Outline

• Introduction
• The historical development of airport terminals
• Components of the airport terminal
• Airport ground access
Introduction

• The airport terminal is not an end point, but an area of transfer along the way. Aircraft itineraries begin and end at an airport’s terminal area, the itineraries of passengers and baggage do not.

• The terminal area provides the facilities, procedures, and processes to efficiently move crew, passengers, and cargo onto, and off of, commercial and general aviation aircraft.

• The airport terminal area, comprised of passenger and cargo terminal buildings, aircraft parking, loading, unloading, and service areas such as passenger service facilities, automobile parking, and public transit stations, is a vital component to the airport system.

• The building configurations, facilities, and processes that comprise an airport terminal area require careful planning and management to ensure the efficient transfer of passengers and cargo through the airport and aviation system.
The historical development of airport terminals

• Just as there were no runways or other airfield facilities during the very earliest days of aviation, there certainly were no terminals, at least the way they are recognized today.
• The first facilities that could be remotely considered airport terminal areas evolved in the early 1920s with the introduction of airmail service.
• The introduction of commercial passenger air service in the late 1920s resulted in the need to develop certain basic passenger processing policies.
• Tickets and boarding passes were issued for passengers, and similar to policies set for rail transport, cargo rates were also charged, typically by the weight of the cargo being transported.
Terminal concepts

- These first terminals were the earliest **centralized facilities**, centralized meaning that all passenger processing facilities at the airport are housed in one building.
- These first centralized facilities became known as the earliest **simple unit terminals**, because they contained all required passenger processing facilities for a given air carrier in a single-unit building.
- In addition to passenger processing facilities, the airport’s administrative offices, and even air traffic control facilities, were located within the unit terminal building.
- This configuration became known as the **combined unit terminal**.
- This terminal area configuration became known as the **multiple-unit terminal** concept.
- The early centralized terminals, including the simple-unit, combined-unit, and multiple-unit terminals, employed the **gate arrival concept**.
- The simple-unit terminal facility normally consists of a single-level structure where access to aircraft is afforded by a walk across the aircraft parking apron.
Multiple-terminal concepts

Figure 6-3. JFK International Airport in New York City provides an example of a multiple-unit terminal concept. (Source: www.airliners.net)
Terminal design concepts

(A) Gate arrival terminals

(B) Pier finger terminals

(C) Pier satellite terminal

(D) Remote satellite terminal

(E) Transporter

(source: FAA)
Linear terminal concepts

- Within **linear terminals**, ticket counters serving individual airlines were introduced and loading bridges were deployed at aircraft gates to allow passengers to board aircraft without having to be outside on the apron, thereby improving convenience and safety for passengers.

- In some instances airports were extended in a **curvilinear** fashion, allowing even more aircraft to park “nose-in” to the terminal building while maintaining short walking distances from the airport entrance to the aircraft gate.
Multiple-unit Curvilinear terminal concepts

Figure. DFW Airport, Whose terminal area employs a Multiple-unit curvilinear terminal concept, now accommodates a large percentage of transfer passengers. (Photo courtesy FAA)
Pier finger terminals

- The **pier finger terminal** concept evolved in the 1950s when gate *concourses* were added to simple unit terminal buildings.
- The pier finger terminal is the first of what are known as **decentralized facilities**, with some of the required processing performed in common-use main terminal areas, and other processes performed in and around individual concourses.
- Moreover, often the main-unit terminal facility and corridors connecting the individual fingers were not expanded along with the construction of additional concourses, leading to passenger crowding in these areas.
Pier finger terminals

Figure The old pier finger terminal complex at Detroit’s metropolitan Airport. (Figure courtesy Detroit metropolitan Airport)
Pier satellite and remote satellite terminals

• Similar to pier finger terminals, **pier satellite terminals** formed as concourses extended from main-unit terminal buildings with aircraft parked at the end of the concourse around a round atrium or *satellite* area.

• Satellite terminal concepts, developed in the 1960s and 1970s, took advantage of the ability to create either underground corridors or **Automated Passenger Movement Systems (APMs)** to connect main terminal buildings with concourses.

• Such terminals are said to be built on the **remote satellite concept**.
Pier satellite and remote satellite terminals

Figure 6-7. Terminal configuration at Seattle–Tacoma International Airport, one of the first airports to employ APMs to reach remote satellite terminals. (Figure courtesy Seattle–Tacoma International Airport)
The mobile lounge or transporter concept

• In 1962 the opening of Dulles International Airport west of Washington, D.C., designed as the first airport specifically for the new jet aircraft of the day, introduced the mobile lounge or transporter concept of airport terminals.

• To travel between aircraft and the terminal building, passengers would board transporters, known as mobile lounges, that would roam the airfield among ground vehicles and taxiing aircraft.

• In addition, mobile lounges require constant maintenance, which over time becomes an excessive cost element of operations (Fig. 6-9).
The mobile lounge or transporter concept

Figure 6.8. Washington Dulles International Airport terminal. (Photo courtesy Metropolitan Washington Airports Authority)

Figure 6.9. Mobile lounge attached to aircraft at Washington's Dulles International Airport, circa 1970. (Photo courtesy Metropolitan Washington Airports Authority)
Hybrid terminal geometries

- Many airport terminal geometries expanded in an ad hoc manner, leading to *hybrid terminal geometries* incorporating features of two or more of the basic configurations.

*Figure 6-10. Chicago O’Hare International Airport combining unit, linear pier and satellite terminal concepts.* (Figure courtesy United Airlines)
The airside-landside concept

- The **airside-landside concept** emerged with the opening of the Tampa International Airport in 1972, and has proliferated throughout the United States at airports such as Pittsburgh International Airport and Orlando International Airport.
The airside-landsdie concept

Figure Example of airside-landsdie concept, Tampa International Airport. (Figure courtesy Hillsborough County Airport Authority)
Off-airport terminals

• In the 1980s the airside-landside concept formed the basis for a series of experimental concepts known as off-airport terminals.

• However, the off-airport terminal concept set the precedent for implementing the idea of passenger processing at sites away from the main airport terminal, setting the stage for the potential future of airport terminal planning.
Present-day airport terminals

• It is clear that no single airport terminal configuration is best for all airports.
• The airport terminal planner has the dubious task of anticipating conditions up to 10 years in the future in an environment that seems to change by the day.
• Several airport terminals today appear more to be shopping malls than passenger processing facilities, and other airport terminals are fully equipped with hotels and conference centers.
• These facilities have actually encouraged visitors to use the facilities at the airport without ever intending to board an aircraft.
Present-day airport terminals (cont.)

• The size and shape of airport terminal configurations has both an uncertain yet exciting future.

• New security regulations imposed by the Transportation Security Administration have established the need to expand airport security facilities.

• The basic function of the airport terminal area, that of efficiently linking passengers and cargo to the airside and landside components of the civil aviation system, should always be understood by airport managers and planners alike.
Components of the airport terminal

- The airport terminal area is in the unique position of accommodating the needs of both aircraft and the passengers that board them.

- The component systems of the airport terminal area may be thought of as falling into two primary categories: the apron and gate system, and the passenger and baggage handling systems.
The apron and gate system

- The five major **aircraft parking** types are *nose-in parking, angled nose-in, angled nose-out, parallel parking*, and *remote parking*.

*Figure 6-12. Aircraft parking positions.*
The apron and gate system (cont.)

- Most large jet aircraft at commercial service airports park **nose-in** to gates at the terminal and connect directly to the terminal building by loading bridges.
- This has some, but not an entirely significant, impact on the efficiency of passenger boarding and deplaning.

**Figure 6-13. Nose-in parking.**
The apron and gate system (cont.)

- Angled nose-in parking
- Angled nose-out parking
- Parallel parking
- Remote parking

- Furthermore, airports with a high number of based aircraft or air carrier aircraft that remain overnight (RON) at the airport, must take into consideration higher volumes of remote parking that is flexible to accommodate aircraft of various shapes and sizes.
Aircraft gate management

- The *turnaround time* of each aircraft directly affects the number of aircraft that can use a gate over the course of a day.
- The *gate usage agreement* that each air carrier has with airport management also plays a significant role in the total number of required gates at the airport terminal.
- The three most common types of gate usage agreements are *exclusive-use*, *shared-use*, and *preferential-use* agreements.
- Under an *exclusive-use agreement*, an air carrier retains sole authority to use a particular gate or set of gates at an airport terminal.
- Under *shared-use agreements*, air carriers and other aircraft schedule use of gates in coordination with airport management and other air carriers serving the airport.
- *Preferential-use agreements* are hybrids of the exclusive-use and shared-use agreements.
Sample Gantt gate utilization chart

• Figure represents a Gantt chart example for a given set of flight schedules, with gates 1 and 2 operating under shared-use agreements and gate 3 operating under an exclusive-use agreement.
The Passenger Handling System

- The commercial airport terminal’s **passenger handling system** is a series of links and processes that facilitate the transfer of passengers between an aircraft and one of the modes of the local ground transportation system.
- These processes include the **flight interface, passenger processing, and access/processing interface**.
- The **flight interface** provides the link between the aircraft gates and passenger processing facilities.
- **Passenger processing** facilities accomplish the major processing activities required to prepare departing passengers for use of air transportation and arriving passengers to leave the airport for ground transportation to their ultimate destinations.
- The **access/processing interface** makes up the facilities that coordinate the transfer of passengers between ground transportation and the terminal building, where passenger processing facilities are typically located.
Loading bridges are part of the flight interface

. (Picture courtesy Pittsburgh International Airport)
Passengers and required processing facilities

-Passengers may be categorized in several manners, some of which include a passengers’ segment of itinerary, trip purpose, group size, type of baggage carried, and type of ticket, and whether the passenger is an international or domestic traveler.

-Passenger processing requirements and other needs vary widely on the basis of the segment of itinerary the passenger is on while at the airport.

-The three primary itinerary segments are departing, arriving, and transferring. Departing passengers are those passengers who are entering the terminal from the ground access system through the access/processing interface.

-Arriving passengers are those passengers who have just deplaned an aircraft and entered the terminal from the flight interface with the intentions of leaving the airport terminal for their final destinations through the access/egress interface.

-Transfer passengers are entering the terminal from the flight interface with the intention of boarding other flights for their ultimate destinations within a relatively short period of time, again through the flight interface.

-The trip purpose of a passenger has traditionally been an indicator of the passenger’s individual needs.
Passengers and required processing facilities

-The two most common trip purposes identified in the industry are *traveling on business*, or *traveling for leisure*, although it is understood that many travelers’ itineraries combine both business and leisure activities.

-The type of baggage carried by passengers may determine not only the processing required by such passengers but also the design and planning of *baggage handling* facilities.

-There are a series of *essential processing facilities* that must be present to ensure appropriate processing for passengers traveling on each itinerary segment.
Ticketing

-The **ticketing** process has come a long way since the early days of passenger processing at airport terminals, although some characteristics dating back to

- **Exclusive-use** ticket counters are typically configured with information systems, computers, and other equipment specific to one air carrier.

- **Common use terminal equipment (CUTE)**
- **Common-use self-service (CUSS)**
Ticketing

Common-use terminal equipment

Common use self-service kiosk
Security screening

• As of 2003, passenger and baggage security screening is managed and operated by the Transportation Security Administration (TSA).

• **At-gate processing**
- The remaining processing to be performed on a passenger prior to boarding an aircraft typically occurs at the gate area.
- This policy was in the process of being phased out in the early months of 2003.
- In addition to boarding, passenger processing within the gate area also includes administrative issues regarding a passenger's ticket, including seat assignment changes, requests to stand by for a flight, and any irregular issues that may arise.

• **Federal Inspection Services**
- Federal Inspection Services (FIS) conducts these formalities, which include passport inspection, inspection of baggage, and collection of duties on certain imported items, and sometimes inspection for agricultural materials, illegal drugs, or other restricted items.

• **Ancillary passenger terminal facilities**
- Nonessential facilities include food and beverage services, retail shops, common waiting areas, information kiosks, post offices, places of worship, hotels, conference centers, bars, and smoking lounges.
Ancillary passenger terminal facilities

- These facilities, known as *concessions*, when properly managed, not only offer benefits to passengers, but also may generate significant levels of revenue to support the operations of the airport.
- On the basis of this information, airport terminal facilities may be appropriately sized and managed to maintain efficient operations.
Passenger and baggage flow through airport terminals
Vertical distribution of flow

- Many of the larger airports distribute the passenger flow over several levels within the airport terminal.
- The primary purpose of distributing passenger processing activities over several levels is to separate the flow of arriving and departing passengers.
- The question of how many levels a terminal building should have depends primarily on the volume of passengers.
- It is also influenced by the type of passengers: domestic, international, and transfer.
Vertical distribution of passenger flow

- a cross section of the major functional areas in a multilevel passenger terminal.

Diagram:
- Parking terminal
- Service vehicle drive
- Bridge
- Deplane drive
- Enplane drive
- Ticketing lobby
- Baggage claim
- Mezzanine level
- First level
- Bridge level
- Ground level
- Lower level
- Passenger terminal

Legend:
- 1. Parking terminal
- 2. Service vehicle drive
- 3. Bridge
- 4. Deplane drive
- 5. Enplane drive
- 6. Ticketing lobby
- 7. Baggage claim
- 8. Mechanical, storage, maintenance facility
- 9. Transit shuttle
- 10. Airport offices
- 11. Concourse
- 12. Baggage sorting
- 13. Satellite transit tunnel
- 14. Gate
Baggage handling

Baggage handling services include a number of activities involving the collection, sorting, and distribution of baggage.

Arriving baggage is unloaded from the aircraft and sent to the central sorting area. Sorted bags are sent to a transferring flight, to the baggage claim areas, or to storage for later pickup.
Security screening of checked baggage

- As of January 1, 2003, all baggage checked in by passengers boarding commercial air carrier aircraft must be screened for explosives and other prohibited items upon check-in at the airport terminal.

- **Baggage claim**

- **Carousels**

  are typically shared between air carriers in a given terminal.
Airport ground access

• Access to the airport from the surrounding community is an integral part of the overall passenger and baggage processing system.

• Airport access is usually divided into two major segments:
  - Access from the **CBD (central business district)** and suburban areas via highway and rapid transit systems to the airport boundary
  - Access from the airport boundary to parking areas and passenger unloading curbs at the terminal building
Access from the CBD and suburban areas to the airport boundary

- The segment connecting the airport with the surrounding metropolitan area is a part of the overall regional or urban transportation system and serves general and airport traffic.
- **Metropolitan planning organizations (MPOs)**
- At the federal level, the Department of Transportation and the Department of Housing and Urban Development provide national inputs through programs such as the Federal Highway Grants-in-Aid Program, and urban transportation planning funds.
Access modes

• A mode of transportation is defined as a type of vehicle used to travel from one point to another.
• The Transportation Research Board defines the most common modes of airport access as:
  - Private vehicles
  - Rental cars
  -Courtesy vehicles
  -Airline crew vehicles
  -Taxicabs
  -Town cars (on-demand limousines)
  -Prearranged limousines
  -Chartered buses and vans
  -Shared-ride, door-to-door vans
  -Scheduled buses
    • Express (including semiexpress) transportation
    • Multistop transportation
  -Rail service
High speed boat
Public transit mode share from selected U.S. airports.

(Figure courtesy National Academy of Sciences, Transportation Research Board)
Public transportation mode share of selected airports outside the United States
Factors influencing demand for ground access

• Demand for ground access, the volume of people that wish to have access between the airport and their respective origins and destinations at commercial service airports, is primarily generated by the number of enplaning and deplaning passengers using the airport.

• These volumes are generated in part by the provision of air service by the air carriers that serve the airport.

• Characteristics of this air service include destinations served, the type of aircraft used, and the daily departure and arrival schedules of the air carriers.

• A significant proportion of trips made to and from airports are generated by the workforce in place at each airport, including airport, airline, and government employees, as well as employees of the many private companies that do business at the airport, including concessionaires, contractors, and suppliers.

• as many functions in the airport operate as much as 24 hours per day, there are a number of trips to the airport that occur outside normal business hours.
Coordinating and planning of ground access infrastructure

- To effectively develop ground access requirements to the airport from the CBD and suburban areas, it is important to gain an understanding of the geographic region from which passengers access the airport.
- General aviation airports typically serve more local areas, such as one CBD, suburban area, or outlying community.
- Although not the most significant determinant of passenger volumes, the ability to access one airport over another indeed has an effect on which airport a passenger will choose to use.
Access from the airport boundary to parking areas and passenger unloading curbs at the terminal building

- The second segment of airport access, from the airport boundary to the parking area and terminal building unloading curbs, is primarily the responsibility of airport management.
- This segment includes vehicle parking facilities, curb frontage at the terminal, intra-airport public transit systems such as shuttle buses or light rail systems, and vehicle roads that connect facilities existing on airport property.
Vehicle parking facilities

- Parking facilities at or near the airport must be provided for passengers, visitors accompanying passengers, people employed at the airport, car rentals and limousines, and those doing business with airport tenants.
- This rate strategy achieves two goals.
  - First, it provides incentive for those intending to park their vehicles for a relatively long period of time to use long-term parking facilities, thereby leaving spaces available for short-term parkers in the closer, more convenient, short-term parking area.
  - Second, it tends to maximize the amount of total revenue generated by the parking system to the airport.

Thus a large parking facility may be considered full when 85 to 95 percent of the spaces are occupied, depending on its use by long- or short-term parking, size, and configuration.
Location of parking facilities at Washington Dulles International Airport

(Figure courtesy Metropolitan Washington Airport Authority)
Type of Vehicle parking facilities

• **Off-airport parking**
  - The success of off-airport parking facilities can have a direct, significant effect on airport revenues, because these facilities do not pay any portion of their revenue to the airport.

• **Employee parking**
  - Employee parking lots may be located as far as several miles from the terminal area.

• **Car rental parking**
  - The car rental parking areas are often located in various locations on airport property.

• **Terminal curbs**
  - The *terminal curb* front provides temporary vehicle storage during passengers’ transition between the terminal and the landside, and it is at the curbside that all passengers, except those using nearby parking or transit facilities, either enter or leave some form of ground transportation.
Technologies to improve ground access to airports

- A variety of technologies are in development and implementation to improve both segments of airport ground access, including advanced traveler information systems (ATIS); emerging bus, rail, and automated people mover technologies; as well as alternative strategies for off-site airport check-in.
Real-time information regarding the status of public buses serving the airport
Real-time traffic conditions broadcast over the internet provide useful information for travelers accessing airport
Smart parking facilities provide specific parking space availability
APM system at Newark Liberty International Airport

Figure 6-31. The APM system at Newark Liberty International Airport connects the airport terminal with parking and rental car facilities, as well as the regional rail transportation centers. (Picture courtesy Port Authority of New York/New Jersey)
Review Video and Answer Question

• What’s special designs and planning at Lisbon airport airside?
• What’s special planning flight arrival at Lisbon airport airside?
• What’s special designs of airport metro station at Porto airport?
• What’s special designs for access systems at Porto and Kuala Lumpur airport?
Lisbon airside and flight arrival (video)
Porto airport metro station (video)
Porto airport metro station (video)
Porto airport metro station (video)
Porto airport metro station (video)
Access System of Kuala Lumpur Airport
(video)
Access System of Kuala Lumpur Airport
(video)
Concluding remarks

• An airport’s terminal serves as a uniquely fundamental component of the airport system, requiring planning and management to accommodate a wide variety of aircraft and passenger types.

• As a result, specific understanding of the operations of a particular airport terminal facility is necessary to operate and plan for the goal of accommodating both passengers and aircraft in the most efficient and high-quality manner.

• Equally important to the terminal itself is the ability for passengers to access the terminal and other airport facilities from the surrounding area.
Concluding remarks (cont.)

• Airport ground access is vital to the airport not only for the passengers a working system brings to the airport, but also by generating revenue for the airport.

• Airport terminals and ground access systems are set to benefit from new technologies which will make operations of these systems more efficient.
Key terms

- airport terminal concepts
- centralized facilities
- simple-unit terminal
- combined-unit terminal
- multiple-unit terminal
- gate arrival concept
- linear terminal
- curvilinear terminal
- decentralized facilities
- pier finger terminal
- pier satellite Terminal
- APM (Automated Passenger Movement Systems)
- terminal concourses
- remote satellite terminal
- mobile lounge concept
- airside-landside concept
- off-airport terminals
- Apron/gate system
- aircraft parking
- nose-in
- angled nose-in
- angled nose-out
- parallel
- remote
- RON (remain overnight)
- turnaround time
- gate usage agreements
Key terms (cont.)

- exclusive-use
- shared-use
- preferential-use
- Gantt chart
- passenger handling system
- flight interface
- passenger processing
- access/processing interface
- access/egress interface

- passenger types
- segment of itinerary
- departing passengers
- arriving passengers
- transferring passengers
- trip purpose
- business travel
- leisure travel
- baggage handling
Key terms (cont.)

- essential processing facilities
- ticketing
- exclusive-use counters
- CUTE (common-use terminal equipment)
- CUSS (common-use self-service) kiosks
- security screening
- at-gate processing
- FIS (Federal Inspection Services)
- ancillary processing facilities
- concessions

- baggage handling
- baggage claim
- carousels
- airport ground access
- CBD (central business district)
- MPO (metropolitan planning organization)
- vehicle parking
- terminal curb