

There are three large and ultra-large widebody aircraft types for airlines to choose from and three more in development. The potential market for these aircraft is assessed here. Large and ultra-large widebodies are being used on established long-haul hub connections, high-density, short-haul domestic services and low-frequency leisure routes.

What is the market for large & ultra-large aircraft?

The large and ultra-large aircraft fleet changed significantly over the past 10 years with the introduction of the A380, a rise in demand for the 777-300ER and a reduction in the fleet of active 747-400s.

Three new aircraft types, the A350-1000, 777-8 and 777-9, are due to enter service over the next six years. *Aircraft Commerce* has analysed fleet and schedule data to identify which markets and routes need or are using large or ultra-large aircraft.

Large and ultra-large types

This analysis defines large and ultra-large aircraft as those that can accommodate 350 or more seats in a typical three-class or intercontinental seating arrangement. For some airlines a three-class layout might include first, business and economy cabins. There has been a growing trend for three-class products to comprise first or business, premium economy, and economy cabins.

The large and ultra-large aircraft market is sub-categorised into current types and those that will enter service over the next five years.

Current fleet

The in-service fleet of large and ultra-large widebodies has increased from 831 to 1,168 aircraft over the past five years, an increase of 337 aircraft or 40%.

The 777-300ER fleet has seen the strongest growth in the large and ultra-large widebody market since the type's operational debut in 2004. In 2016, the 777-300ER is the dominant type, accounting for 55% of the fleet. There are 639 777-300ERs in service with 36 airlines. The largest operators are Emirates (116), Cathay Pacific (53), Air France (43) and Qatar Airways (33).

A 777-300ER will accommodate 396 passengers in a standard two-class layout

and have a range of up to 7,370 nautical miles (nm) with a full passenger payload.

The actual capacity of large and ultra-large aircraft varies by airline.

Many 777-300ERs are configured with three or four classes, although there are many operating in a two-class layout. Some of the highest capacity 777-300ER layouts include: Air France's 468-seat, three-class cabin; Emirates' 427-seat, two-class cabin; and Qatar Airways' and Etihad Airways' 412-seat, two-class cabins. All these carriers also operate 777-300ERs in lower capacity layouts.

In contrast to the high-capacity examples, All Nippon Airways (ANA) operates 777-300ERs in low-density, four-class configurations with seat numbers ranging from 212 to 264.

The rest of the active large and ultra-large widebody fleet includes A380s (187), 747-400s (179), A340-600s (70), 777-300s (51), 747-8Is (30), 747-400ERs (6) and some 747-200s and 747-300s.

The 747-400 is in service with 31 operators, including British Airways (BA) (39), United Airlines (22), and Lufthansa (13). Qantas (6) is the only operator of the 747-400ER. Both variants seat 344 in a typical three-class arrangement. In this layout the 747-400 and 747-400ER have a range of up to 7,245nm and 7,635nm with a full passenger payload.

Most of the active 747-400 fleet is configured with three or four classes. Virgin Atlantic operates a high-density, 455-seat, three-class layout on the 747-400, comprising upper, premium economy, and economy sections. In contrast BA operates some 747-400s with as few as 275 seats in a four-class layout. It also operates 747-400s with 299 and 345 seats in four-class configurations.

The 747 family was the dominant type in the large and ultra-large widebody fleet for many years but its numbers are now in decline. Some airlines have replaced the 747 with the A380.

The A380 entered service in 2007 and

is now operated by 13 airlines. The largest operators are Emirates (77), Singapore Airlines (19), Lufthansa (14), Qantas (12) and BA (11). Airbus suggests the A380 can accommodate 544 passengers in a typical four-class arrangement, with a range of up to 8,200nm with a full passenger payload.

Many A380s are configured with three- or four-class cabins, but Emirates has introduced a high-density, two-class cabin on some of its aircraft that can accommodate up to 615 seats. It also operates A380s in lower-density, three-class arrangements. One of the lowest-capacity layouts for A380s is Singapore Airlines' 379-seat, four-class cabin. It also operates A380s in other layouts, such as three classes with up to 471 seats.

Boeing developed the 747-8I in response to the A380. The 747-8I is currently only in service with Lufthansa (19), Air China (6) and Korean Air (5). Boeing says it can accommodate 410 seats in its standard three-class layout, and has a range of up to 7,730nm with a full passenger payload. In practice, operators have configured it with fewer seats. Lufthansa has configured its 747-8Is with 340 or 364 seats in four-class cabins. Air China operates it in a 365-seat, four-class layout, while Korean Air operates it with 368 seats in a three-class set-up. These seat numbers are close to the capacities of many airlines' 747-400s. Lufthansa configures its 747-400s with 371 or 393 seats in three classes.

The in-service fleet of A340-600s & 777-300s is in decline. The A340-600 is in service with seven operators including Lufthansa (18), Iberia (17), and Virgin Atlantic and South African Airways (9). It has 346 seats in a standard three-class layout, and a range of up to 7,800nm. In its aircraft characteristics document for the A340-600, Airbus suggests that it could seat up to 380 passengers in certain three-class configurations. The capacity of the active fleet ranges from Lufthansa's

The Middle East market has seen the largest expansion in large and ultra-large widebody services. Emirates operates the biggest fleet of large and ultra-large widebodies. It is the largest operator of the A380 and 777-300ER, and deploys these aircraft on services via its hub in DXB.

281-seat, four-class configuration to Iberia's 342-seat two-class cabin.

Boeing says that the 777-300 can seat 425 passengers in a typical two-class layout. It is more often used on high-density, regional sectors, than on longer-haul services, due to its restricted range of 3,120-5,045nm with a full passenger payload. The largest 777-300 operators are Cathay Pacific (12), Emirates (12) and ANA (7).

Future fleet

In the medium to long term the large and ultra-large aircraft fleet will be built around current variants that remain in production, plus three new types that are in development: the A350-1000, the 777-8 and 777-9.

There are 785 large and ultra-large widebodies on order. The only in-service large and ultra-large widebodies that remain in production are the 777-300ER, A380, and 747-8I. There are 155, 132 and 11 of each type respectively on firm order. Based on the current fleet and order backlog, the 777-300ER and A380 will be the most numerous current generation aircraft in the future large and ultra-large global fleet.

There are 181 A350-1000s on order. The aircraft is expected to enter service in 2017, and seat 366 passengers in a standard three-class layout. It will have a range of up to 7,950nm with a full passenger payload.

There are at least 243 777-9s on firm order. It will seat 400-425 passengers and have a range of up to 7,600nm.

The 777-8 will accommodate 350-375 seats, and have a range of up to 8,700nm with a full passenger payload. At least 53 777-8s are on firm order.

There are 10 more 777Xs on order for an unannounced customer, but it is not possible to identify the variant.

According to Flightglobal's Fleets Analyzer, the first 777-9 and 777-8 are due for delivery in 2020 and 2022.

Airlines

Some of the largest operators of large and ultra-large aircraft are: Emirates (205), Cathay Pacific (68), Lufthansa (64), BA (62), Air France (53), Singapore Airlines (52), Korean Air (45), Qatar Airways (43), Etihad Airways (39) and Thai Airways (36). These 10 airlines



account for more than half the global fleet of large and ultra-large widebodies.

Emirates operates the most large and ultra-large aircraft, and has 17% of the active fleet of 1,168 aircraft. Most of Emirates' large and ultra-large aircraft are A380s and 777-300ERs. The carrier is the largest operator of both types.

Rapid expansion by Middle Eastern carriers is a major factor in the growth of the large and ultra-large widebody fleet over the past few years. Qatar Airways and Etihad have also grown their large and ultra-large widebody fleets. Since 2011 the combined large and ultra-large widebody fleet of Emirates, Etihad and Qatar Airways has increased from 112 to 287 aircraft, accounting for 20% of all large and ultra-large aircraft. All three carriers' operating bases are close to each other. They have used the locations of their home markets to provide hub-and-spoke networks linking East and West, predominantly using widebodies.

Some longer-established large and ultra-large widebody operators, such as Korean Air, Cathay Pacific, Lufthansa, Air France and BA have also increased their fleets in this size segment over the past five years.

Others, however, have reduced the number of large and ultra-large widebodies they operate. A decade ago Japan Airlines (65) was the largest operator of aircraft in this size category. More than 75% of its large and ultra-large fleet comprised 747-300s or 747-400s. It has since retired all of its 747s and focused its widebody fleet growth around a smaller number of 777s and smaller types, including the 767-300ER and 787-8.

Emirates (251), Qatar Airways (102)

and Etihad (50) have the biggest outstanding orders for large and ultra-large widebodies. All three have 777-8s, 777-9s and A380s on order. Emirates also has 777-300ERs on order, while Qatar Airways and Etihad have A350-1000s on backlog. Other significant order backlogs for large and ultra-large aircraft include those for Cathay Pacific (47), United Airlines (45), and ANA (29).

Market demand

All large and ultra-large widebodies are long-range aircraft. Most aircraft will be used on long-haul routes linking major hubs. Some carriers will also use the aircraft on high-density regional services.

Most airlines will first build demand and add capacity on a route by increasing frequencies with smaller aircraft. Possible frequencies are constrained by flight times, time zone differences, and acceptable departure and arrival times. Larger aircraft are introduced once an airline has reached an optimal number of frequencies. Some airlines may only introduce large and ultra-large widebodies on well-established routes, or use them to open new routes.

Large and ultra-large widebodies may be used to serve slot-restricted airports. These may be operating close to capacity, or have some form of curfew in place that limits the number of frequencies an airline can operate. This is the case with Emirates, which is one reason why it operates a large fleet of A380s.

In some cases, large and ultra-large widebodies might be the most efficient means of providing desired capacity with the number of slots available.

Airline schedule data from 2011 and

TOP 20 TRANSATLANTIC ROUTES WITH AVERAGE AIRCRAFT SIZE OF 350 SEATS PLUS IN 2016

Airport Pair	Origin Country	Destination Country	Seats	Flights	Approx Rtn Freq	Av Seats	Av Seats change since 2011
Frankfurt (FRA) - Miami (MIA)	Germany	USA	385,032	732	x 1 daily	526	+83
Frankfurt (FRA) - Los Angeles (LAX)	Germany	USA	482,976	1,008	x 9-10 weekly	479	+135
Frankfurt (FRA) - San Francisco (SFO)	Germany	USA	783,528	1,804	x 2-3 daily	434	+68
London Gatwick (LGW) - Havana (HAV)	UK	Cuba	99,008	238	x 2-3 weekly	416	+35
Frankfurt (FRA) - Houston (IAH)	Germany	USA	577,841	1,430	x 2 daily	404	+106
London Gatwick (LGW) - Las Vegas (LAS)	UK	USA	311,520	789	x 7-8 weekly	395	-21
Bordeaux (BOD) - Punta Cana (PUJ)	France	Dominican Republic	7,760	20	x 10 annual	388	NEW
Nantes (NTE) - Punta Cana (PUJ)	France	Dominican Republic	12,802	33	x 16 annual	388	NEW
Manchester (MAN) - Orlando (MCO)	UK	USA	555,425	1,436	x 2 daily	387	+37
Frankfurt (FRA) - New York (JFK)	Germany	USA	1,076,119	2,811	x 3-4 daily	383	+51
Paris Charles de Gaulle (CDG) - Pointe A Pitre (PTP)	France	Guadeloupe	48,368	127	x 1-2 weekly	381	-42
Paris Charles de Gaulle (CDG) - Los Angeles (LAX)	France	USA	814,809	2,190	x 3 daily	372	+82
Paris Charles de Gaulle (CDG) - Mexico City (MEX)	France	Mexico	530,568	1,436	x 2 daily	369	+75
Glasgow (GLA) - Orlando (MCO)	UK	USA	114,959	312	x 3 weekly	368	+29
Rome Fiumicino (FCO) - Vancouver (YVR)	Italy	Canada	12,512	34	x 17 annual	368	NEW
Lamezia Terme (SUF) - Toronto (YYZ)	Italy	Canada	10,304	28	x 14 annual	368	+31
Paris Charles de Gaulle (CDG) - Calgary (YYC)	France	Canada	16,698	46	x 23 annual	363	+29
Frankfurt (FRA) - São Paulo (GRU)	Germany	Brazil	526,348	1,454	x 2 daily	362	+9
Frankfurt (FRA) - Buenos Aires (EZE)	Germany	Argentina	258,106	713	x 1 daily	362	+29
Frankfurt (FRA) - Mexico City (MEX)	Germany	Mexico	261,364	722	x 1 daily	362	+18

Source: Innovata

Notes: Figures for each airport-pair include both directions of travel. Seat and av seat numbers are therefore based on two-way capacity.

2016 have been analysed to identify some of the highest-density non-stop routes on which large and ultra-large widebodies have been used over the past five years. For the purposes of this analysis, airports in Western Russia are categorised as European, while those in Eastern Russia are Asian. US territories in the Pacific are categorised as North America. New routes are airport-pairs that are served in 2016 but which did not exist in 2011.

Transatlantic

The transatlantic market includes any routes from Europe to the Caribbean and North, Central and South America.

Some of the busiest transatlantic routes are between the United States (US) and the United Kingdom (UK). The next largest traffic flows are between the US and Germany, the US and France, the US and the Netherlands, and the UK and Canada. The largest traffic flows linking Europe with South America are between Portugal and Brazil, and Spain and Brazil.

More than 126 million bi-directional seats will be available on transatlantic services in 2016. The average aircraft size on transatlantic services has grown from 265 to 275 seats since 2011, indicating a general trend among airlines to gradually increase aircraft size. Many routes have seen a large increase in average aircraft size (see table, this page).

A340-600s, A380s, 747-400s, 747-8Is and 777-300ERs are all operating on transatlantic services in 2016, including services from Europe to North, Central, and South America, and the Caribbean.

Smaller types, including the A330-200 and -300, A340-300, A350-900, 757, 767-300ER, 767-400, 777-200ER, and 787-8 and -9 will also be used on transatlantic routes.

BA will provide the most transatlantic capacity in 2016, followed by Delta Air Lines, United Airlines, American Airlines, Lufthansa, Air France, Virgin Atlantic, KLM, Iberia and Air Canada.

Some of these carriers prefer medium-widebody aircraft for the bulk of their transatlantic services. Delta has a small number of 747-400 flights scheduled for 2016, but most of its transatlantic capacity is operated by A330s and 767s. United will operate some 747-400s in 2016, but most of its transatlantic capacity is provided by 757s, 767s and 777-200ERs. It has already phased out a large number of 747-400s and begun introducing 787s in this market.

American Airlines will use 777-300ERs on transatlantic services in 2016, but 70% of its capacity will be provided by 757s, 767s, 777-200ERs and A330s.

The main operators of large and ultra-large widebodies on transatlantic services are Air France, BA, Lufthansa, Turkish Airlines and Virgin Atlantic.

Lufthansa operates most of its transatlantic services from Frankfurt (FRA) and Munich (MUC). It has reduced the capacity provided by A340-600s and 747-400s in this market since 2011. It has also reduced the capacity provided by A330-300s and A340-300s on transatlantic services but increased the seats provided by A380s, and introduced 747-8Is on some routes. It operates both

types on services to North America, and also to South America, including to Brazil and Argentina. Lufthansa's average aircraft size on transatlantic services has grown from 306 to 340 seats since 2011.

BA operates most of its transatlantic services and all of its large and ultra-large widebody capacity from London Heathrow (LHR). It also operates transatlantic services from London Gatwick (LGW), and London City (LCY) but these are all flown by 777-200ERs and specially configured A318s. BA has reduced the transatlantic capacity provided by 747-400s, but these aircraft will still operate more than 13,500 flights in this market in 2016. It has reduced 767 operations on transatlantic services but introduced 787s and A380s to its schedules since 2011 and also operates 777-300ERs in this market. BA's average aircraft size on transatlantic services has increased from 271 to 285 since 2011.

Air France will operate A380s and 777-300ERs on transatlantic services in 2016. It has increased the capacity provided by both types since 2011, and almost completely removed the 747-400 from transatlantic operations over the same period. It has reduced the capacity provided by A330-200s and A340-300s on transatlantic services but increased operations with 777-200ERs. Air France's average aircraft size on transatlantic routes decreased from 316 to 310 from 2011 to 2016.

Virgin Atlantic will have transatlantic capacity on A340-600s and 747-400s in 2016, but since 2011 this has shrunk as it restructures its fleets around the A330-



300 and 787-9. Most of Virgin's 747-400s are now operated on leisure routes from LGW to destinations in North America and the Caribbean. The A340-600s all operate from LHR to the USA. Virgin Atlantic's average aircraft size on transatlantic services reduced from 353 to 329 seats from 2011 to 2016.

Turkish Airlines will operate 777-300ERs on transatlantic services from Istanbul (IST) in 2016. Most of these will serve North American destinations.

Large and ultra-large widebodies are being used to increase capacity on established transatlantic routes in 2016. BA has replaced 747-400s on its service between LHR and Los Angeles (LAX) with a mix of 777-300ERs and A380s. In 2011 it operated about 19 flights per week on LHR-LAX, all with 747-400s. In 2016 it is scheduled to operate double-daily services, using 777-300ERs or A380s. The reduction in frequency equates to five fewer flights per week in 2016. The extra seats on the A380 mean that the total capacity offered by BA from LHR-LAX has actually increased by 5% since 2011, despite a 27% reduction in the number of flights. LHR is operating near capacity, and is particularly slot-constrained, so using the A380 allows BA to provide the same or even more seat capacity with fewer flights. This could free up slots at LHR for new services.

Large and ultra-large widebodies are also being used on new transatlantic routes. Turkish Airlines is operating 777-300ERs on services between IST and Atlanta (ATL), Miami (MIA) and San Francisco (SFO) in 2016. These airport pairs have all been introduced since 2011.

In 2016, the largest transatlantic route based on total seat capacity will be

LHR to New York (JFK). There will be 40 million two-way seats available across 19-20 daily return flights on this airport-pair in 2016. The average aircraft size on LHR-JFK is 286 seats. The route is served by multiple carriers, with a wide range of aircraft types from A330s and 767s to 747-400s and 777-300ERs.

The next largest transatlantic routes in 2016 will be LHR-LAX, and Paris Charles de Gaulle (CDG) to JFK.

LHR has more departing seats on transatlantic services than any other airport. Eight of the 10 largest transatlantic routes arrive at or depart from LHR. Many of the heaviest transatlantic routes are operated by multiple airlines, and aircraft are a mix of medium, large and ultra-large widebodies.

Identifying routes with an average aircraft size of 350 seats or more shows how and where some airlines are using their large and extra-large widebodies.

Two of the 10 largest transatlantic routes by seats have an average aircraft size of 350 seats or more. LHR-LAX has an average aircraft size of 353 seats. It is served by BA, United, Virgin Atlantic and American Airlines with various aircraft types including A380s, 777-300ERs, 777-200ERs, A340-600s and 787-9s.

The route from Paris Orly (ORY) to Pointe A Pitre (PTP) in Guadeloupe has an average aircraft size of 354 seats. It is operated by Air France, Corsair and Air Caraïbes. The latter two carriers use 747-400s and A330s configured in high-density layouts on this leisure route.

There are 32 transatlantic airport-pairs with an average aircraft size of 350 seats or more in 2016, compared to just 16 in 2011. Many of these 32 routes link

The 777-300ER has been the fastest growing type in the large widebody market since it entered service. Many airlines, including Cathay Pacific, have used 777-300ERs to replace 747-400s. In 2016 all of Cathay Pacific's trans-Pacific flights will be operated by 777-300ERs.

Europe with North America, the Caribbean and South and Central America. Most are established services that have grown in capacity since 2011. Four are new airport-pairs.

Fifteen of the 20 largest routes based on average aircraft size have seen an increase in the average number of seats per departing flight since 2011.

The route with the largest average capacity is FRA-MIA with an average aircraft size of 526 seats (see table, page 18). This is an increase of 83 seats since 2011. Lufthansa is the exclusive operator on this airport-pair and provides a daily A380 return service.

FRA is the origin point for eight of the top 20 transatlantic routes measured by average aircraft size. All these routes are operated by Lufthansa, but some are also operated by other carriers. Lufthansa has been replacing 747-400 capacity on these routes since 2011 with larger A380s, 747-8Is or a combination of the two. In many cases, it has maintained similar flight frequencies, but has grown capacity by deploying the larger aircraft.

Some of the transatlantic routes with the largest average aircraft size are high-density, established airport-pairs such as FRA-JFK and CDG-LAX. The average aircraft size on routes such as Bordeaux (BOD) to Punta Cana (PUJ) in the Dominican Republic shows that there is a need for large and ultra-large widebodies on some lower frequency leisure routes.

Trans-Pacific

The trans-Pacific market includes all services between the Asia-Pacific region and North, Central and South America.

The trans-Pacific market is dominated by services between North America and the Asia Pacific. Some of the largest trans-Pacific routes connect destinations in the US and Japan. The next largest traffic flows link the US to China, South Korea, Australia and Hong Kong.

Services between South America and the Asia Pacific will account for 1% of trans-Pacific capacity available in 2016.

The largest market between South America and the Asia Pacific connects Chile with New Zealand. There are currently no services between the Asia Pacific and Central America.

There will be about 54 million bi-directional seats available on trans-Pacific

ALL TRANS-PACIFIC ROUTES WITH AVERAGE AIRCRAFT SIZE OF 350 SEATS PLUS IN 2016

Airport Pair	Origin Country	Destination Country	Seats	Flights	Av Rtn Freq	Av Seats	Av Seats change since 2011
Dallas Fort Worth (DFW) - Sydney (SYD)	USA	Australia	315,900	702	x 1 daily	450	+56
Los Angeles (LAX) - Guangzhou (CAN)	USA	China	497,792	1,124	x 10-11 weekly	443	+149
New York (JFK) - Seoul Incheon (ICN)	USA	South Korea	925,646	2,196	x 3 daily	422	+104
Los Angeles (LAX) - Melbourne (MEL)	USA	Australia	665,132	1,666	x 16 weekly	399	-5
Santiago (SCL) - Sydney (SYD)	Chile	Australia	169,026	429	x 4 weekly	394	NEW
Los Angeles (LAX) - Seoul Incheon (ICN)	USA	South Korea	1,268,144	3,242	x 4-5 daily	391	+77
Los Angeles (LAX) - Brisbane (BNE)	USA	Australia	551,511	1,461	x 2 daily	377	-4
Detroit (DTW) - Seoul Incheon (ICN)	USA	South Korea	256,432	682	x 1 daily	376	+106
Vancouver (YVR) - Taipei (TPE)	Canada	Taiwan	420,259	1,120	x 10-11 weekly	375	+55
Atlanta (ATL) - Seoul Incheon (ICN)	USA	South Korea	267,102	732	x 1 daily	365	+55
Detroit (DTW) - Tokyo Narita (NRT)	USA	Japan	265,827	734	x 1 daily	362	-41
Vancouver (YVR) - Manila (MNL)	Canada	Philippines	274,628	760	x 7-8 weekly	361	+63
San Francisco (SFO) - Sydney (SYD)	USA	Australia	487,142	1,352	x 13 weekly	360	+2
San Francisco (SFO) - Manila (MNL)	USA	Philippines	296,912	842	x 8 weekly	353	-64
Detroit (DTW) - Shanghai (PVG)	USA	China	253,463	720	x 1 daily	352	+17
San Francisco (SFO) - Singapore (SIN)	USA	Singapore	149,100	426	x 4 weekly	350	NEW

Source: Innovata

Notes: Figures for each airport-pair include both directions of travel. Seat and av seat numbers are therefore based on two-way capacity. SYD-DFW and MNL-SFO only served direct in one direction in 2011.

services in 2016, an increase of 35% in this market since 2011. The number of flights has increased by 37%, so leading to a small reduction in the average aircraft size from 277 to 273 seats from 2011 to 2016.

A380s, 747-400s, 747-8Is and 777-300ERs are all used on trans-Pacific services in 2016, mostly between North America and the Asia Pacific. Medium-widebodies including A330s, 767s, 787s and 777-200ERs are also used.

United Airlines will provide the most trans-Pacific capacity in 2016, followed by Delta, Korean Air, Cathay Pacific Airways, Japan Airlines, Air Canada, All Nippon Airways (ANA) and American Airlines. United and Delta will use 747-400s on trans-Pacific services in 2016, but most of their capacity will be provided by medium-widebodies. United is accelerating the retirement of its remaining 747-400s and Delta plans to retire the type by 2017.

The main users of large and ultra-large widebodies on trans-Pacific services will include Asia Pacific carriers Cathay Pacific, Korean Air, EVA Air, Air China and Qantas. Other significant operators include ANA, United, China Eastern Airlines, Air Canada and China Airlines.

Cathay Pacific serves eight airports in the US and Canada from its Hong Kong (HKG) hub. It has withdrawn A340-300s and 747-400s from trans-Pacific services since 2011. All of its flights in this market are now operated by 777-300ERs, resulting in a decrease in average aircraft size from 383 to 304 seats since 2011.

Korean Air has reduced the number of trans-Pacific flights operated by A330s, 777-200ERs and 747-400s over the past five years. It has increased the number of flights operated by A380s and 777-

300ERs and introduced 747-8Is on its services from Seoul Incheon (ICN) to the US and Canada. This has resulted in an increase in Korean Air's average aircraft size on trans-Pacific services from 285 to 311 seats from 2011 to 2016.

EVA Air is based in Taipei (TPE), Taiwan, from where it serves up to nine trans-Pacific destinations in the US and Canada. Most of these services are flown by 777-300ERs, with some flown by 747-400s and A330s. EVA Air's average aircraft size on trans-Pacific routes has shrunk from 323 to 319 seats since 2011.

Air China also serves nine trans-Pacific routes from its hub at Beijing (PEK). Most of these services are flown by 777-300ERs or 747-400s and its average aircraft size has grown from 282 to 298 seats in this market since 2011.

Qantas operates trans-Pacific services from Sydney (SYD), Melbourne (MEL) and Brisbane (BNE). Most of these are flown by A380s or 747-400s. Qantas has increased its A380 capacity in this market since 2011. It has withdrawn 767s from trans-Pacific services. Qantas' average aircraft size on trans-Pacific routes has grown from 380 to 408 seats since 2011.

Some airlines are using large or ultra-large aircraft to increase capacity on established trans-Pacific routes, without increasing frequencies. Korean Air has done this since 2011 on ICN-JFK by replacing 777-300ERs with 747-400 and A380 flights. In other cases the aircraft size and frequency have both increased.

Large and ultra-large widebodies are being used on new trans-Pacific routes. Cathay Pacific is operating 777-300ERs from HKG to Boston (BOS) in 2016. This airport-pair was not served in 2011.

The trans-Pacific airport-pair with the most available seats in 2016 is Tokyo

Narita (NRT) to Honolulu (HNL) in Hawaii. There will be nearly two million bi-directional seats available on this airport-pair across an average of 10 daily return flights. The average aircraft size on HNL-NRT is 262 seats.

The next largest routes are LAX-NRT, LAX-SYD and LAX-ICN. Five of the 10 largest trans-Pacific routes arrive at or depart from LAX, which has the most departing seats of any airport in this market. The average aircraft size of the top 10 busiest routes ranges from 219 to 391 seats. All of the 10 largest routes are served by multiple carriers and mostly by a mix of medium, large and ultra-large widebodies. Only LAX-TPE and SFO to HKG are served exclusively by large and ultra-large widebodies. Due to its proximity to the Asia Pacific region, some flights between Guam (GUM) and ICN are operated by narrowbodies.

Six of the 10 largest trans-Pacific routes have seen a reduction in the average aircraft size since 2011.

Only one of the 10 busiest trans-Pacific routes has an average capacity of more than 350 seats. The average aircraft size on LAX-ICN is 391 seats (*see table, this page*). This is operated by Asiana Airlines using 777-200LRs, 777-300ERs, 747-400s, and A380s, and by Korean Air using A380s and A330-200s.

There are 16 trans-Pacific routes with an average aircraft size of 350 seats or more (*see table, this page*), compared to 15 in 2011. Established airport-pairs account for 14 of the 16, and 11 of these have increased in average aircraft size since 2011. Three have grown by more than 100 seats (*see table, this page*).

Two other routes, SFO to Singapore (SIN) and SYD to Santiago (SCL) in Chile, have been introduced since 2011.

TOP 20 ROUTES FROM EUROPE TO ASIA/ASIA PACIFIC WITH AVERAGE AIRCRAFT SIZE OF 350 SEATS PLUS IN 2016

Airport Pair	Origin Country	Destination Country	Seats	Flights	Av Rtn Freq	Av Seats	Av Seats change since 2011
Frankfurt (FRA) - Singapore (SIN)	Germany	Singapore	923,832	2,178	x 3 daily	424	+69
London Heathrow (LHR) - Kuala Lumpur (KUL)	UK	Malaysia	914,832	2,164	x 3 daily	423	+64
Paris Charles de Gaulle (CDG) - Bangkok (BKK)	France	Thailand	503,296	1,199	x 11-12 weekly	420	+82
Frankfurt (FRA) - Hong Kong (HKG)	Germany	Hong Kong	590,120	1,430	x 2 daily	413	+49
Moscow Sheremetyevo (SVO) - Hong Kong (HKG)	Russia	Hong Kong	293,862	731	x 1 daily	402	+149
Moscow Sheremetyevo (SVO) - Khabarovsk (KHV)	Russia	Russia	458,028	1,164	x 11-12 weekly	393	+121
Paris Charles de Gaulle (CDG) - Singapore (SIN)	France	Singapore	569,832	1,458	x 2 daily	391	+1
Munich (MUC) - Bangkok (BKK)	Germany	Thailand	284,076	732	x 1 daily	388	+19
Frankfurt (FRA) - Delhi (DEL)	Germany	India	558,472	1,450	x 2 daily	385	+91
Frankfurt (FRA) - Seoul Incheon (ICN)	Germany	South Korea	829,050	2,154	x 3 daily	385	+47
Brussels (BRU) - Bangkok (BKK)	Belgium	Thailand	147,444	384	x 3-4 weekly	384	+42
Moscow Vnukovo (VKO) - Khabarovsk (KHV)	Russia	Russia	114,878	302	x 3 weekly	380	+115
Frankfurt (FRA) - Bangkok (BKK)	Germany	Thailand	794,572	2,104	x 2-3 daily	378	+12
London Heathrow (LHR) - Dhaka (DAC)/Sylhet (ZYL)	UK	Bangladesh	157,920	420	x 4 weekly	376	+51
Milan Malpensa (MXP) - Bangkok (BKK)	Italy	Thailand	141,112	376	x 3-4 weekly	375	+59
London Heathrow (LHR) - Singapore (SIN)	UK	Singapore	1,702,739	4,559	x 6-7 daily	373	-11
Munich (MUC) - Tokyo Haneda (HND)	Germany	Japan	499,426	1,346	x 13 weekly	371	NEW
Copenhagen (CPH) - Bangkok (BKK)	Denmark	Thailand	342,880	929	x 9 weekly	369	+47
Stockholm Arlanda (ARN) - Bangkok (BKK)	Sweden	Thailand	346,638	943	x 9 weekly	368	-21
Moscow Sheremetyevo (SVO) - Petropavlovsk (PKC)	Russia	Russia	266,860	730	x 1 daily	366	+109

Source: Innovata

Notes: Figures for each airport-pair include both directions of travel. Seat and av seat numbers are therefore based on two-way capacity.

The trans-Pacific airport-pair with the highest average aircraft size in 2016 is Dallas Fort Worth (DFW) to SYD at 450 seats. Qantas is the sole operator on this route and is scheduled to provide a daily return service using A380s in 2016.

The origin points serving the most trans-Pacific routes with an average aircraft size of 350 seats or more are ICN (4) and LAX (4). Korean Air and Asiana Airlines operate multiple types on ICN-JFK and ICN-LAX, including A380s.

Korean Air and Delta are the sole operators on ICN-ATL and ICN to Detroit (DTW). Korean Air uses A380s, 747-8Is and 777-300ERs on ICN-ATL, while Delta uses 747-400s on ICN-DTW.

Europe to Asia/Asia Pacific

This analysis splits Russia into European and Asian regions. In 2016 domestic services between these two Russian regions account for the largest capacity flow between Europe and Asia, and the Asia Pacific. The next largest traffic flows are between the UK and India, Germany and China, France and China, Russia and China, and the UK and Hong Kong.

In 2016 there will be almost 99.5 million bi-directional seats available on services between Europe, and Asia and the Asia Pacific. The average aircraft size in this market increased by just eight seats from 215 seats in 2011 to 223 in 2016.

Despite the presence of short-haul, domestic Russian services, many routes in this market involve long distances, especially those between Europe and Asia

Pacific destinations, such as LHR to Jakarta (CGK) in Indonesia. This route has a great circle distance of 6,329nm. All the main large and ultra-large widebody types will be used on many of the routes connecting Europe with Asia or the Asia Pacific in 2016.

Aeroflot will provide the most seats on services between Europe and Asia and the Asia Pacific in 2016. The next largest operators will be Turkish Airlines, Lufthansa, BA, Singapore Airlines, Ural Airlines, S7 Airlines, Thai Airways and Air China. A large number of the seats provided by Aeroflot, Ural Airlines and S7 Airlines will be on services between Russia's European and Asian regions.

The main users of large and ultra-large widebodies between Europe, and Asia and the Asia Pacific in 2016 will include Lufthansa, Thai Airways, Singapore Airlines, Cathay Pacific and Aeroflot. Other users will include Turkish Airlines, Air France, Korean Air and BA.

Lufthansa will operate to 12 countries in Asia and the Asia Pacific from its FRA and MUC hubs in 2016. Its average aircraft size on routes in this market has increased from 313 to 341 seats since 2011. Three-quarters of Lufthansa's capacity in this market will be operated by large and ultra-large widebodies. It has more than doubled the number of flights operated by A380s to Asia and the Asia Pacific since 2011. It has also introduced 747-8I services in this period while reducing capacity provided by 747-400s and A340-600s. Lufthansa also operates A330-300s, A340-300s and some A320 family aircraft in this market.

Thai Airways operates to 11 European destinations from its Bangkok (BKK) hub, mostly using large or ultra-large widebodies. Since 2011 Thai Airways has withdrawn A340-600s from this market and reduced capacity flown by 747-400s. It has introduced A380s, increased the number of flights operated by 777-300ERs and increased its average aircraft size from 369 to 409 seats on services between Europe and Asia and the Asia Pacific.

Singapore Airlines will serve 13 European destinations from SIN in 2016, mostly using A380s and 777-300ERs. It will also use A350-900s and 777-200ERs on some services to Europe. Its average aircraft size in this market has increased from 347 to 349 seats since 2011.

Most of Cathay Pacific's capacity between Europe and Asia and the Asia Pacific was previously operated by 747-400s. In 2016 Cathay Pacific will fly to 11 European hubs from HKG. Most of these flights will be operated by 777-300ERs, although A350-900s will be used on its services to LGW and Dusseldorf (DUS). Its average aircraft size in this market has decreased from 347 to 303 seats since 2011.

Aeroflot will operate to 16 countries in Asia and the Asia Pacific, in addition to airports in the Asian region of Russia, using a variety of narrowbodies and medium widebodies. The only large widebodies in Aeroflot's fleet are 777-300ERs, which it uses on services from Moscow Sheremetyevo (SVO) to China, Hong Kong, South Korea, Thailand and Vietnam, as well as on domestic Russian

ALL INTRA-ASIA PACIFIC ROUTES WITH AVERAGE AIRCRAFT SIZE OF 350 SEATS PLUS IN 2016

Airport Pair	Origin Country	Destination Country	Seats	Flights	Av Rtn Freq	Av Seats	Av Seats change since 2011
Tokyo Haneda (HND) - Sydney (SYD)	Japan	Australia	569,731	1,464	x 2 daily	389	NEW
Kuala Lumpur (KUL) - Sapporo (CTS)	Malaysia	Japan	162,110	430	x 4 weekly	377	NEW
Kuala Lumpur (KUL) - Chengdu (CTU)	Malaysia	China	269,178	714	x 2 daily	377	0
Kuala Lumpur (KUL) - Hangzhou (HGH)	Malaysia	China	158,340	420	x 4 weekly	377	0
Kuala Lumpur (KUL) - Tokyo Haneda (HND)	Malaysia	Japan	275,964	732	x 1 daily	377	0
Kuala Lumpur (KUL) - Gold Coast (OOL)	Malaysia	Australia	276,341	733	x 1 daily	377	0
Kuala Lumpur (KUL) - Busan (PUS)	Malaysia	South Korea	157,586	418	x 4 weekly	377	NEW
Kuala Lumpur (KUL) - Xi'an (XIY)	Malaysia	China	157,963	419	x 4 weekly	377	NEW
Bangkok (BKK) - Sapporo (CTS)	Thailand	Japan	254,607	688	x 1 daily	370	NEW
Sydney (SYD) - Bangkok (BKK)	Australia	Thailand	937,107	2,569	x 3-4 daily	365	+41

Source: Innovata

Notes: Figures for each airport-pair include both directions of travel. Seat and av seat numbers are therefore based on two-way capacity.

services, such as the 3,664nm route between SVO and Petropavlovsk (PKC) in the Russian Far East.

Large and ultra-large widebodies are being used on established and new routes between Europe and Asia and the Asia Pacific.

There are examples of large and ultra-large widebodies being used to provide additional capacity on established airport pairs. Thai Airways has replaced 747-400s on BKK-FRA and BKK-LHR using a mix of 777-300ERs and A380s. This has allowed it to increase capacity by 6% and 13%, while reducing frequencies by 7% and 6% on these airport-pairs.

Cathay Pacific is using 777-300ERs on services from HKG to Madrid (MAD) and Manchester (MAN). These airport-pairs have been introduced since 2011.

The airport-pair with the most seats on services between Europe and the Asia Pacific is LHR-HKG. This will be served by 7-8 daily return flights in 2016 with nearly 1.9 million bi-directional seats.

The next largest routes are LHR-SIN, LHR to Delhi (DEL), LHR-BKK and LHR to Mumbai (BOM).

Six of the top 10 routes arrive at or depart from LHR, which has the most departing seats of any airport in this market. The average aircraft size on LHR-HKG has reduced from 343 to 327 seats since 2011. LHR-SIN and LHR-BOM also saw a reduction in average aircraft size. The 10 largest routes from LHR are served by multiple carriers, with seven served by a mix of medium, large and ultra-large widebodies. FRA-SIN is the only top 10 route served exclusively by large and ultra-large types.

The other two top 10 routes are not served by any large or ultra-large widebodies. These are IST to Baku (GYD) in Azerbaijan, and the Russian domestic service between Moscow Domodedovo (DME) and Novosibirsk (OVB).

Four of the 10 largest routes between Europe and the Asia Pacific have an

average aircraft size of 350 seats or more. These are FRA-SIN, LHR to Kuala Lumpur (KUL), LHR-SIN and LHR-BKK. The total number of routes in this market with an average capacity of 350 seats or more has increased from 23 in 2011 to 31 in 2016.

Most of those 31 routes are established airport-pairs that have grown, but some have been introduced since 2011, including HND-MUC, TPE to Amsterdam (AMS), and PKC to Moscow Vnukovo (VKO).

The route with the largest average capacity is FRA-SIN (*see table, page 24*) with an average aircraft size of 424 seats, an increase of 69 since 2011. FRA-SIN will be operated by Lufthansa with A380s and by Singapore Airlines with A380s and 777-300ERs in 2016.

The origin airports serving the most destinations with an average aircraft size of 350 seats or more in this market are BKK (10) and FRA (8).

Five of the 20 largest routes based on average aircraft size originate in FRA. All are served by Lufthansa and at least one other carrier. Significantly they are all served by some A380 frequencies.

Intra-Asia Pacific

The intra-Asia Pacific market accounts for all routes within the Asia-Pacific region. This includes a number of large domestic markets such as China, Japan, Indonesia and Australia. Domestic Chinese routes alone will account for more than a third of all seats available in the intra-Asia Pacific market in 2016.

The largest international markets in the Asia Pacific connect China with South Korea, and China with Japan. Intra-Asia Pacific routes vary from short-haul domestic services, to long-haul sectors, such as Auckland (AKL) to PEK, which has a distance of about 5,600nm.

There will be 1.49 billion bi-directional seats available on intra-Asia Pacific services in 2016, an increase of

nearly 50% since 2011. Average aircraft size has only grown from 156 to 161 seats during this period.

The largest capacity providers in the intra-Asia Pacific market in 2016 will be China Southern Airlines and China Eastern Airlines. The next largest operators will be Air China, ANA, Lion Air, Japan Airlines and Xiamen Airlines.

Much of China Southern's and China Eastern's capacity is provided by narrowbody aircraft on domestic Chinese routes. Most of Lion Air's and Xiamen Airlines' capacity is also focused on narrowbody operations in their domestic markets of Indonesia and China.

The main users of large and ultra-large widebodies on intra-Asia Pacific services in 2016 will include Cathay Pacific, Thai Airways, Singapore Airlines, Korean Air, and China Airlines.

Thai Airways, China Airlines and Korean Air are using a mix of narrowbodies, medium widebodies and large and ultra-large widebodies on intra-Asia Pacific services in 2016. Cathay Pacific and Singapore Airlines will use medium widebodies or large and ultra-large widebodies on their intra-Asia Pacific networks. All five airlines will make extensive use of A330s on intra-Asia Pacific airport-pairs.

Cathay Pacific's average aircraft size has decreased from 335 to 326 seats since 2011. It will use large and ultra-large widebodies on services from HKG to 19 intra-Asia Pacific destinations in 2016. These will mainly be operated by 777-300s and 777-300ERs, and by some 747-400s. The main airport-pairs on which Cathay Pacific will use these aircraft include HKG-TPE, HKG-NRT, HKG to Manila (MNL) and HKG-SIN.

Thai Airways will deploy 777-300s, 777-300ERs, 747-400s and A380s on intra-Asia Pacific services from BKK in 2016. Its average aircraft size in this market increased from 282 seats in 2011 to 310 in 2016. Some of the routes the carrier serves with large and ultra-large

TOP 20 MIDDLE EAST ROUTES WITH AVERAGE AIRCRAFT SIZE OF 350 SETAS PLUS IN 2016

Airport Pair	Origin Country	Destination Country	Seats	Flights	Av Rtn	Av Seats	Av seats change since 2011
Dubai (DXB) - New York (JFK)	UAE	USA	1,073,844	2,196	x 3 daily	489	+44
Dubai (DXB) - San Francisco (SFO)	UAE	USA	357,948	732	x 1 daily	489	+89
Dubai (DXB) - Los Angeles (LAX)	UAE	USA	537,900	1,100	x 10-11 weekly	489	+154
Dubai (DXB) - Mauritius (MRU)	UAE	Mauritius	723,096	1,482	x 2 daily	488	+101
Dubai (DXB) - London Gatwick (LGW)	UAE	UK	1,147,444	2,380	x 3-4 daily	482	+110
Dubai (DXB) - Sydney (SYD)	UAE	Australia	1,043,946	2,193	x 3 daily	476	+5
Dubai (DXB) - Copenhagen (CPH)	UAE	Denmark	366,504	778	x 7-8 weekly	471	+226
Dubai (DXB) - Melbourne (MEL)	UAE	Australia	686,898	1,463	x 2 daily	470	+70
Dubai (DXB) - Washington Dulles (IAD)	UAE	USA	365,486	780	x 7-8 weekly	469	+191
Dubai (DXB) - Dusseldorf (DUS)	UAE	Germany	683,500	1,464	x 2 daily	467	+124
Dubai (DXB) - Munich (MUC)	UAE	Germany	1,088,260	2,334	x 3-4 daily	466	+138
Dubai (DXB) - Barcelona (BCN)	UAE	Spain	682,140	1,464	x 2 daily	466	NEW
Dubai (DXB) - Brisbane (BNE)	UAE	Australia	473,948	1,022	x 9-10 weekly	464	+64
Dubai (DXB) - Perth (PER)	UAE	Australia	678,693	1,466	x 2 daily	463	+167
Doha (DOH) - Bangkok (BKK)	Qatar	Thailand	1,350,886	2,928	x 4 daily	461	+140
Dubai (DXB) - Taipei (TPE)	UAE	Taiwan	336,410	732	x 1 daily	460	NEW
Dubai (DXB) - Manchester (MAN)	UAE	UK	1,008,696	2,196	x 3 daily	459	+62
Dubai (DXB) - Houston (IAH)	UAE	USA	325,196	732	x 1 daily	444	+178
Dubai (DXB) - Madrid (MAD)	UAE	Spain	650,212	1,464	x 2 daily	444	+154
Dubai (DXB) - Shanghai (PVG)	UAE	China	648,604	1,464	x 2 daily	443	+93

Source: Innovata

Notes: Figures for each airport-pair include both directions of travel. Seat and av seat numbers are therefore based on two-way capacity.

widebodies include domestic services to Phuket (HKT), and Chiang Mai (CNX), BKK-SIN, and BKK-HKG.

Singapore Airlines will use large and ultra-large widebodies on 16 intra-Asia Pacific routes from SIN in 2016. Its large widebody services will be flown by 777-300s, 777-300ERs or A380s. The routes with the largest number of seats on large and ultra-large widebodies will be SIN-CGK, SIN-SYD, and SIN to Shanghai (PVG). The average aircraft size on intra-Asia Pacific services has decreased from 306 to 303 seats since 2011.

Korean Air is using 777-300s, 777-300ERs, 747-400s, 747-8Is and A380s on some intra-Asia Pacific flights in 2016. In addition to several routes from Seoul Gimpo (GMP), it will use large and ultra-large widebodies on up to 30 destinations within the region from ICN. Some of its most significant large widebody capacity in this market will be deployed on the domestic service between GMP and Jeju (CJU) on which it operates 747-400s, as well as other narrowbody and medium widebody aircraft. Other routes on which Korean operates large and ultra-large aircraft include ICN-HKG, ICN-MNL, and ICN-SIN. Korean's average aircraft size in this market has decreased from 228 to 215 seats since 2011.

Air China has increased its average aircraft size on intra-Asia Pacific services from 166 to 177 seats since 2011. It will use 777-300ERs and 747-400s on intra-Asia Pacific routes in 2016. Many are domestic services, including those from PEK to Shanghai (SHA), Guangzhou (CAN) and Shenzhen (SZX).

Large and ultra-large widebodies have been used on existing intra-Asia Pacific routes to increase capacity. Singapore Airlines introduced A380s on SIN-PEK and increased its capacity on this airport-pair by 22%, without altering the number of frequencies.

Large and ultra-large widebodies have also been used on new routes in this market. Thai Airways is scheduled to operate 747-400s and 777-300s on BKK to Sapporo (CTS), Japan in 2016. This route did not exist in 2011.

The airport-pairs with the most available seats in the intra-Asia Pacific market are all domestic services. The largest is the high-density, short-haul route GMP-CJU in South Korea, with a sector length of just 243nm. In 2016 there will be nearly 14.5 million bi-directional seats available across 75,000 flights on GMP-CJU, making it the largest airport-pair in the world by available capacity. The average aircraft size on this route in 2016 is 192 seats. On average, there are more than 100 return flights per day on GMP-CJU, served by six different airlines using a mix of types, including 737s, A320s and 747-400s.

The next largest intra-Asia Pacific routes are Tokyo Haneda (HND) to CTS, and HND to Fukuoka (FUK) in Japan, and SYD-MEL in Australia. The average aircraft size on these routes ranges from 188 seats on SYD-MEL, to 269 on HND-CTS, down from 318 in 2010 when HND-CTS was the largest global airport-pair (see *Who needs the A380 & for which routes? Aircraft Commerce, Issue 71, page 7*).

GMP-CJU, HND-CTS, and HND-FUK are all served by multiple carriers and a mix of narrowbody, medium widebody, and large and ultra-large widebodies. SYD-MEL is operated by multiple airlines using regional jets, narrowbodies and medium widebodies.

There are 10 intra-Asia Pacific routes with an average capacity of 350 seats or more in 2016 (see table, page 25), down from 15 in 2011. Five of the 10 routes are new since 2011, including HND-SYD, which has the largest average aircraft size in this market at 389 seats. This route is served by daily return flights from Qantas using 747-400s, and ANA with 787s. Only one of the remaining five established airport-pairs has seen growth in average aircraft size since 2011. This is the only major market whose average aircraft size has not increased since 2011.

Seven of the 10 routes with average capacities of 350 seats or more are operated from KUL. AirAsia X is the sole operator on these routes. It operates high-density A330-300s with 377 seats on these services. Frequencies vary from daily returns, to four flights per week.

The high average aircraft size of these routes shows that there could be a market for large and ultra-large widebodies on low-frequency leisure services within the Asia Pacific, in addition to established long-haul hub connections and high-density domestic airport-pairs.

Middle East

The Middle East market accounts for all flights to, from and within the Middle-

Lufthansa has been replacing its 747-400 fleet with a mix of A380s and the 747-8I. The German flag carrier is the largest operator of the latest 747 variant. It employs them on a wide range of markets from transatlantic services to routes between Europe and the Asia Pacific.

East region.

The number of bi-directional seats available to, from and within the Middle East has risen by 350 million or 55% since 2011. There has been growth on services within the Middle East and to and from other regions. The strongest growth has been from the Middle East to extra-regional destinations.

Much of this can be attributed to the continued expansion of Emirates, Qatar Airways and Etihad Airways. All three use large and ultra-large widebodies on intra- and extra-regional services. They are the biggest operators of large and ultra-large widebodies in the Middle East, on networks that connect East with West via their respective hubs at Dubai (DXB), Doha (DOH) and Abu Dhabi (AUH).

Emirates operates an all-widebody fleet. It is the largest global operator of large and ultra-large widebody aircraft, and the largest operator of A380s and 777-300ERs. Since 2011, it has reduced capacity from medium widebodies, including A330-200s, A340-300s and -500s, and 777-200ERs, in favour of A380s and 777-300ERs. In 2016 large and ultra-large widebodies will account for 92% of Emirates' global seat capacity. Emirates' average aircraft size across its entire route network increased from 343 seats in 2011 to 404 seats in 2016.

Emirates will operate large and ultra-large widebodies to 68 countries from DXB in 2016. Its largest markets include the UK, India, the US and Saudi Arabia. It uses large and ultra-large widebodies to increase capacity on established routes. Its DXB-LHR route, for example, is now almost exclusively operated by A380s, whereas in 2011 nearly 60% of flights were flown by 777-300s or -300ERs. This has led to a 26% increase in capacity, with only 16% more flights. Emirates operates large and ultra-large widebodies on new routes introduced since 2011.

Qatar Airways and Etihad Airways both operate mixed fleets of narrowbody, medium widebody and large and ultra-large widebodies. Both airlines operate A340-600s, 777-300ERs and A380s.

Qatar's largest destination markets for its large and ultra-large aircraft are Thailand, the US, the UK, China and Saudi Arabia. Etihad provides its highest available large and ultra-large capacity on services from AUH to the UK, Australia, Thailand, the US and Saudi Arabia.



Qatar and Etihad have used large and ultra-large widebodies on new airport-pairs, or to increase capacity on established services.

The three largest routes in the Middle East in 2016 are all intra-regional. The route with the most available capacity is the domestic Saudi Arabian service from Riyadh (RUH) to Jeddah (JED), with 5.5 million bi-directional seats available. This will be served by 34-35 daily return flights in 2016. The average aircraft size on this route decreased from 242 seats in 2011 to 219 in 2016.

The next largest routes are DXB-DOH, DXB to Kuwait (KWI) and DXB-LHR, all of which have seen an increase in average aircraft size since 2011. DXB is the origin point for eight of the 10 largest routes in this market. The average aircraft size on the top 10 routes varies from 194 seats on DXB to Muscat (MCT) in Oman, to 399 on DXB-LHR.

All of the top 10 routes are served by multiple airlines. With the exception of LHR-DXB, they are operated with a mix of narrowbodies, medium widebodies and large and ultra-large widebodies.

LHR-DXB is only operated by widebodies. It is the only one of the 10 largest routes with an average aircraft size of more than 350 seats. It has an average capacity of 399 seats per flight, up by 40 seats since 2011, partly due to the high number of flights served by A380s. As well as Emirates' multiple daily services, there are twice-daily A380 flights operated by Qantas, which has relocated its stopover for flights between LHR and Australia from SIN and HKG to DXB.

The number of airport-pairs originating in the Middle East with an

average aircraft size of 350 seats or more has increased from 33 in 2011 to 101 in 2016, a rise of 206%. Many have seen a very large increase in average aircraft size (see table, page 26). DXB is the origin point for 77 of these routes. Established airport-pairs account for many of the 101 routes with an average aircraft size of 350 seats or more, but some have been introduced since 2011, including DXB to Barcelona (BCN), DXB-TPE and DXB-DFW. All are operated exclusively by Emirates with 777-300ERs and A380s.

The airport-pair with the largest average aircraft size is DXB-JFK (see table, page 26). Emirates operates this route with three daily A380 flights with an average aircraft size of 489 seats.

The 20 largest routes based on average aircraft size have all seen a rise in average seat capacity since 2011. Much of this is due to Emirates adding larger aircraft and/or increasing frequencies.

Other markets

A number of other markets could support large or ultra-large widebody services, including intra-Europe, intra-North America, intra-Asia and Africa.

There are only a few large and ultra-large widebodies being operated on intra-European routes. Turkish Airlines is scheduled to operate 777-300ERs on some domestic services from IST in 2016, along with some frequencies from IST-LHR and IST to Athens (ATH).

Rossiya will use 747-400s and 777-300s on some domestic Russian flights and services between Russia and Ukraine. Some non-European carriers will use fifth freedom rights to connect their hubs to



one European airport via another. Singapore Airlines will, for example, operate from MAN via MUC to SIN using 777-300ERs in 2016.

The largest intra-European routes by available capacity in 2016 are domestic services: IST to Izmir Adnan Menderes (ADB) in Turkey; ORY to Toulouse (TLS) in France; and MAD-BCN in Spain. These will have an average capacity of 189, 175 and 194 seats respectively. Only IST-ADB will be served by large and ultra-large widebodies, with Turkish Airlines using 777-300ERs on some frequencies.

Only one intra-European airport-pair will have an average aircraft size of 350 seats or more in 2016. Onur Air will operate A330s in a high-density, 358-seat configuration between Antalya (AYT) in Turkey and Kazan (KZN) in Russia with about three flights per week.

Large and ultra-large widebodies are not used on many intra-North American airport-pairs. Air Canada operates 777-300ERs on some flights between Toronto (YYZ) and Vancouver (YVR), and American Airlines uses the same type on some frequencies on MIA-LAX. Cathay Pacific uses fifth freedom rights to operate YVR-HKG via JFK.

The largest intra-North American routes by seat capacity in 2016 are LAX-SFO, domestic Mexican services from Mexico City (MEX) to Cancun (CUN) and Monterrey (MTY), and LAX-JFK. None of these routes will be operated by large or ultra-large widebodies. There are no intra-North American airport-pairs with an average aircraft size of 350 seats or more.

Large and ultra-large widebodies are not used widely on intra-Asia airport-

pairs. The largest intra-Asia airport pairs are all domestic Indian services, providing up to 120 million seats in 2016. In 2016 there will be more than eight million bi-directional seats available on DEL-BOM, which will be served by more than 60 daily return flights. The next largest routes are DEL to Bengaluru (BLR), and BOM-BLR. DEL-BLR and BOM-BLR do not have any large and ultra-large widebody frequencies. BOM-DEL is mainly served by narrowbodies or medium widebodies, but Air India uses 777-300ERs on some frequencies.

Air India uses 777-300ERs on some domestic flights between DEL and Hyderabad (HYD), and BOM and Ahmedabad (AMD). Biman Bangladesh operates 777-300ERs on its domestic service from Dhaka (DAC) to Chittagong (CGP), while Emirates uses the type to connect Colombo (CMB) in Sri Lanka with DXB, via Male (MLE) in the Maldives.

Large and ultra-large widebodies are being used on services to, from and within Africa in 2016. The largest intra-Africa airport-pair is the South African domestic service between Johannesburg (JNB) and Cape Town (CPT). This is served by 45 daily return flights and 5.6 million two-way seats in 2016. Most of the rotations on JNB-CPT are operated by narrowbodies, but South African Airways (SAA) uses A340-600s on some flights, and on some flights between JNB and Lagos (LOS) in Nigeria, and between JNB and Accra (ACC) in Ghana. Other intra-African large and ultra-large widebody services include Ethiopian Airlines' 777-300ER services from Addis Ababa (ADD) to LOS, and from ADD to Luanda (LAD) in Angola.

Korean Air operates a wide variety of large and ultra-large widebodies including 747-400s, 747-8Is, 777-300ERs and A380s. It uses large widebodies on, long-haul hub routes but also on high-density, short-haul domestic services in South Korea.

A number of airlines are using large and ultra-large widebodies on services to Africa from extra-regional destinations in 2016. Emirates will provide the most capacity on large and ultra-large types. It serves 17 destinations in Africa from DXB, mostly with 777-300ERs.

Ethiopian Airlines' services on ADD-LOS and ADD-LAD are the only two intra-Africa routes with an average size of 350 or more seats. Another 23 routes between Africa and extra-regional destinations have an average aircraft size in excess of 350 seats. Ten of these are Emirates routes linking Africa with DXB. The route with the largest average capacity is ORY to Mauritius (MRU), operated twice weekly by Corsair using 747-400s in a high-density layout with 582 seats.

Summary

Large and ultra-large widebodies are being used in many of the world's largest air passenger markets on established, high-capacity, long-haul routes linking major hubs. Large widebodies are being operated on some short-haul, high-density domestic services.

In some cases large and ultra-large widebodies have been introduced on established routes to increase capacity, and to operate new airport-pairs.

There is evidence to suggest a need for large and ultra-large widebodies on some lower-frequency leisure-orientated routes.

The Middle East, transatlantic, Europe to Asia and Asia Pacific, and trans-Pacific markets have all seen a rise in the number of routes with an average aircraft size of 350 seats or more, while the intra-Asia Pacific market has seen a fall. The number of airport-pairs with an average aircraft size of 350 seats or more across these five markets grew from 102 in 2011 to 190 in 2016. The strongest growth in large and ultra-large widebody services has come from the Middle East as Emirates, Qatar Airways and Etihad continue to expand their international networks. Few large and ultra-large widebodies are used in the intra-Europe and intra-North America markets. **AC**

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