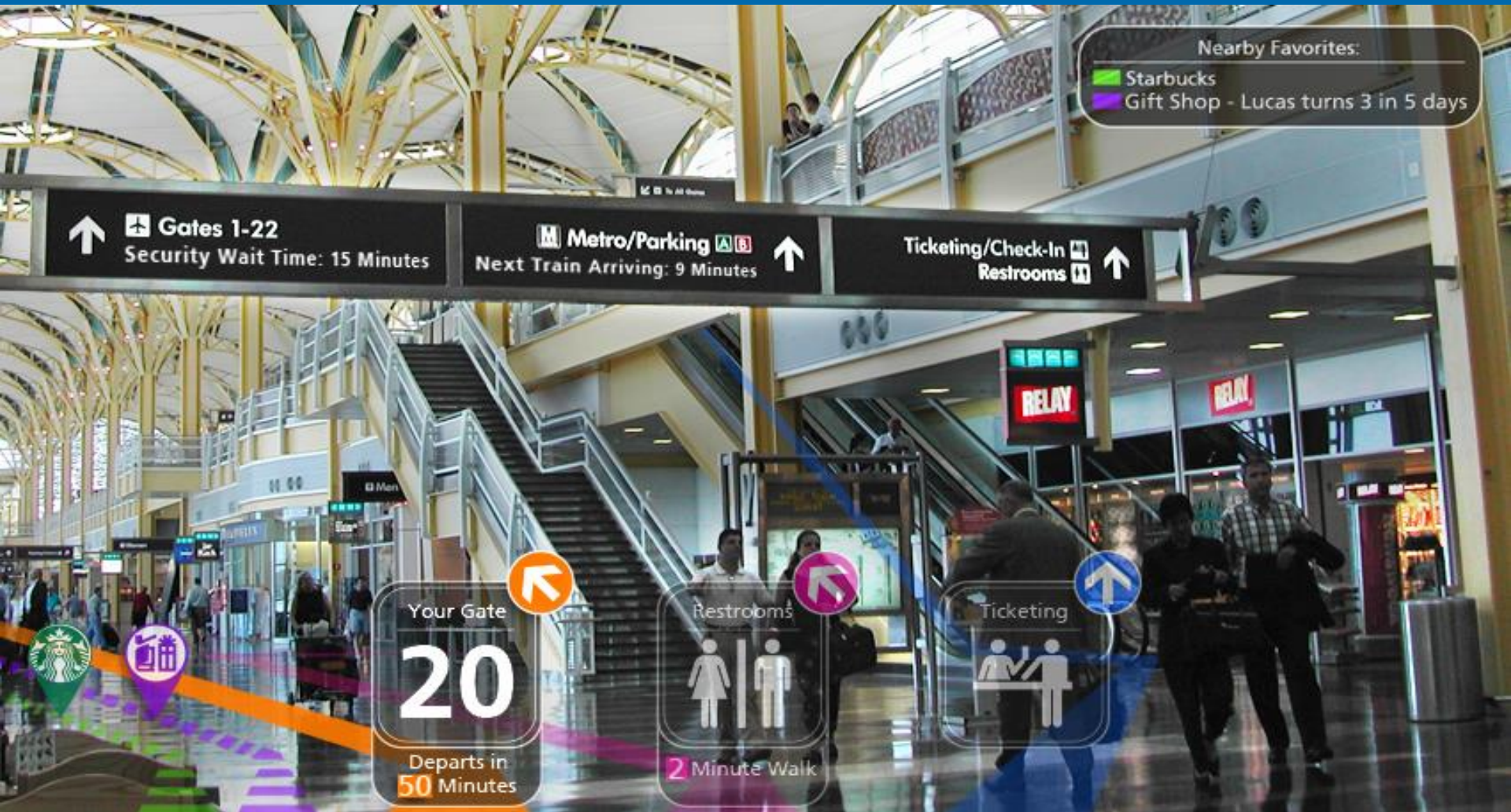


# The Future Wayfinding Experience





# The Future Wayfinding Experience



# FOR ADDITIONAL INFORMATION



Michael Erhart  
[merhart@apple-designs.com](mailto:merhart@apple-designs.com)



Gideon D'Arcangelo

[Gideon.darcangelo@arup.com](mailto:Gideon.darcangelo@arup.com)

Americas Digital Services leader for Arup



Bonnie Powell

[bonnie.powell@nrel.gov](mailto:bonnie.powell@nrel.gov)

National Renewable Energy Laboratory



Michael Erhart

[merhart@apple-designs.com](mailto:merhart@apple-designs.com)

Apple Designs



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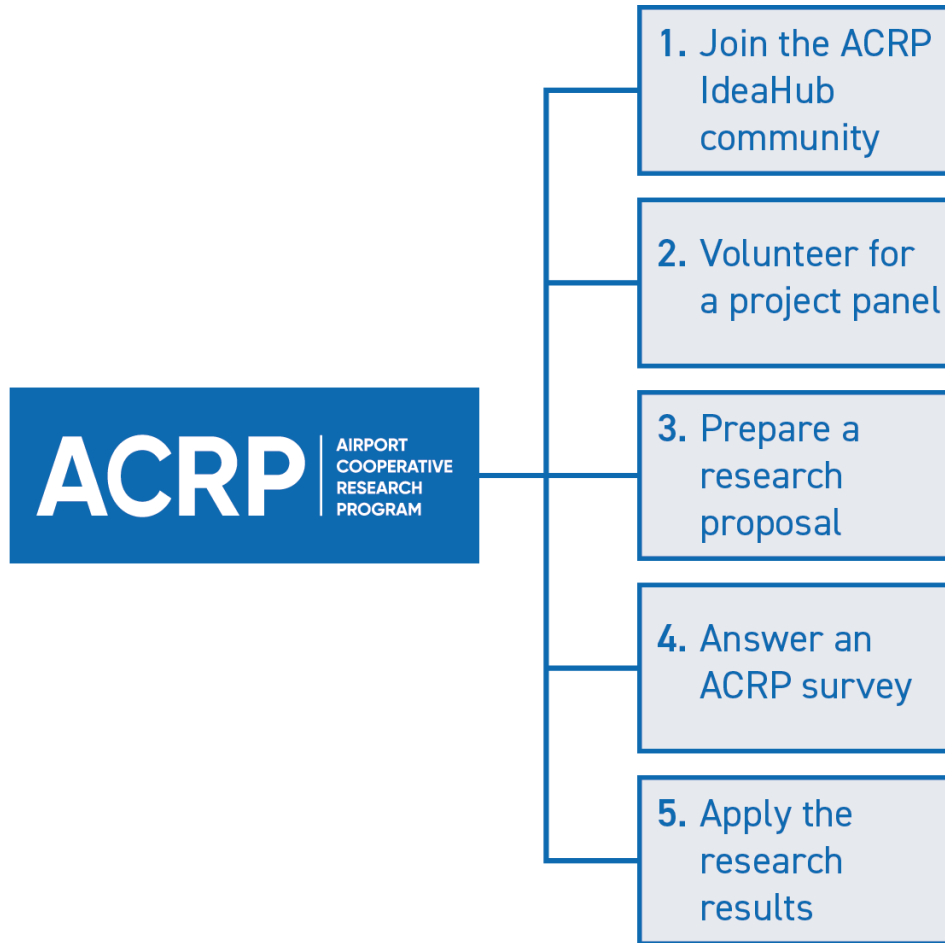
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