IARO report 20.14

Airport Rail Stations

The new station on the DART Orange Line at Dallas Fort Worth Airport nearing completion at the time of the IARO workshop in April 2014

IARO Report 20.14: Airport Rail Stations

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ISBN tba

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£250 to non-members

IARO's mission is to spread world class best practice and good practical ideas among airport rail links world-wide.

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1. Introduction

This report looks at airport rail stations around the world in order to identify best practice and lessons that can be learned. It has been written following the IARO workshop held in Dallas, Texas, USA, in April 2014 which discussed airport rail stations and made a site visit to the then nearly completed station on the DART Orange Line at Dallas Fort Worth Airport.

The report considers stations at airports served by a variety of rail links - light rail, metros, airport expresses and high speed lines. It considers the number of stations required, location in relation to the terminal (both vertically and horizontally), links from stations to terminals and signing.

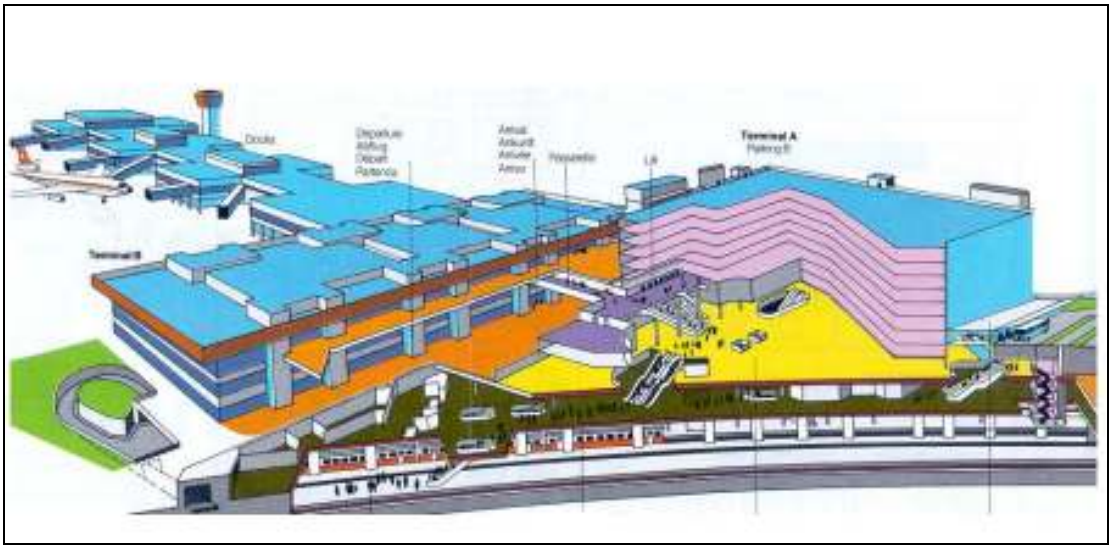
2. Station Location

The first, and fundamental, criterion for location is for it to be as close as possible to the airport terminal. However, there are choices to be made in terms of the vertical level or where there are separate arrivals and departures terminals, or multiple terminals.

Small airports can achieve best practice by having a station very close to the terminal. At London Southend Airport, a new terminal was opened in 2012 along with a new station, around 100 metres away, at the same level and directly facing each other.

At mid sized airports with single terminals, it is also possible to locate the station close to the terminal, such that walking distances are short. However, it is usually necessary to locate the tracks and platforms below ground level so as to enable other facilities such as roads or taxiways to cross the rail line. A good example of this is (below) at Oslo Gardemoen, where the rail station and airport terminal opened together in 1998.

A similar situation occurs at Zurich (below), although the airport site is more constrained and there are multiple levels above the station. However, once a change of level is necessary, lifts (elevators) can be provided for passengers with baggage that can serve these multiple levels quickly and with sufficient capacity.



Vancouver Airport is served by the Canada Line light rail link (right). As it is light rail, it is possible to elevate it on relatively light structures and thus locate the station at an upper level. This means that the station is more visible than underground, and passenger links can cross over roadways and car parks. Visibility is important both for ease of finding the station and also because it helps to market the link.

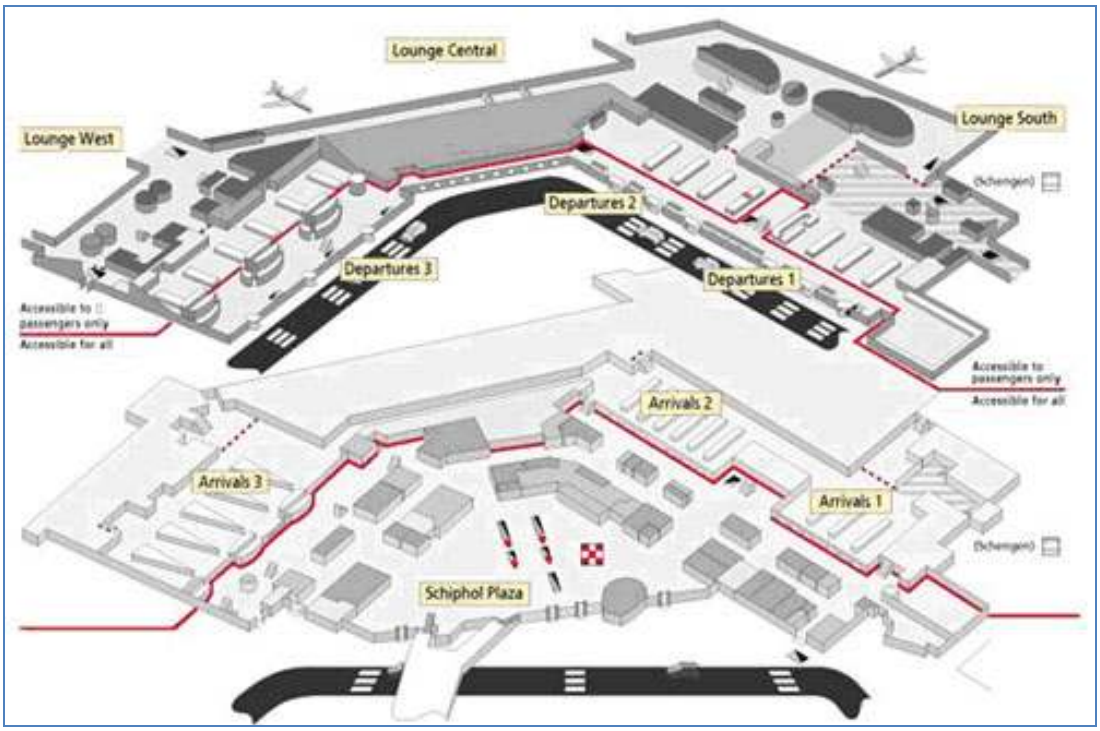
A similar situation occurs at London City Airport, also served by light rail, which has a very visible station at an upper level, although here passengers go down to ground level to access the terminal. Nevertheless, the rail link is very accessible and popular, being used by around 50% of air passengers.

Possibly the best example of the use of levels at an airport rail station is at Hong Kong. Here the station is at two levels, which match the airport terminals levels. The train from the city arrives at the airport at an upper level, such that passengers walk directly at the same level to check in. Trains then leave the station and return at a lower level which matches the airport arrivals level, so that again no level changes are required.

There are some examples where the station location is not ideal. Rail infrastructure is very expensive and it may not be possible to bring a line close to the terminal. In such a situation it may be better to have a remote station and accept that a link between the airport and the station is required. At London Luton, the airport station is around 3 km from the rail line, and it would have been very expensive to divert the rail line, or indeed rebuild the airport terminal next to the station. A bus provides the link, but it is clearly not as attractive as a station close to the terminal.

Berlin Schoenefeld is another example of an airport station just a bit too far from the terminal. In the picture (left), the station is in the top left and the terminal is bottom right. They are linked by a 350 metre long, slightly curved, covered walkway. In addition, a main road has to be crossed by an pedestrian underpass. Road transport appears much more accessible and more attractive. The new Berlin Brandenburg Airport, on the same site as Schoenefeld, has a very much better located rail station, directly beneath the new midfield terminal.

At larger airports, it is possible to locate a station at a central location, such as at Amsterdam Schiphol (below), where the platform and tracks are at level -1, with a ticketing concourse at ground level. This is the same level as the terminal arrivals facilities, so that arriving passengers walk straight from baggage reclaim to the station concourse. The station concourse, called the Plaza, also serves other public transport services and taxis. The walking distances are shorter than to the road access and car parks and therefore give a better level of service.



Some mid sized and most large airports have more than one terminal, often some distance apart, and the choice has to be made about how many stations should serve the terminals. The table below indicates some of the issues involved.

Single station	More than one station
Trains stop only once	Trains stop more than once, with longer journeys for the second stop and possible passenger confusion
Transit or walkways required to access other terminals	Train can be used as inter terminal transit
Ideal for through stations	Better for large airports with rail spurs and terminus stations

Manchester Airport has a single station serving its three terminals, with elevated (moving) walkways. As well as trains, the station also serves buses and coaches and will be the terminus of the Metrolink light rail extension currently under construction for completion in 2016.

Chicago O'Hare Airport, handling some 67 million passengers annually, also has a single station, centrally located and linked to the terminals by a transit system, which also serves rental car and remote parking lots. The Blue Line serving Chicago O'Hare is particularly popular with staff as it operates 24 hours a day and serves many residential neighbourhoods, but is less successful in attracting air passengers.

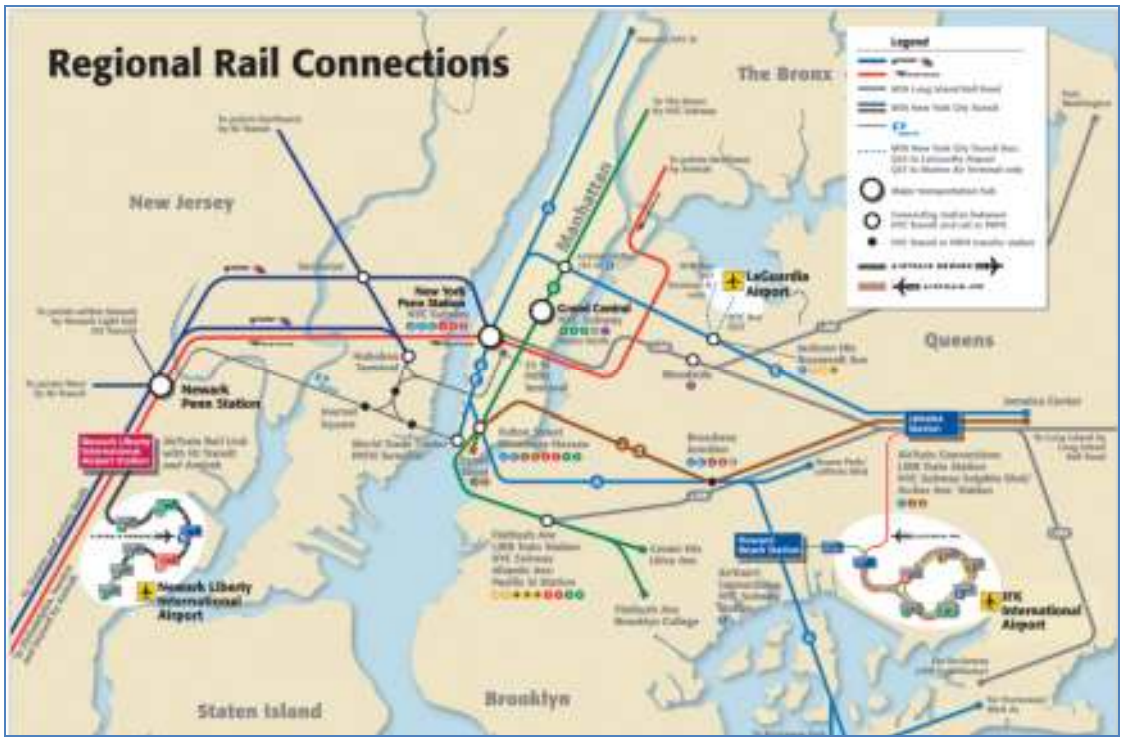
One of the most successful airport rail stations is at Frankfurt, where there are high speed, long distance, regional and local S Bahn trains. In fact there are two stations but they are located adjacent to each other at Terminal 1. The regional train station is underground and had 3.5 million passengers in 2012. The high speed rail station is in a cutting and served 5.6 million passengers. Both are connected by a wide bridge across roadways to the terminal. The bridge contains the AiRail terminal which has check in desks. Links to Terminal 2 are provided by bus (landside) and transit (airside). A major commercial development above the station called The Squaire includes 200,000 square metres of offices, retail, hotel, car parking and public space. 36% of Frankfurt's non transfer passengers use rail.

London's Gatwick Airport handles around 35 million passengers a year, and also has a single rail station, with a rail share of 36%. Gatwick's history shows how its rail station developed. The first terminal, opened in 1936, was connected by an underground passage to the station (right). The current South Terminal opened in 1958 immediately next to a new station (below).

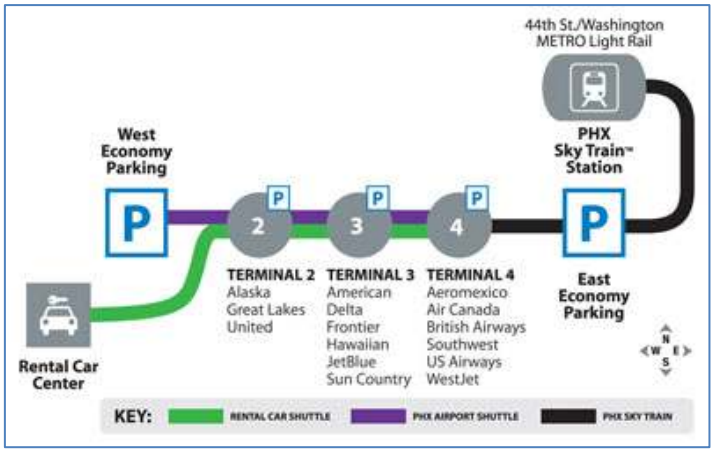
The North Terminal was added in 1988, connected by a transit to the station (below). Plans for further expansion include a second runway and new terminal to the south (left of the picture below), and the plans retain a single, though expanded, station, connected to the new terminal by a transit. The choice of a single station in this case is clear as the rail line has many through services, which a two station solution would mean longer journey times for non airport rail passengers.

Airports with more than one terminal also require inter terminal connections. For transfer passengers, these are usually provided airside (unless border controls need to be used) and may be by bus or transit. However, landside connections are also required and these can be combined with a link to a single rail station. It may also be possible to serve other areas, such as rental car or remote parking areas.

The London Gatwick example described above is both an inter terminal connector and a link from the North Terminal to the station. Other examples of transit links to stations which also serve other areas can be found in New York, Chicago O'Hare, Phoenix and Paris CDG Airports.



At New York's JFK and Newark Airports, Airtrain services connect the terminals with each other, remote parking and rental car areas, and rail stations. The map above shows the Airtrain links connecting to the local, regional and subway stations as well as other areas. The use of rail by air passengers is low (5% at Newark and 8% at JFK), in part because these links, while good as inter terminal connectors, are less attractive as station links because of the long journey times to the stations.



The Sky Train at Phoenix Sky Harbor Airport (right) also links the terminals, car parks and light rail.

Transit links may also be appropriate if the station is remote from the terminal. In San Francisco, Oakland Airport (10 million annual passengers) has been linked by bus to Coliseum Station on the BART system for some time but will be replaced later in 2014 by the Oakland Airport Connector, a cable drawn transit system which will be quicker, operate at a higher frequency and have a higher capacity.

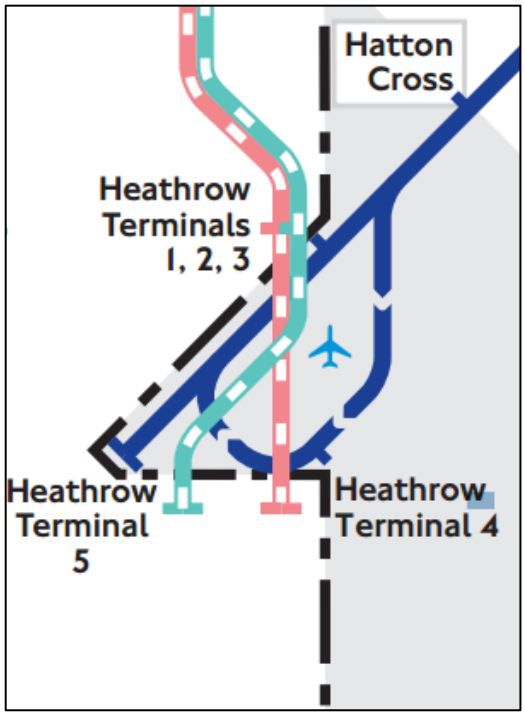
Distance from a remote station is undoubtedly an issue which limits air passenger use of rail. As well as the London Luton and New York JFK examples already mentioned, Dusseldorf's main airport station requires a 6 minute transit ride and Paris Orly Airport is linked to RER

Line B at Antony by the OrlyVAL transit. The rail share is relatively small at both these airports (18% at Dusseldorf, 14% at Paris Orly).

The decision as to whether to continue with a single station or to build a second one as the airport expands has been approached differently at various airports. At Paris CDG, the original plan had a central station linked by bus to a number of separate terminals. However, as the airport developed, the second terminal was built and progressively extended along a new axis. A second station was built in the centre of this Terminal 2 complex to serve an extension of the RER spur line, and also TGV services on a new high speed line built to connect lines around Paris. In due course the various areas were connected by a transit system. CDG handles 62 million passengers a year and has a rail mode share of 28%

A similar choice was faced at Kuala Lumpur. The station at the first terminal is well located within the original terminal complex. However, when a temporary Low Cost Carrier Terminal was established remotely from the original terminal, it was served by a bus linked to a station on the route to the airport. A second terminal for the low cost carriers to the south of the original terminal was opened in May 2014 and the line has been extended to this new terminal

The airport with the most stations is London Heathrow (page 12). Handling 72 million passengers, the first rail link (the Underground Piccadilly Line) opened in 1976 to a station serving Terminals 1, 2 and 3, to which it was linked by underground walkways. In fact this was the second station, with the first at Hatton Cross serving the maintenance area. When Terminal 4 was built in 1986, the Piccadilly Line was extended in a loop from Hatton Cross to Terminals 1, 2 and 3 via the new terminal. Then, with Terminal 5 opening in 2006, the line was extended from Terminals 1, 2 and 3 to Terminal 5, so there are 4 stations on the Piccadilly Line.

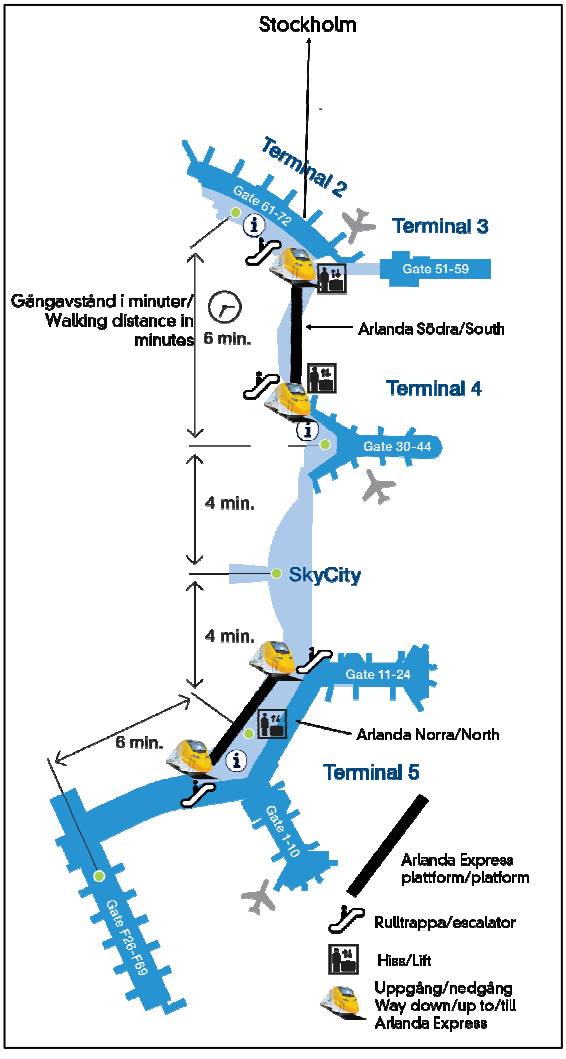


Heathrow Express reached the airport in 1998, with two stations, at Terminals 1, 2 and 3 and Terminal 4. The Terminals 1, 2 and 3 station is reached by the same underground walkways as the Piccadilly Line, but it is a separate station with its own ticketing facilities, vertical circulation and platforms. When Terminal 5 was built, Heathrow Express was extended and the station shares some facilities with the Piccadilly Line but still has its own platforms (and there is space for further platforms for additional services). So, Heathrow has 7 stations, and the clear advantage is that every terminal is directly served. The rail services also act as an inter terminal link. The disadvantage is that not every train serves every station, and it may be confusing for visitors to understand which station to use, although London Underground show best practice in signing and information provision.

Stockholm's Arlanda Airport has 3 stations, which may seem a lot for an airport handling 20 million passengers a year. However, it is clear from the layout plan (right) that they are located so as to minimise the walking distances to all parts of the terminals. For Arlanda Express, there are 4 main access points, at each end of the platforms for their 2 stations.

There is a third station accessed from SkyCity, a centrally located retail, catering and services areas. This station serves the SJ regional trains, which are chosen by passengers less concerned with the fastest service, and therefore perhaps less concerned with the time take to reach the furthest parts of the terminals.

Philadelphia Airport handles 30 million passengers but has a similar situation as Arlanda with terminals or concourses along a line, served by SEPTA trains. There are five closely space stations along the line which means walking distances are short. However, it is not used as an inter terminal connector because the trains are not very frequent (every 30 minutes).



3. Station Design

Introduction

Once the location has been fixed, there are then a number of design features that can affect operations and customer reaction, including platform design, ticketing facilities, retailing, barriers, vertical circulation, maintenance and signing. This chapter identifies best practice and lessons to learn in some worldwide air rail links.

Rail stations have to meet particular rail safety standards which are often different in both philosophy and detail from those applied in aviation. Many airport stations are under ground which brings a further set of safety and evacuation requirements. And, of course, the classic design mantra - form follows function - means that design should directly meet the station's, and the passengers' requirements.

Platforms

Platform layout may be determined by the track route. If the station serves through trains, there is not much alternative to the basic design of platforms serving trains from both directions, with passenger bridges across the tracks. However, many airport stations are termini at the end of the line, which allows the possibility of walking to the terminal without having to change level. Examples of single level terminus stations can be found at Salt Lake City Airport (right), Dallas Fort Worth and Lyon St Exupery.

There is a surprising amount of variation in platform height. With the widespread use of rolling luggage, best practice is to have train floor and platform level the same. This also allows wheelchair users and passengers with buggies to get on and off easily. Many railways have traditionally had platforms lower than train floor height, in some cases substantially lower, so this is often quite a challenge. On the other hand, many metros have had this feature for some time.

One of the best examples of matching platform and train floor heights is at Stockholm Arlanda Airport (left). The Arlanda Express stations at the Airport only serve these trains, so it was possible to match the heights.

Other examples of with matching platforms can be found on the Heathrow Express and the Hong Kong Airport Express Line. As noted, many metros achieve this throughout their networks, and examples can be found on airport links in Hamburg, Delhi, Washington and Copenhagen. Light rail trains also often have matching heights,

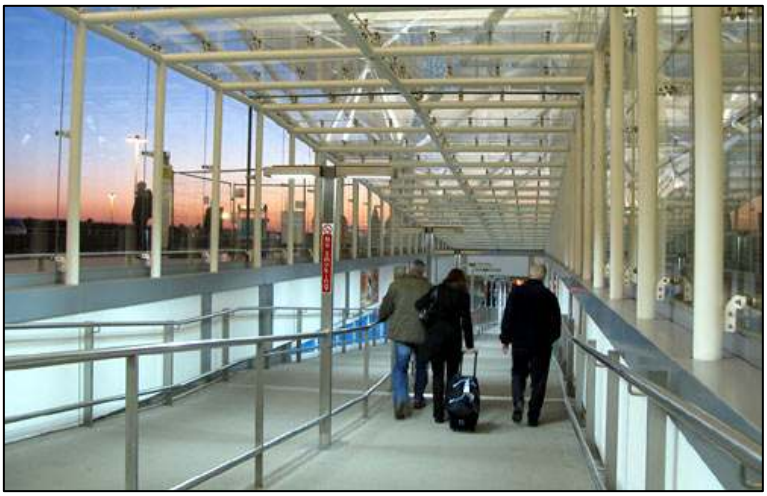
such as at London City Airport, Salt Lake City and the Rhonexpress at Lyon St Exupery.

Sometimes it is possible to match the platform height with the train floor by the doors, but there are then steps within the train, for example in double deck trains. For wheelchairs, it is possible, but labour intensive and time consuming, to place a ramp at a door. In cases such as at London Gatwick Airport, where inappropriate trains are being used, the height difference between platform and train floor makes the carrying of luggage by passengers very difficult.

A safety feature of some railways is platform screen doors, which are sometimes also used to ensure a better climate in the station. Good airport examples of these are seen at Hong Kong and the Copenhagen (Metro). If climate is not an issue, screen doors do not need to be full height. With baggage on wheels, or on a trolley, screen doors are particularly worthwhile at airport station to prevent bags falling on to the tracks.

Vertical circulation

In most cases, vertical circulation is required between train and terminal. Some stations are below ground, others require rail tracks or roadways to be crossed. There are four ways of providing vertical circulation - stairs, ramps, escalators and lifts (elevators). Stairs are universally used, as they are always available, and are satisfactory for short height changes and for people without baggage. Ramps have the advantage of also not being subject to being taken out of service and are generally high capacity. However, with the standard 1 in 12 (8%) slope, the horizontal distance travelled may be quite long. Examples of ramps can be found at London Stansted Airport Station (right).



For mechanical assistance, the choice is then between escalators and lifts (elevators). For the larger airports, it is likely that both may be provided. Lifts (elevators) are generally a requirement to meet the disability regulations for passengers in wheelchairs, but they are also more suitable for passengers with baggage, especially heavy baggage or baggage on trolleys, which cannot use escalators for safety reasons. If the vertical distance to be covered is significant, lifts (elevators) may also be quicker, even taking into account the waiting time. At the Heathrow Express Stations, the platforms are 25 metres below ground level (more to the departures level at Terminal 5, page 15) and so lifts are often preferred by passengers, even those with little time to spare. At smaller airports, the minimum provision would be stairs and a lift (elevator).

Barriers

Two types of barrier may be required at airport rail stations, for revenue protection and to prevent baggage trolleys on platforms.

Revenue protection barriers are common on many metro and city railway networks, have been in place for many years and operate effectively and efficiently in for commuters and regular travellers. Many barrier lines feature a wide gate for wheelchairs or passengers with baggage, such as at London Luton Airport Parkway (right). However, the standard barrier is a challenge for passengers with heavy baggage, or with non standard tickets, and their use at stations served by the Gatwick Express in London has been controversial, with additional staff being required to assist passengers. The revenue protection objective is less relevant on dedicated airport services, where the extent of ticketless travel is less and staff are available on the train to sell tickets.

Baggage, particularly baggage on trolleys, may also be a reason to provide barriers which then prevent the trolley being taken on to the platform. Actually, it is empty trolleys which are more of a hazard, which might be left by passengers. In some situations, this is felt to be unsafe and so trolleys are prevented from accessing the platforms, such as at Heathrow. This is not best practice, as it means that passengers have to unload their baggage from the trolley before reaching the train. However, it also prevents trolleys being taken onto trains, which is also a potential safety risk. Practice is far from standard and the picture (below), at

Manchester Airport, shows a trolley barrier on the station platform which prevents trolleys being taken on to the escalator, although they are permitted on the platform (and can use lifts to leave the station). It is normal practice for trolleys to be prevented from using escalators for safety reasons, another reason for preferring lifts (see above).

Ticketing

Although there may be many other ticket purchasing opportunities, it is an absolute requirement to have some facilities at an airport station, as many of the passengers will be using the service for the first time. Ideally a staffed ticket office should be provided, as many passengers will require information as well as tickets. A good example of this is at London Heathrow Terminal 5, where tickets can be purchased for any of the rail services from one location. Ticket offices can be supplemented by ticket machines, which are popular with some passenger types and are reasonably familiar around the world. Of the two examples shown below, the one on the left is certainly much easier to use than the one on the right, even for native language speakers.

Retailing

Airports have extensively developed their retail offer and so it might seem that there are similar opportunities to develop retail and catering in airport rail stations. However, experience is that such facilities are only limited and are much better focused in waiting areas. Departing air passengers will, of course, be anxious to get into the terminal building to check in and arriving air passengers will either board a waiting train or wait the few minutes for the next one, so platform level retail facilities tend to have limited demand, perhaps only for a coffee stall. There may however, be opportunities for targeted advertising such as at London Southend Airport (right).

Signage

Airport signage is of course a major subject in its own right, so this brief description notes only some special characteristics associated with airport rail stations. Given the international nature of aviation, languages other than the native one may be required or, even better, pictograms. However, there are differences between aviation and rail pictograms and there may be a disconnect between the station and the terminal. Below are some examples of the different words and symbols used.

It is also important when considering train information not to use final destination, which is not likely to be known to a visitor. It is better to say 'trains to city centre' or similar, as shown left. If the train is going somewhere beyond, then the information should say that it is via the city centre. Variable message signs are common place and can show the time of the next train, its destinations and other stations, plus other information. Other information which is useful

includes maps, interchange information and timetables. Public address announcements are generally not appropriate, except for safety and emergency matters.

Architecture

Finally, in this chapter, a brief comment on architecture. It is not correct to treat architecture as an 'add on' to design as the architecture of a facility is much more than just it's 'look and feel'. However, in this brief commentary, consideration is given only to how the appearance of an airport station contributes to its success.

As noted earlier, underground stations have particularly challenging conditions to deal with and also are not visible from distance, so the ability to create a visually attractive space is limited. However, the best examples are where it has been possible to create a large open space, such as at Chicago O'Hare (below).

Lighting and decor are very important in underground spaces, and there are good examples of the former at Heathrow Terminal 5 (below left) and Zurich (below right).

Ground level airport stations are able to utilise the long tradition of station architects by providing a roof or shed over the whole station. Lyon St Eupery's station is perhaps one of the best known examples (below), where the rail station dominates the airport. While such

grand buildings may be criticised as being wasteful and expensive, there is no doubt that they are iconic and memorable. The real test is probably if they help the passenger to make an easier journey. Other examples can be found at Paris CDG airport, Frankfurt and Beijing.

Finally, there may be opportunities to use the architecture as part of the promotion and marketing of an air rail link, a good example of which is the bridge (below) being built as part of the new RTD line to Denver International Airport.

4. Conclusions

This report has considered a number of aspects about airport stations, including location, layout, design, signing and architecture. IARO members have experience in planning, designing and operating airport railways and understand what works and what does not, so that best practice and lessons to be learned can be identified.

Airport stations are a fundamental part of the air rail link, along with the other parts of the infrastructure, the service provided and the marketing of the service. For the inbound passenger, the airport station is the first part of the city that is experienced outside the airport and, while airports have many familiar and common features (border controls, baggage reclaim etc), the rail station may be very different in different coutnries. It is therefore important to reassure passengers and make it easy and understandable to navigate the station, the timetable, the fares and other features of the service.

The examples described in this report show how best practice can be achieved, but it is clear that every situation is different and requires careful consideration of the particular requirements. Through its publications, events and contacts, IARO can make a contribution to the success of existing and planned air rail links.

IARO's Air/Rail conferences and workshops

Copies of the published reports of the earlier workshops and other research reports are available price £250 (free to IARO members). See www.iaro.com/publications.htm. Papers presented at more recent workshops are available on CD-ROM at the same price.

Workshops are very focused, dealing in detail with a restricted number of key issues, and complement the regular Air Rail Conferences. Workshops and conferences (with site visits) have been held as follows.

1993 - Zürich
1994 - Paris
1996 - London (Heathrow Express, Stansted Express)
1997 - Oslo (Airport Express Train)
1998 - Hong Kong (Airport Express Line)
- Frankfurt (with the AIRail station and the Cargo Sprinter)
1999 - Workshop 1: Berlin (the Schönefeld link)
- Copenhagen (the Øresund Link)
2000 - Workshop 2: Milan (Malpensa Express)
- Paris (plans for CDG Express)
- Washington (Baltimore-Washington International Airport)
2001 - Zürich airport: Air rail links - improving the partnership
- Workshop 3: Madrid (and its airport rail links)
- London Heathrow (Heathrow Express)
2002 - Workshop 4: Amsterdam, for railways serving airports but not as their main job - "Help - there's an airport on my railway".
- New York (the Airtrain projects)
2003 - Workshop 5: Barcelona. Today's design and funding issues for airport railways
- Frankfurt (The AIRail project)
- Workshop 6: Newark. Practical air rail intermodality
2004 - Workshop 7: Oslo. Leisure passengers – a market for airport railways.
2004 - Brussels (Thalys:Air France code-share)
2005 - Chicago (Chicago's future in an era of successful air-rail intermodality)
- Shanghai study tour
- Workshop 8: Edinburgh. Security on airport railways.
2006 - Workshop 9: Baltimore (BWI). Security on airport railways.
- Regional meeting 1: Stockholm
- Workshop 10: Marketing and ticketing innovations (e-air-rail) Düsseldorf
- Regional meeting 2: Kuala Lumpur
2007 - Los Angeles: Air/Rail East/West
- Baltimore: The seamless journey
- Vienna (Wien): Communications
2008 - October - London Gatwick. One-day conference on ticketing
2009 - June - Hamburg, with site visit to the new S-Bahn
- October - Vancouver: light rail to airports
2010 - October - Lyon, with a site visit to the LesLYS express tram to the city
- November/December - Far East study tour (with AREMA)
2011 - October - Venice
2012 - September - Berlin
2013 - July - Birmingham (high speed rail)

- September - Gatwick (Branding)

2014 - April - Dallas, Texas, (Airport stations)

Planned workshops and conferences

2014 - June - Brussels (EU matters)
- September - Stockholm (Which type of air rail link?)
- November - London (Planning air rail links)

Details are available from IARO, or on www.iaro.com: you can sign up for details of future events in different parts of the world on www.iaro.com/events.htm

Future plans are, of course, subject to change.