TURKISH AVIATION ACADEMY

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Ground Access

Prof. Amedeo Odoni

Istanbul Technical University

Air Transportation Management

M.Sc. Program

Airport Planning and Management

Module 13

March 2015

Objective and Outline

- To review the principal aspects of airport ground access systems and discuss related issues

- Topics:
  - Road access and rail access
  - Geographic distribution of demand
  - Curbside requirements
  - Automobile parking requirements
  - Ground connectors **within** the airport
  - Automated people movers

Airport Ground Access: General Observations

- Provision of adequate facilities and services: a very tough problem
  - Many origin-destination pairs
  - Numerous choices of modes or combinations thereof
  - Several constituencies, variety of needs
- Must provide plenty of spare capacity due to variability of demand, uncertainty, 24-hour operations
- Externalities invite political pressure
- Large investments required; resources are often misallocated
- APM Systems have revolutionized the design of very large terminals

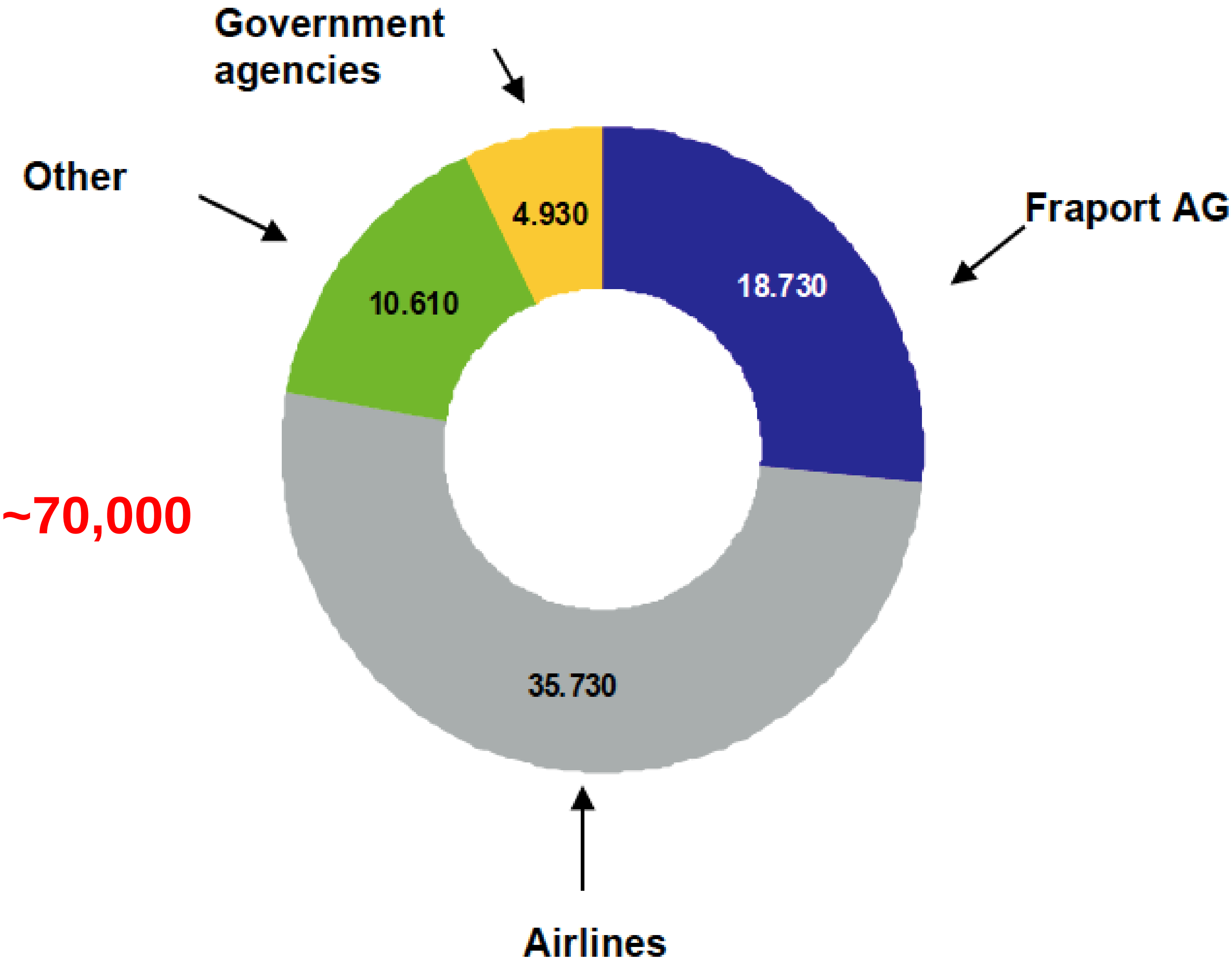
Responsibilities of Airport Access and Parking Departments

- Demand analysis and forecasting
- Short-term parking
- Long-term parking
- Shuttle bus service to long-term parking
- Executive valet parking
- Tourist bus parking
- 24-hour parking and road assistance service
- Airport taxi and car rental services
- Airport railway station
- Airport road system traffic management
- Terminal curbside management
- APM System management and maintenance

Types of Demand for Road Access

- Three types of demand:
  1. Origin-destination passengers and well-wishers/greeters
  2. Airport-related employees
  3. Service, delivery, government and other commercial vehicles
- Type 1 (passengers and well-wishers) is the demand that airport managers mostly focus on:
  - Concentrated at a few locations the airport
  - Must be serviced efficiently and are revenue generators
- Type 2 (employees) may also represent large ground access demand (500 to 1,100 employees per million annual pax at busy airports)
- Type 3 demand can also be large at the busiest airports, especially those having big cargo volumes
- At large airports, each type represents at least 20% of access trips

Employment, Frankfurt Airport



Total ~70,000

Where do they come from?

- O/D passengers are typically dispersed in a metropolitan area
- Only a modest fraction of passengers start or end their trip at the center of the city (this fraction varies significantly depending on city's characteristics)
- Employees typically live at the periphery of the city
- Service and commercial vehicles also typically originate and terminate at the periphery of the city

Number of trips per day: an example

- [Based on Example 17.1 in de Neufville and Odoni]
- Consider an airport with 20 million annual passengers (80% O/D and 20% transfers) and 18,000 employees
- 16 million one-way person-trips per year by O/D passengers to/from the airport or about 44,000 per day
- Each employee comes to the airport about 250 days per year (about 500 one-way trips per year) or about 70% of the days
- Therefore employees make approximately 18000x(0.7)x2 ≈ 25000 one-way person-trips each day
- Thus, employees may add another 50+% to the number of trips made by passengers
- Moreover, employee trips are typically concentrated in the peak ground traffic hours of the day

One-Way Vehicle Trips per Transported Passenger

Access mode	Vehicle-trips per passenger
Private car	1.29
Taxi	1.09
Drive and Park	0.74
Rental Car	0.69
Courtesy Bus	0.33
Scheduled Bus	0.10

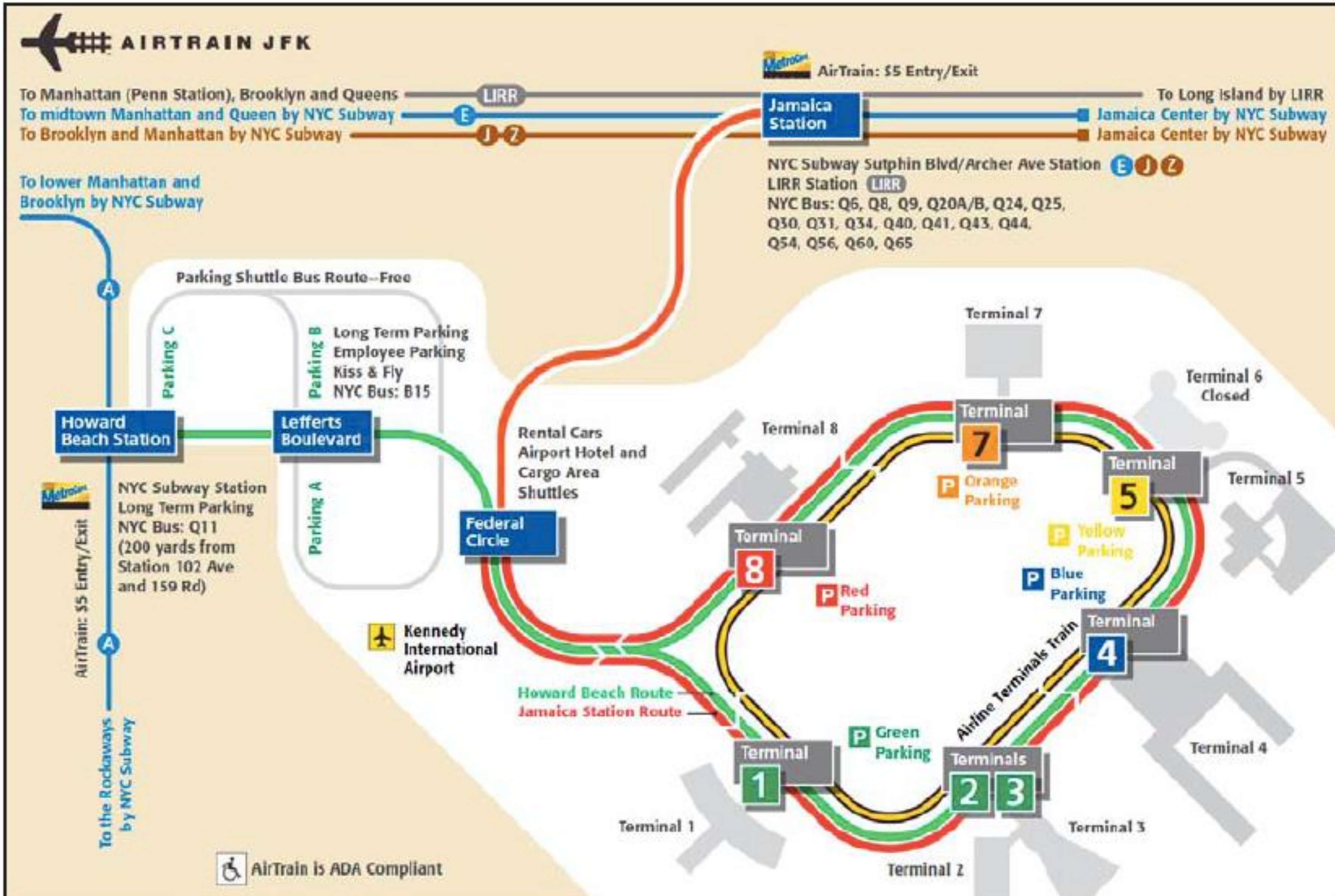
Attitudes toward Access by Private Car

- Many airport operators have an ambiguous attitude concerning ground access by private cars
- Provide ample parking facilities and adequate roadways, recognizing
  - Convenience to passengers that private car offers
  - Revenue potential from car parking and car rentals
- Promote access by public transportation (buses, rail) because of low efficiency of private cars and the environmental impacts and congestion they cause
- Few airports actively discourage access by private cars through unavailability of capacity or exorbitant parking fees
- Private car access to a few airports (e.g., Hong Kong, Osaka Kansai) is prohibitively expensive because of local conditions

Types of Rail Connections

- Direct, special-purpose rail line between the airport and the central city district, possibly with a few intermediate stops (Heathrow Express, Brussels, Milan Malpensa, Shanghai)
- Special-purpose rail line provides a connection between the airport's terminals and the local urban transit rail system (AirTrain at NY JFK, Boston)
- Local urban transit rail system extends to the airport as one of the system's stops (Athens, Hong Kong, London Gatwick, Singapore)
- National rail system extends to the airport as one of the system's stops (Copenhagen, Lyon, New York Newark, Oslo)
- More than one of the above (Amsterdam, Frankfurt, Paris CDG, Tokyo Narita, Zurich)

AirTrain, New York JFK Airport



Airports Served by Rail Systems in Europe [1]

Country	City	Airport	High Speed	Intercity	Metropolitan
Austria	Vienna				yes
Belgium	Brussels				yes
Denmark	Copenhagen			yes	
France	Lyon		yes	yes	
	Paris	de Gaulle	yes	yes	yes
		Orly			yes
Germany	Berlin	Schonefield	planned		yes
	Dresden				yes
	Duesseldorf		yes	yes	yes
	Frankfurt		yes	yes	yes
	Hamburg				yes
	Hannover			u. c.	yes
	Koeln-Bonn		yes		yes
	Leipzig-Halle		yes	yes	yes
	Munich				yes
	Stuttgart				yes
Greece	Athens				yes
Italy	Milan	Malpensa		yes	
	Rome	Fuimicino		yes	

Airports Served by Rail Systems in Europe [2]

Netherlands	Amsterdam			yes	yes
Norway	Oslo			yes	
Poland	Warsaw				yes
Portugal	Lisbon				yes
	Porto				yes
Russia	Moscow	Domodedovo			yes
		Sheremetyevo			yes
Spain	Barcelona				yes
	Madrid				yes
Sweden	Arlanda				yes
Switzerland	Geneva			yes	yes
	Zürich			yes	yes
Turkey	Istanbul				yes
United Kingdom	Birmingham			yes	
	Glasgow				scrapped
	London	Gatwick		yes	
		Heathrow		yes	yes
		Stansted			yes
	Manchester				yes
	Newcastle				yes

Airports Served by Rail Systems in Asia and Australia

Country	City	Airport	Intercity	Metropolitan
Australia	Sydney			yes
China	Beijing			yes
	Shanghai	Pudong		yes
	Hong Kong	Chep Lap Kok		yes
Dubai		Al Maktoum		yes
		International		yes
India	Delhi			yes
Israel	Tel Aviv			yes
Japan	Nagoya	Chubu		yes
	Osaka	Shin Kansai		yes
	Sapporo	Shin Chitose	yes	
	Tokyo	Haneda		yes
		Narita	yes	yes
Korea	Seoul	Gimpo		yes
		Incheon		yes
Malaysia	Kuala Lumpur	Sepang	yes	
Philippines	Manila			planned
Singapore	Singapore	Changi		yes
Thailand	Bangkok	Don Muang	yes	
		Suvarnabhumi		yes

Airports Served by Rail Systems in Canada and USA

City	Airport	Intercity	Metropolitan
Atlanta			yes
Baltimore			yes
Boston	Logan		yes
Chicago	Midway		yes
Chicago	O'Hare		yes
	Midway		yes
Cleveland			yes
New York	Kennedy		yes
	Newark Liberty	yes	
Minneapolis/St.P			yes
Philadelphia			yes
Phoenix			yes
Portland (Oregon)			yes
San Francisco	International		yes
	Oakland		yes
St. Louis			yes
Toronto CANADA			u.c.
Vancouver CANADA			yes
Washington	Baltimore		yes
	Dulles		u.c.
	Reagan		yes

The Advantages of Road Access

- People with bags:
  - have a strong preference for door-to-door access to airports without need for a transfer
  - only private cars and taxis can offer this
- People who travel without heavy bags:
  - typically business travelers who can pay for the convenience that a taxi or a rented car can offer
- Therefore difficult for rail systems to compete with the attractiveness to passengers of road access to airports
- Rail links to airports are competitive only if they:
  - Provide efficient access to a large number of destinations in a metropolitan area
  - Are connected to a national rail system
  - Offer a significant cost advantage

Access Modal Share for a Major Airport*

	Access Modal Share (without employees) 2011	Access Modal Share (without employees) 2014	Access Modal Share (with employees) 2014
Private car/rental	34%	36%	35%
Taxi	49%	37%	29%
Van/Coach	4%	7%	8%
Bus	3%	4%	12%
Subway/Metro	10%	16%	17%
Total	100%	100%	100%

* This airport is in a city with an excellent public transport system

Market Share of Passengers Served by Rail Systems

United States		Europe and Asia	
Airport	Market Share	Airport	Market Share
Washington/Reagan	14	Oslo	43
Atlanta	8	Tokyo/Narita	36
Chicago/Midway	8	Geneva	35
Boston	6	Zurich	34
Oakland	4	Munich	31
Chicago/O'Hare	4	Frankfurt	27
St. Louis	3	London/Stansted	27
Cleveland	3	Amsterdam	25
Philadelphia	2	London/Heathrow	25
Miami	1	Hong Kong	24
Baltimore	1	London/Gatwick	20
Los Angeles	1	Paris/de Gaulle	20

Conclusions re Access via Public Transport

- High-speed rail access to a city center may address the needs of only a modest fraction of passengers
- Public transport (rail, bus, shared vans/coach) typically has less than a 50% share of ground access trips to and from busy airports – often much less than 50%
- Access by non-public transport (private cars, taxis, car rental) enjoys a significant advantage, in terms of passenger convenience; this advantage is hard to overcome, despite the (out-of-pocket) cost disadvantage of non-public transport
- Providing a competitive set of options for public transport to/from airports can be very expensive in terms of capital and operating costs
  - Best case is when a well-developed public transport infrastructure exists already and the airport-related options are only marginal additions to the existing infrastructure

A Formula for Curbside Length Requirement

- $$C_1 = P \times M_1 \times F_1 \times \left(\frac{D_1}{60}\right) \times L_1 \times \left(\frac{1}{V_1}\right) \qquad (1)$$

C_1= the length of curbside that must be provided for cars (private automobiles, taxis, etc.)

P = peak hour passengers at the terminal*

M_1= fraction of passengers who choose cars for ground access

F_1= fraction of car-using passengers who use the curbside

D_1= average stay ("dwell time") of a car at curbside (in **minutes**)

L_1= length of curbside needed to park an average car briefly

V_1= average number of passengers per car (not including driver)

* *P* is the total number of peak hour passengers, if the curbside is common for arriving and departing passengers; or only the number of arriving passengers; or only of departing ones

A Formula for Curbside Length Requirement [2]

- For buses, hotel vans and shuttle buses, an expression entirely analogous to (1) can be used to compute C_2, the length of curbside necessary to serve such buses and vans
- The total length of curbside is then given by $C = C_1 + C_2$
- Typical values for the length of curbside needed to park a vehicle are L_1=7 m for cars and L_2=14 m for buses
- Typical values, in minutes for dwell times, *D,* for US airports:

Private Cars	2 - 4
Taxis and Limousines	1 - 3
Vans and Shuttles	2 - 5
Other	Varies

The higher values apply to arrivals and the lower values to departures; **enforcement** is **critical**

- The fractions, *M* and *F,* and the number of passengers per vehicle, *V,* depend on local conditions and can only be determined from surveys or by comparison to similar airports

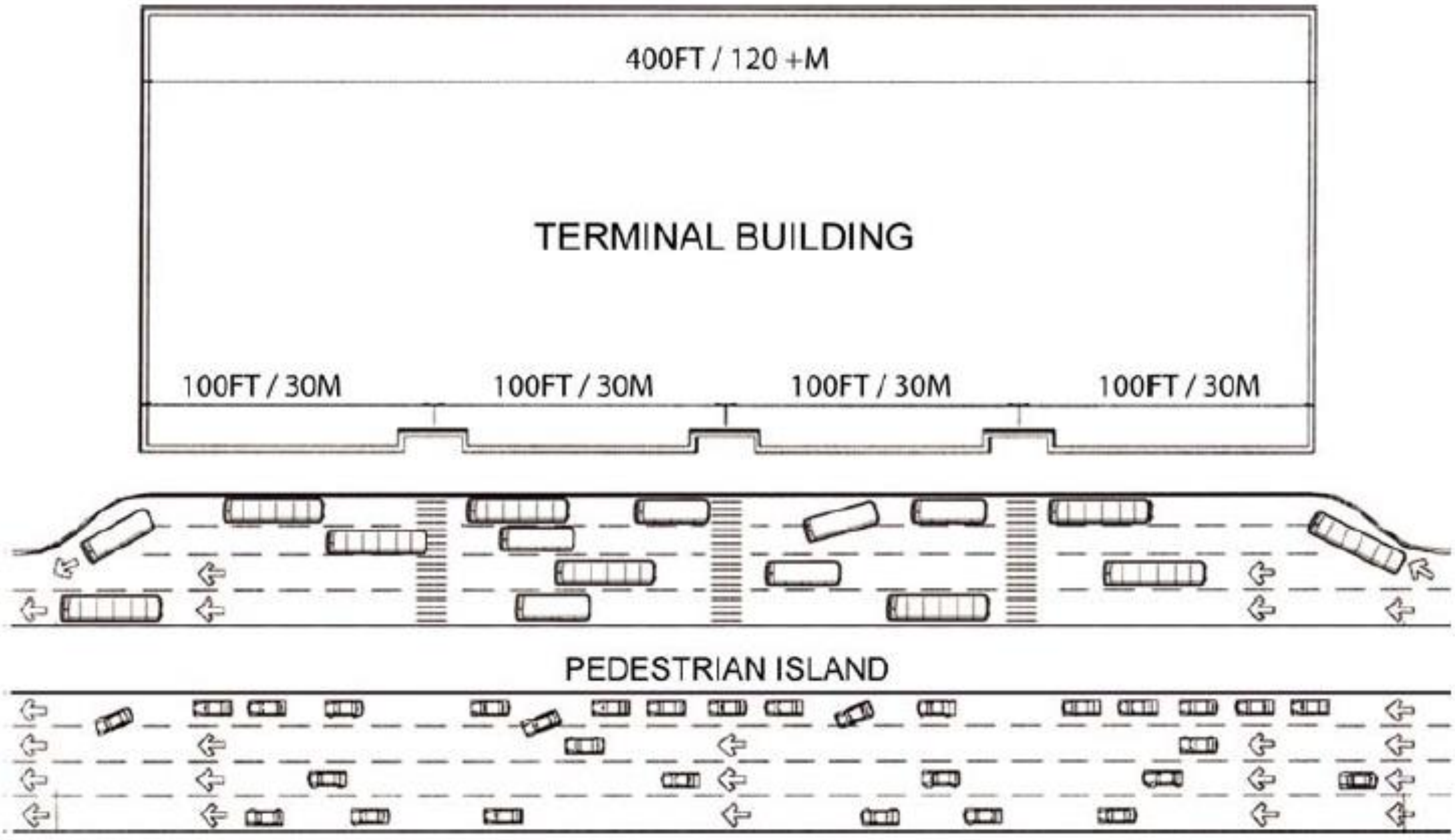
A Numerical Example

- Consider a terminal with a 2-level access road – upper level for departures, lower for arrivals
- Consider the curbside length requirement for cars at the departures level
- Assume 2,400 peak-hour departing pax [corresponds to roughly 10 million total annual pax (= arriving + departing) at the terminal]
- Assume M_1=0.5, F_1=0.6, D_1=2 min, L_1=7.2 m and V_1=1.2 pax/car (all of these are reasonable values for some types of airports)
- From (1), we have C_1= 144 m is the needed curbside length requirement for cars (private + taxis) only
- Note the sensitivity to each of the assumptions above; for example, if D_1=3 min (instead of 2), C_1=216 m

Some Curbside Planning Guidelines

- To maximize curbside availability:
  - Place pedestrian islands between access road lanes
  - Construct 2-level access road to separate departures curbside (upper level) from arrivals curbside (lower level)
- Enforce short dwell times (this is critical)
- Separate bus and van traffic from car traffic, if possible
- Provide remote areas where taxis can wait until their turn to pick up arriving passengers
- Provide short-term parking where greeters can wait until they can pick up the arriving passengers they are waiting for
- Smartphones, technology can be helpful
- Spreadsheet analyses can be performed easily; accurate inputs is the key

Sketch of curbside design with pedestrian island



Source: Silverman, Fred. "Terminal Groundside Access Systems," FAA White Paper

From: *Airport Passenger Terminal Planning and Design,* ACRP Rpt 25, vol. 1

Example of Curbside Requirements Estimation

	Single Curb Model								
11		Design Hour	Peak 15 Minutes	Vehicle		Peak 15 Min.	Vehicle	Peak 15 Min.	Peak 15 Min.
12		Demand in	as % of Demand	Dwell Time	Multiple	Demand in	Length	Demand	Demand
13	**Vehicle Type**	**Vehicles**	30%	**(min.)**	**Stop Factor**	**Minutes**	**(ft)**	**(ft* min.)**	**(ft)**
14	Private Auto	500	**150**	3.0	1.0	**450**	22	**9,900**	**660**
15	Rental Car Shuttle*	50	**15**	2.0	1.0	**30**	50	**1,500**	**100**
16	Taxis	200	**60**	1.5	1.0	**90**	22	**1,980**	**132**
17	Limousines	100	**30**	2.0	1.0	**60**	50	**3,000**	**200**
18	Hotel Shuttles*	30	**9**	2.0	1.0	**18**	50	**900**	**60**
19	Airport Shuttles*	30	**9**	2.0	1.0	**18**	40	**720**	**48**
20	Buses*	30	**9**	2.0	1.0	**18**	50	**900**	**60**
21	Other	30	**9**	2.0	1.0	**18**	30	**540**	**36**
22	Total	**970**	**291**					Total	**1,296**
23									
24	Existing Curbfront Length		1,200	ft		Existing Capacity Ratio	**0.54**		
25	Effective Double Parking Capacity**		**2,400**	ft		Existing Level of Service (LOS)	**B**		
26							**Required LOS 'C'** Curbfront Range = from	**997**	ft
27	* Consult the schedules to determine the maximum frequency of each vehicle						to	**1157**	ft
28	** Assumes a 4 lane curbside roadway where double parking is allowed								

Source: *Airport Passenger Terminal Planning and Design*, ACRP Report 25, vol. 2

Curbside: LOS A

Source: *Airport Passenger Terminal Planning and Design*, ACRP Report 25, vol. 1

Curbside: LOS C

Source: *Airport Passenger Terminal Planning and Design,* ACRP Report 25, vol. 1

Double-parking near doors is common and occasional triple-parking may occur. This LOS is appropriate for peak period design conditions at major airports. Demand is between 55% and 65% of the double-parking capacity of the curbside. Capacity of adjacent lanes is reduced by about 5% due to increased frequency of double-parking.

Curbside: LOS F

Source: *Airport Passenger Terminal Planning and Design,* ACRP Report 25, vol. 1

Airport Parking Facilities

- A critical component of the ground access system at most airports
- Often critical to airport revenues; can be highest generator of income at some airports
- Widely differing provisions depending on country and car ownership and use
  - 200* - 1,400** spaces per million annual pax
    - * typical of some European airports
    - ** the highest number encountered at US airports
  - 300 - 400 per 1000 airport-related employees
- An airport with 50 million passengers may require as many as 30,000 or more total parking positions for passengers and employees!

Types of Automobile Parking Facilities

- Short-term (pick-up of arriving pax) [1,200 cars/year per space; high charges]
- Premium (or "valet") parking: special services, very expensive
- "Structured parking": a multi-level building, typical occupancy of one to a few days per space [200 cars/year per space; 35 m^2 per space; high capital cost, $20+K or more per space in United States; $20+ per day]
- Long-term parking: used by people on long trips (several days to weeks occupancy); usually remotely located
- Rental car parking: often remotely located; often consolidated, multi-story facilities for several rental car companies
- Employee parking: can require large numbers of spaces; but emplyee parking areas can be widely dispersed within the airport site

Characteristics of Parkers: Athens

	Short-term	Long-term
Purpose of visit	Meeters/greeters (78%)	Passengers (94%), business travel (83%)
Frequent flyers?	No (4 trips/yr)	Yes (18 trips/yr)
Economic status	Medium (75%)	High and high-medium (86%)

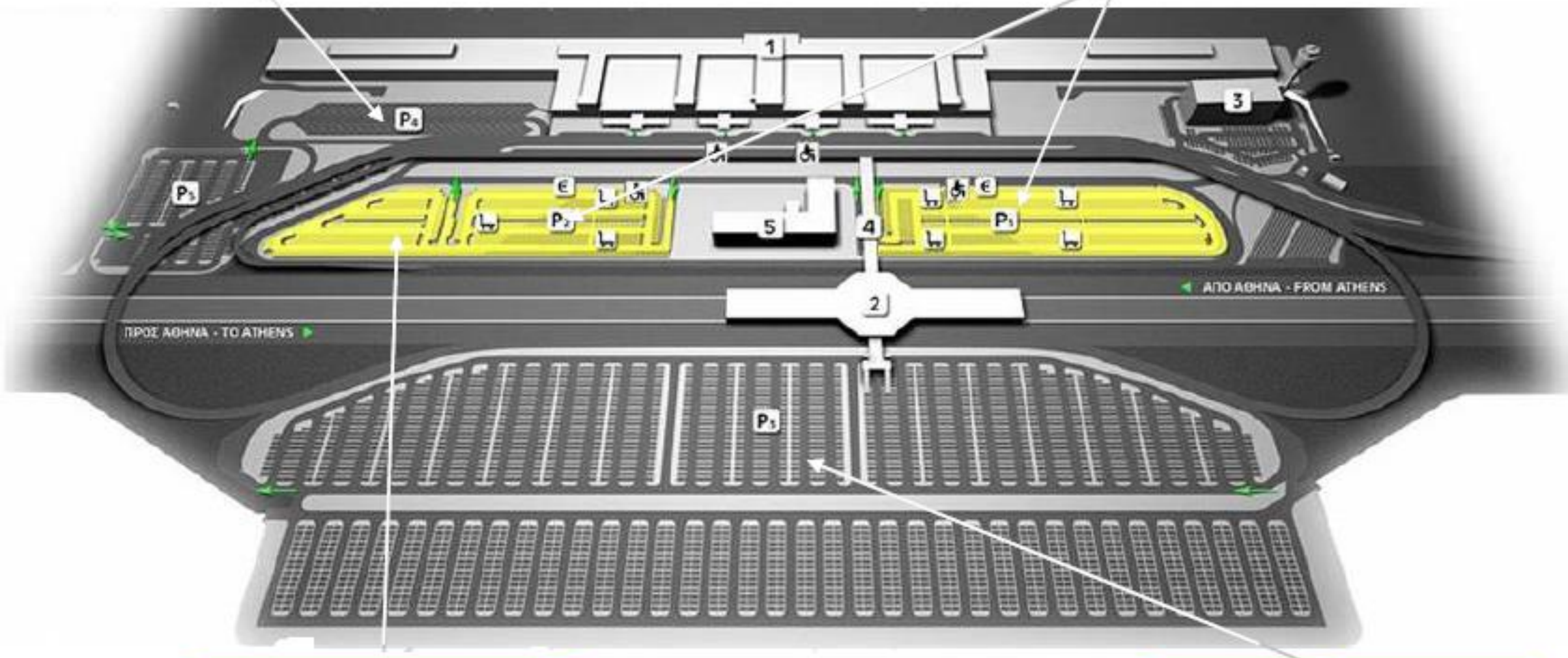
Future plans:

- Upgrade of parking equipment
- Multi-storey parking facility (+5000 spaces by 2016)
- Introduction of new parking products thereafter

Athens Airport: Parking Facilities

Bus lot : P4
(48 spaces)

Short Term : P1 & P2
(Short Term – 1,132 spaces)



Executive Valet
(225 spaces)

Long Term : P3
(3,700 spaces)

Automated People Movers (APM)

- A technology that has made possible a true revolution in airport design
- Enables the development of airports and terminal buildings with enormous capacity
- 1971 Tampa Airport (conventional satellites)
- 1978 Atlanta Airport (midfield satellites)
- APM systems (actual or planned) at ~50 airports as of 2015
- "Landside APM systems": Accessible to general public; connect different terminals, or terminals to train stations or terminals to ground access systems
- "Airside APM systems": Accessible only to those who have been screened (security check or boarding pass) for access to airside (gates, stands)

APM Technology

- Steadily-improving technologies and performance
- Self-propelled vehicles (most with rubber tires) or cable-propelled
- Exclusive guideways (single-lane or dual-lane)
- Automated (driverless, centrally controlled)
- A few manufacturers dominate
  - Self-propelled APM: Bombardier Transportation Holdings, Mitsubishi, IHI/Nigata,Siemens
  - Cable-propelled APM: Doppelmayr Cable Cars, Leitner-Puma
- Capital intensive (typically very expensive)
- Highly reliable with solid safety record
- Not subject to congestion and delays

Design Considerations for APM Systems

- APM systems have different characteristics and requirements
  - Speed (30 – 80 km/hr)
  - Seating (few seats, everyone sitting)
  - Vehicle capacity (4 seats to 50+ standing passengers)
  - Baggage-carrying capacity and space (only hand luggage, full luggage including baggage carts)
  - Guideway design and location (elevated structures, roofs, tunnels, at grade)
  - Frequency of service (2-3 min to 10 min)
  - Routing (fixed, flexible)
  - Passenger separation (departing only, arriving only, both)
  - Passenger information systems (an important consideration)

Airport APMs: Americas

Airport	Airside	Landside	Airport	Airside	Landside
Atlanta	X	X	New York EWR		X
Chicago (ORD)		X	Orlando (MCO)	X	
Cincinnati	X		Oakland		X
Dallas/Ft. Worth	X		Phoenix		X
Denver	X		Pittsburgh	X	
Detroit	X		Sacramento	X	
Houston	X	X	San Francisco		X
Las Vegas	X		Seattle-Tacoma	X	
Mexico City		X	Tampa	X	X
Miami	X	X	Toronto		X
Minneapolis	X	X	Washington Dulles	X	
New York JFK		X			

Airport APMs: Europe, Asia, Middle East

Airport	Airside	Landside	Airport	Airside	Landside
Birmingham		X	Beijing	X	X
Dusseldorf		X	Hong Kong	X	X
Frankfurt		X	Kuala Lumpur	X	X
London LGW		X	Osaka Kansai	X	X
London LHR	X	X	Seoul Incheon	X	
London Stansted	X		Singapore	X	X
Madrid	X		Taipei	X	X
Paris CDG	X	X	Tokyo Narita	X	
Paris Orly		X	Cairo		X
Rome	X		Doha	X	
Zurich	X		Dubai	X	X
			Jeddah	X	

Landside APM Vehicles

AirTrain – New York JFK (Bombardier)

Suspended Monorail – Dusseldorf (Siemens)

Airside APM Vehicles

Bypass Shuttle – Tokyo Narita (Leitner-Poma)

Cable-propelled, air levitated – Detroit Metro (Leitner-Poma)

Minimum Connecting Time

- **Minimum Connecting Time (MCT)** is used by airlines to specify the minimum time required for passengers to transfer between connecting flights at a particular airport
- MCT is very important in practice, because it is used to issue tickets to connecting passengers: MCT essentially determines which connections are “legitimate” (feasible) and which are not
- Therefore crucial to airlines and to operators of “hub” airports
- However, if applied uncritically, the MCT just measures the time required to transfer between the farthest pair of gates in an airport
- Simply penalizes the airports with the biggest terminals, which are also the most important ones
- **MCT must be refined to be useful!**

Minimum Connecting Time [2]

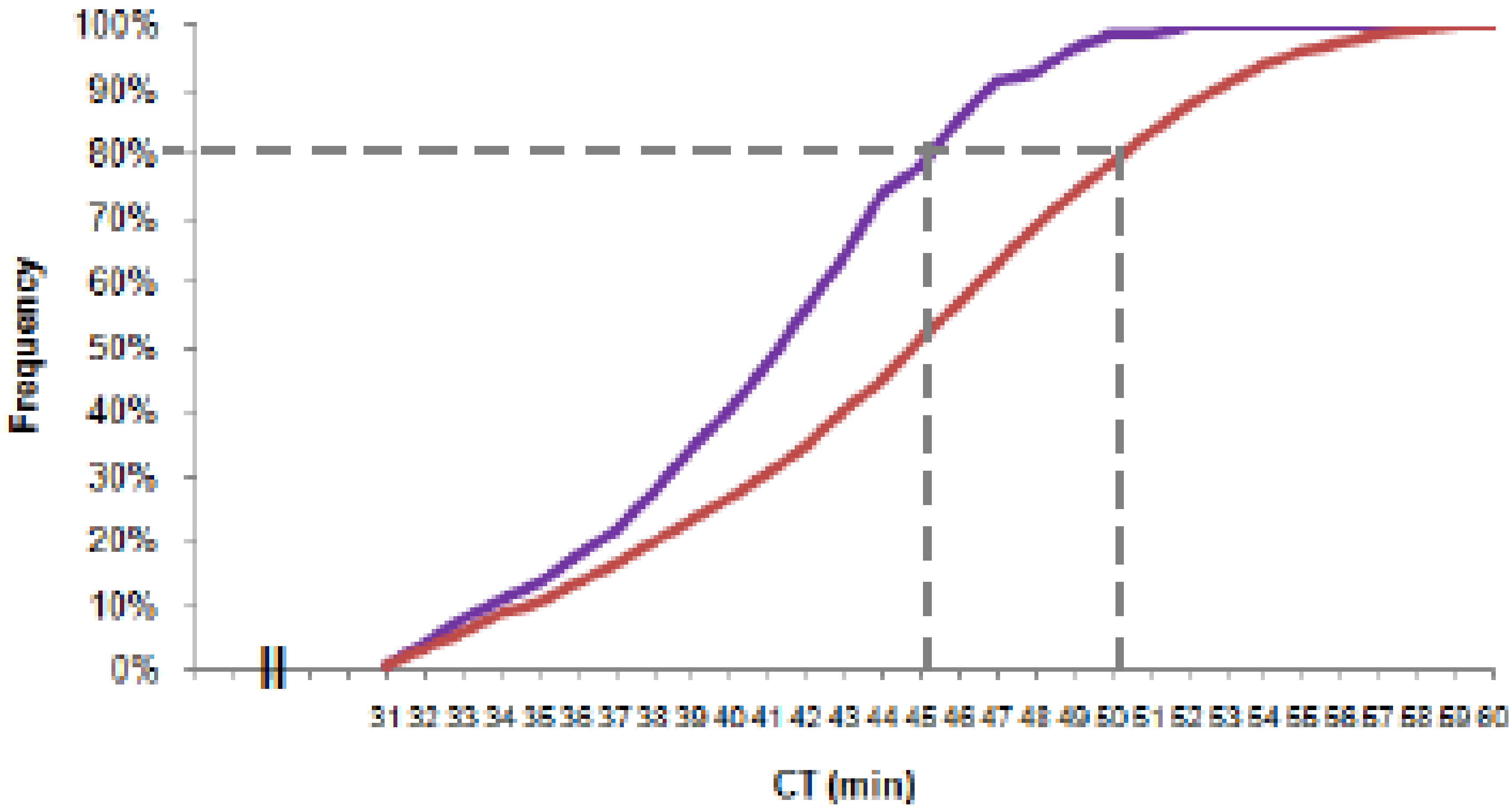
- Increasing number of airports specify multiple MCTs
  - Example: New York JFK

  MCT = 35 min domestic-domestic connection, same terminal

  MCT = 40 min domestic-international, same terminal

  MCT = 75 min domestic-international, different terminals
- Still very difficult to determine MCT because of numerous complicating factors that impact the values of MCT:
  - Disembarkation (what time to assume?), security screening, gate closure
  - Bag transfer time
  - Several alternative paths may exist between two gates (APM, walking)
- Travel agents and experienced passengers do not place much trust in the MCT that airports and airlines announce
- MCT can be reduced through judicious gate assignments

Distribution of Connection Times; Gate Assignment



- Cumulative distribution of connecting times under two different sets of flight gate assignments ("purple" assignment is better than "red" assignment)

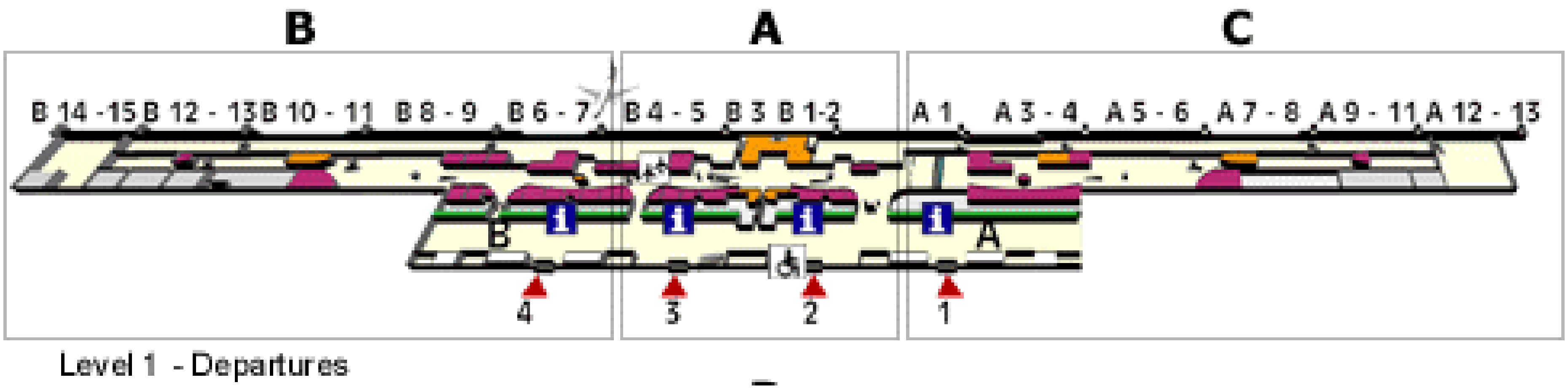
Baggage Handling Systems (BHS)

- Absolutely critical to all airports!
- Increasingly complex and enormously expensive at major airports
- Their design must address many difficult technical problems and, in turn, imposes many costs and constraints on the design of the entire terminal
- Three main elements:
  - Subsystem for security inspection of the checked bags
  - IT-based control systems that keep track of bags and route them through the terminal
  - Mechanical systems that convey checked-in bags and transfer bags through the terminal

Theoretical vs. Actual Performance

- The actual performance and capacity of large and complex BHS often falls far short (e.g., by one-third!) of the theoretical values
- Numerous technical problems may surface (e.g., unreliable mechanical components, difficulty in reading tags)
- Flow control problems may also contribute to serious performance deterioration (e.g., queuing problems, bottlenecks, load imbalances)
- Denver International in the 1990s is well-known example ($500 million increase in cost, 15 months of delay in airport opening at $30 million per month)

Main Terminal Building (MTB): Departures Level

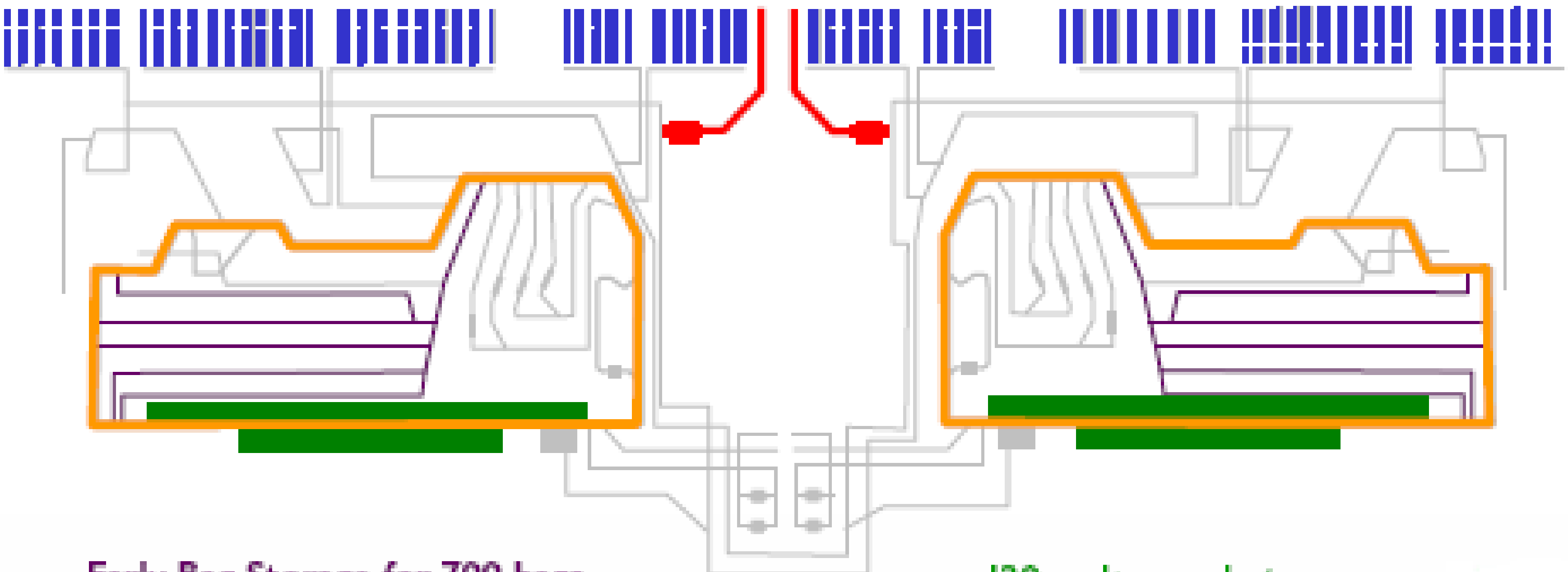


The Athens BHS

2 sorters

144 in-gauge check-in counters operated by airlines

2 out-of-gauge (OOG) counters operated by AIA



Early Bag Storage for 700 bags

120 make-up chutes

BHS Athens

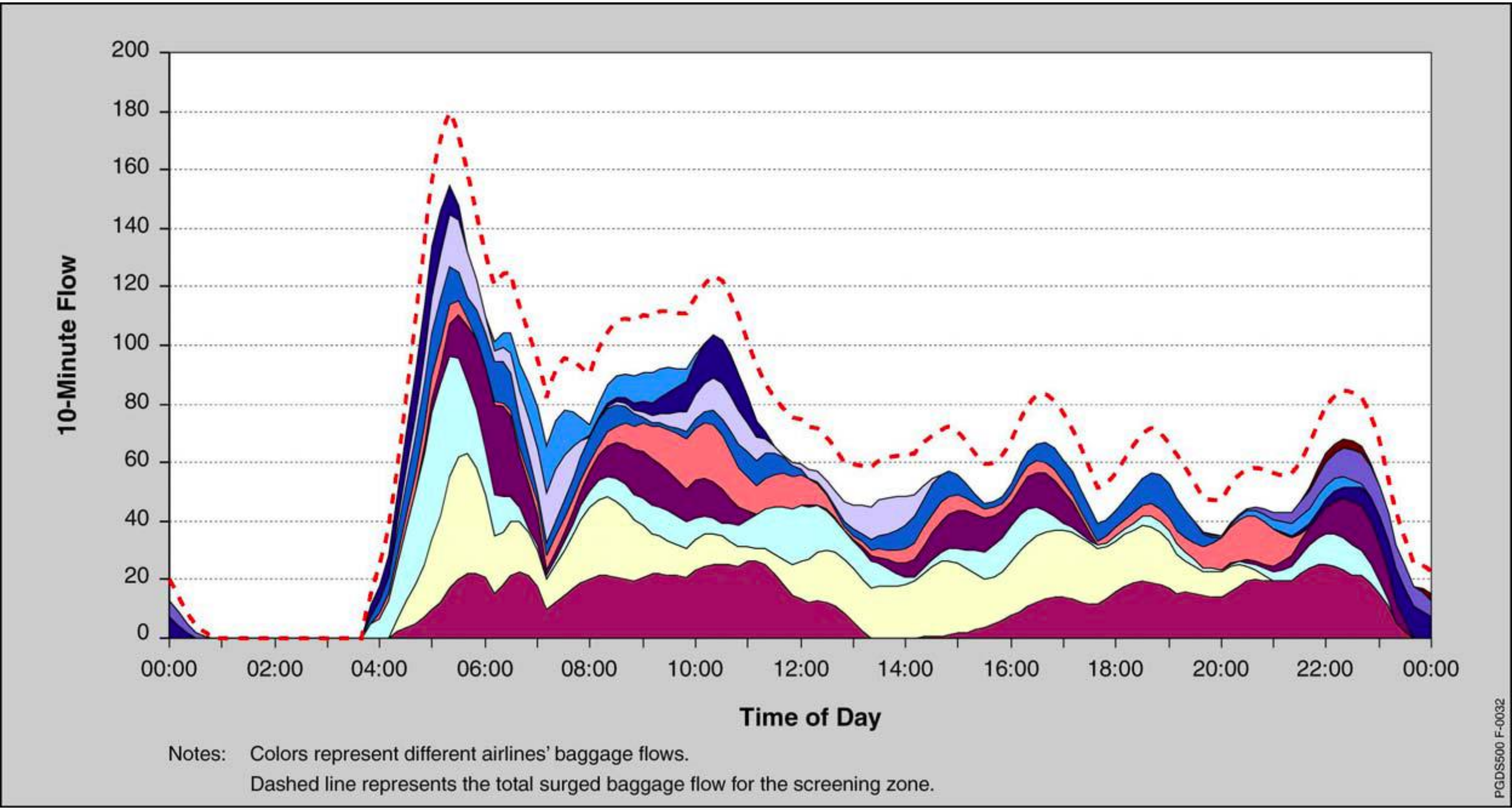
- Type: Tilt Tray Sorter system with 5-level screening
- Bar code labels (~6 cents each)
- Capacity: 10,500 bags per hour
- Two sorters, North and South
- Sorter speed: 1.9 m per second
- 100% hold baggage screening
- 4 feeding lines for transfer baggage
- 4 manual coding stations
- 6 km+ of conveyor lines [*modest compared to many others*]
- More than 30,000 moving parts
- 11 baggage claim carousels (arrivals) sub-divided into Schengen and extra-Schengen

BHS Athens: Some Annual Statistics

Annual volume:	6.9 million bags
Oversize ("out of gauge" – OOG):	1%
Transfer bags:	12.4%
Peak month:	830,000 bags
Peak day:	41,000 bags
Peak hour:	8,200 bags
Average day:	18,600 bags
System availability:	99.6%
Mis-sortation rate:	1 bag in 30,000
Bags per passenger:	0.97
Manual handling staff (peak periods):	55 handlers and coders
Control room staff:	14 schedulers + controllers

What to Plan for?

Source of figure: PGDS



Baggage Claim (Arriving Passengers)

- The simplest, as a process, part of baggage handling
- Yet, may be the most important, as far as passenger perceptions are concerned
- Passenger information is critical in shaping perceptions
  - “Time to first baggage”, etc
- IATA guidelines:
  - ~ 0.3 m (~1 ft) of linear frontage per passenger for bag claim devices (wide body: ~ 80 – 120 m; narrow body: ~ 30 – 50 m)
  - ~ 9 m (or more) between bag claim devices
- Issue of allocation of carousels at terminals sharing flights subject to or exempt from customs inspection (e.g., extra-Schengen vs. Schengen)
- Bag claim halls at large terminals may be vast, especially when many long-range flights are involved

Growing Importance of Security-Related Issues

- Over the past 25 years, and especially since 2001, security has become
  - The most important source of uncertainty in planning for passenger terminal facilities
  - The fastest-growing cost element at airports

- Security regulations change rapidly in response to events and airport planners and operators have no choice but to comply with any changed mandates

- Changes may affect not only security processing requirements (facilities, equipment, personnel) but also fundamental aspects of air transport operations (e.g., passenger behavior, liquid-explosives scare of 2006 ➔ 20% increase in checked bags)

Costs of Airport Security

- Cost of passenger screening at airport terminals in USA is roughly $6 billion per year (TSA cost plus equipment cost) – roughly $10 per passenger
- Cost in Europe is roughly $5 billion (similar to US on a per passenger basis)
- Security processing and "early presentation" requirements also increase the time that passengers allocate to travel
- Cost of this additional time is very large; for example:

  (20 extra minutes per departing passenger)x(500 million passengers)x($0.5 per passenger minute) = $5 billion per year in US alone!

Who Pays?

- Passengers and airlines in US pay for roughly 40% of the $6 billion airport security costs through ticket taxes and charges to airlines ($2.50 ticket tax for each of first two segments of a one-way trip)
- General tax funds pay for the remainder
- User burden varies widely from country to country
- Users requiring special services often pay extra
- European Parliament (summer 2008): “Aviation security is a government responsibility; governments should pay for most of the costs, except when special arrangements are sought”

Who Provides the Service?

- Varies widely according to national law:
  - Government (special agency like TSA; national Police; national Army)
  - Airport operator
  - Subcontractor (“outsourcing”)
- In all cases, national government retains responsibility for authorizing and monitoring arrangements
- Labor issues arising with increasing frequency; can disrupt airport operations

Major Security Tasks

- Passenger and Hand Baggage Screening
- Access Control
- Hold Baggage Screening
- Baggage Reconciliation

- http://news.bbc.co.uk/2/hi/uk_news/8449008.stm

Ongoing Developments

- Very fast evolution of BHS
- Increased sophistication, complexity, automation
- Security costs have accelerated the "demise" of linear, decentralized terminal concept
- Huge costs (e.g., large systems of ~$500 million)
- Increased role of radio frequency identification (RFID) technologies: more reliable than bar code tags, can incorporate a lot of information, cost is rapidly declining, but still about 4 times higher
- "Big players" entering the field

References

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Questions? Comments?