

Masterthesis

Course

MBA Aviation and Tourism Management

Topic

**Strategic Fleet and Network Analysis
of Amazon Air in Europe:
A Comparison with the USA**

appraised by

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List of Abbreviations

A333	Airbus 330-300
ABR	"Contract": Callsign of ASL Airlines Ireland
ABX	"Abex": Callsign of ABX Air (a subsidiary of ATSG)
A/C	Aircraft
ACMI	Aircraft, Crew, Maintenance and Insurance
ADS-B	Automatic Dependent Surveillance-Broadcast technology
AFR	"Air France": Callsign of Air France
AMZ	Amazon
ASL	Airlines, Support and Leasing: an aviation company based in Dublin, Ireland
AT75	ATR (Avions de Transport Régional) 72-500: Turboprop aircraft
ATI	"Air Transport": Callsign of Air Transport International (a subsidiary of ATSG)
ATP	British Aerospace Advanced Turboprop
ATSG	Air Transport Services Group
AWC	"Zap": Callsign of Titan Airways
B733	Boeing 737-300
B734	Boeing 737-400
B738	Boeing 737-800
B763	Boeing 767-300
BCS	"Postman": Callsign of EAT
CAM	Cargo Aircraft Management (a subsidiary of ATSG)
COVID	Coronavirus Disease
DEP	Departure Airport
DEST	Destination Airport
DFLD	Deutsche Lärmdienst e.V. (engl.: German Aircraft Noise Service)

DHL	Deutsche Post's postal and parcel service provider. The acronym DHL is derived from the surnames of its American founders: Adrian Dalsey, Larry Hillblom and Robert Lynn.
DVZ	Deutsche Verkehrszeitung (engl.: German Transport Newspaper)
EAT	European Air Transport, a subsidiary of Deutsche Post AG (DHL).
EANS	European Aircraft Noise Services
EC	European Comission
EU	European Union
FDX	"FedEx": Callsign of FedEx Express
FPO	"French Post": Callsign of ASL Airlines France
FR24	Flightradar24
GCL	"Saxonia": Callsign of CaroLogic Germany
GIS	Geographic Information System
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
lcl	local time
MSA	"Mistral Wings": Callsign of Poste Air Cargo (Italy)
nm	nautical miles
NPT	"Neptune": Callsign of West Atlantic UK
OBS	Observation
OPR	Aircraft Operator
P2P	Point to Point
QGIS	Quantum-GIS
REG	Aircraft Registration
RFS	Road Feeder Service
STA	Scheduled time of arrival

STD	Scheduled time of departure
SWN	"Air Sweden": Callsign of West Atlantic Sweden
TAY	"Quality": Callsign of ASL Airlines Belgium
UK	United Kingdom
USA	United States of America

List of Airports

IATA	ICAO	Airport Name & Country
BCN	LEBL	Barcelona El Prat, Spain
CAG	LIEE	Cagliari Elmas, Italy
CDG	LFPG	Paris Charles de Gaulle, France
CGN	EDDK	Cologne/Bonn, Germany
CTA	LICC	Catania-Fontarossa, Italy
CVG	KCVG	Cincinnati Northern Kentucky Int'l, Kentucky, USA
EMA	EGNX	East Midlands, UK
FCO	LIRF	Rome-Fiumicino, Italy
HAJ	EDDV	Hanover, Germany
ILN	KILN	Wilmington Air Park, Ohio, USA
KTW	EPKT	Katowice, Poland
LCA	LCLK	Larnaca, Cyprus
LEJ	EDDP	Leipzig/Halle, Germany
LGG	EBLG	Liege, Belgium
LNZ	LOWL	Linz, Austria
MAD	LEMD	Madrid-Barajas, Spain
MXP	LIMC	Milan Malpensa, Italy
SEN	EGMC	London Southend, UK

1 Introduction

Amazon Air – the airline of the e-commerce and technology giant Amazon – represents a remarkable development in the world of logistics. Following its launch in the USA, the airline has also been active in Europe for several years. This Masterthesis is focused on analysing Amazon Air's development in Europe and thus closing a significant research gap. While preliminary studies on Amazon Air's network and fleet already exist for the USA, there is a gap in comprehensive research for the European region.

After some insiders have already been speculating this, Amazon Air confirmed officially that it starts operating in Europe in 2020. The press release states that a regional air freight centre will be opened at Leipzig/Halle Airport in Germany and that initially two Boeing 737-800s will be used in a European air freight network. (Amazon.com, 2020)

In recent years, reports about Amazon Air's activities have attracted a certain amount of attention in academic literature, the industry press and dedicated online portals. This is because Amazon Air has developed in a fairly unexpected and, at first glance, inexplicable way compared to well-known cargo airlines. US researchers at Chicago DePaul University, who regularly analyse the development of Amazon Air in the USA, label Amazon Air as "something of a unicorn in the air-cargo world". (Schwieterman, Craig and Mader, 2022). According to them, Amazon's airline represents one of the "most significant developments in the U.S. air-cargo business" (Schwieterman and Walls, 2020, p. 1).

At this point, it should be noted that this paper deals with the airline Amazon Air. Even though the aircraft are labelled 'Prime Air', they should not be confused with the developments of the drone unit, which is marketed as 'Amazon Prime Air'.

The objective of this Masterthesis is to scientifically analyse the development of Amazon Air in Europe. The focus is on analysing the network and the fleet in operation. The results of the analysis are intended to be comparable with existing research on their development in the USA. The following four research questions are defined for this aim:

- Research Question 1: How do the actual flights conducted by Amazon Air in Europe compare to those in the USA? What does a network analysis reveal about Amazon Air's strategy in Europe compared to the USA?
- Research Question 2: What is the relationship between Amazon Air and its partners (such as DHL) in Europe compared to the USA? Could these partnerships potentially turn into competitive situations in the future?
- Research Question 3: How has the fleet of Amazon Air in Europe developed and how does this development differ from the USA? What role do subcontractors play in Amazon Air's strategy in Europe compared to the USA?
- Research Question 4: Can predictions for future fleet planning and network strategy in Europe be made based on Amazon Air's development in the USA?

In order to answer these research questions, Chapter 2 provides a literature review. This firstly contextualises the global development of Amazon's airline. The existing studies on Amazon Air in the USA are then presented with their most significant conclusions. The knowledge that is already available on Amazon Air in Europe is outlined thereafter. It should be mentioned here that there is only a very limited amount of scientifically substantiated literature available. With the intention of developing an initial scientifically founded basis with this thesis, the literature research ends with a selection of potential data sources. It also examines the methods that are state-of-the-art in academic study of aviation regarding fleet and network analyses.

Based on this research, this dissertation describes a methodology developed to analyse the activity of Amazon Air in Europe on the basis of own collected data. In chapter 3, this is described more profound.

This is followed in Chapter 4 by the analyses that result from the methodology as described. Firstly, these include assessments of Amazon Air's network in Europe, followed by an analysis of the fleet in operation. Furthermore, in this chapter a first comparison is made with the data available from US research.

Finally, Chapter 5 provides a comprehensive discussion of the findings from the analysis in the previous chapter. The discussion is orientated along the four research questions defined above. The results of this Masterthesis are interpreted and contextualised within its limitation. Recommendations for further research are provided thereafter.

2 Literature Review

2.1 Evolution of Amazon Air Globally

Amazon – founded in 1995 as an online bookseller in Seattle – today is the undisputed leader among online retailers. In addition, it is a technology company that pioneers in the fields of cloud computing and artificial intelligence. However, the focus of this literature review is on Amazon's logistics division. (Schäfer, 2023, p. 298)

The e-commerce market has developed rapidly in recent years. Customers expect to have their online purchases delivered to their desired location within few days or at even hours (Morrell, 2019, p. 15). Amazon makes ambitious promises to its Prime customers: Depending on the product, it will arrive within one, two or at the latest three working days after ordering. Some eligible items are even delivered on the evening of the day of the order.

As large and complex as the Amazon Group is, so are the logistics, which is used to enable fast fulfilment. The company is balancing between space- and cost-intensive warehousing in local markets and fast delivery of goods that are not stored locally. To reduce this cost, Amazon is taking active control of more and more parts of their supply chain, which includes airfreight. Compared to using external service providers, cost savings of 30% could be possible, reports the KfW IPEX-Bank in its analysis (Sternberg, 2020). The investment bank estimates that Amazon could save between two and four USD per parcel if it uses its own aircraft instead of those of integrators. This could result in total savings of two billion USD, which corresponds to 6% of Amazon's annual shipping expenditure. Amazon showcases an increased flexibility to deviate from traditional supply chain models. It could work more efficiently because of its ability to utilize all the data that the company processes itself to optimise its operations (Brett, 2020a). In addition to digitisation, virtual or augmented reality also offer potential for improvements (Morrell, 2019, p. 15). For example, Amazon could be able to optimise the volume, weight and dimensions of its own shipments much earlier than integrators, meaning that shipments can be compiled virtually in advance.

Other freight forwarders or airlines can only consolidate shipments on site at the airport, as they do not have so much information that early (Schäfer, 2023, p. 300).

In addition to the cost aspect, Amazon's focus is on the efficiency of the supply chain. The efficiency of the entire supply chain to the end consumer depends largely on the efficiency of the middle section of the journey (Morrell, 2019, p. 104). This is where e-commerce retailers – to a certain extent – rely on cargo airlines for many shipments (Bowen, 2022, p. 103). Even though air freight is expensive, its use can reduce the total cost of the supply chain: "the higher cost of air cargo actually added better cost efficiency to the end product. [...] In an extremely globalised world and a competitive global market, speed to market and first mover advantage coupled with the efficiency of supply chain management became the thin line between profit and loss" (Morrell, 2019, p. 15).

Until 2016, Amazon utilized space in planes of other providers for this purpose, primarily DHL, FedEx, UPS and the U.S. Postal Service. Since 2016, Amazon Air's own branded air-cargo aircraft are operating in the USA (Schwieterman and Craig, 2023). As of 2021, Amazon Air is also active in Canada (Dhillon, 2021). More literature research on the development of Amazon Air in the USA is outlined in subchapter 2.2.

Also in 2016, at least a temporary network was established during the Christmas peak in Europe (Air Cargo News, 2017). However, the first aircraft branded as Amazon Air did not arrive in Europe until almost four years later. More literature research on the development of Amazon Air in Europe is described in subchapter 2.3.

Amazon Air is also active in India since early 2023. Two Boeing 737-800s (B738) operated by Quikjet Cargo Airlines connect the cities of Hyderabad, Bengaluru, Delhi, and Mumbai (Amazon.com, 2023). The activities in India will not be discussed in more detail as part of this study.

In addition to the three markets USA, Europe and India, Schwieterman, Walls et al. (2020) also observed transoceanic flights between the USA and Amsterdam in Europe, as well as Shanghai in Asia. These flights were operated by Atlas Air. In 2021, these efforts were reduced to the Chicago-Amsterdam route (Schwieterman and Walls et al., 2021, p. 11). No transoceanic activities of Amazon Air could be detected in 2022 and 2023 (Schwieterman and Craig, 2023). Instead, Amazon is probably relying on other capacities, such as those of integrators. There is therefore no further discussion of transoceanic flight activities in this paper.

When it comes to intercontinental activities, however, it is worth to consider maritime operations. Here, Amazon acts as a non-vessel operating carrier. Amazon negotiates exclusive contracts with established container lines. Due to the large capacities that Amazon purchases, the company receives lower tariffs. As Amazon is more digitalised, their containers can already be consolidated e.g. in Asia for the individual Amazon warehouses in Europe or the USA. As a result, the container does not have to be reopened at its destination port, which saves process costs. Amazon even sells free capacity to third parties. (Schäfer, 2023, pp. 298-299)

Selling on free capacity to third-party customers also appears to be a developing business area for Amazon in the aviation segment. It is increasingly striving to become a logistics service provider for third-party shipments as well. In 2020, Amazon already offered "logistics as a service" (Gowans, 2020). In 2021, the "Fulfilment by Amazon" service was also introduced in the USA. This third-party delivery service is for retailers who let Amazon handle the storage and the fulfilment of their goods (Schwieterman and Craig, 2023). The following year, "Buy with Amazon" was rolled out. This programme allows Prime customers to select Amazon as a shipping option even for orders that were not placed directly on the Amazon.com platform. With such services, Amazon is becoming a competitor for companies such as DHL, FedEx and UPS (Schwieterman, Morgado and Mader, 2022).

At the end of 2022, Bloomberg (Soper and Johnson, 2022) reported that Amazon is beginning to sell free capacity on its aircraft on the open market. For example, perishable goods such as pineapples and salmon are transported on routes from Hawaii and Alaska to the USA (Brett, 2023a).

The literature review in this first subchapter has explored Amazon's logistics developments. The company is emphasising its strategies to balance cost-effective warehousing and rapid delivery across the globe. Amazon's focus on data optimization, digitisation, and emerging technologies enables efficient supply chain management. The introduction of Amazon Air in 2016, along with intercontinental maritime operations, showcases the company's commitment to rapid and cost-effective delivery. Additionally, Amazon's expansion into logistics services for third-party shipments further solidifies its position as a key player in the logistics industry.

2.2 Amazon Air's Network and Fleet in the USA

The findings on the expansion of Amazon Air in the USA, which are summarised in this subchapter, are largely based on the extensive studies by Prof. Schwieterman and his team (2020-2023) at the Chaddick Institute at Chicago DePaul University and the study by Bowen (2022) published in the *Transportation Journal*. These are supplemented by press releases and other publicly available information from reports by investment banks and consulting firms.

Amazon Air began its operations in the US in 2016, starting with a B767-300 (B763) branded as 'Prime Air' in the cargo version. The fleet grew up quickly (Morell, 2019, p. 133; Schwieterman and Craig, 2023). Although Amazon is known for its rapid and ambitious growth (Soper and Johnson, 2022), the Amazon Air division grew particularly fast in the years of the COVID pandemic. In addition to the generally growing e-commerce market, the pandemic has boosted shopping from home. Furthermore, Amazon's strategic decision to have

more control over its supply chains contributed to this (Schwieterman and Craig, 2023).

For this move, Amazon has engaged a number of strategic partners through equity partnerships, which are common in the industry (Morrell, 2019, p. 151). In 2016, leasing agreements for 20 B763s each were signed by Atlas Air – one of the world's leading ACMI providers (Aircraft, Crew, Maintenance and Insurance) – and the Air Transport Services Group (ATSG). ATSG leases the aircraft through its subsidiary Cargo Aircraft Management (CAM); ABX Air (ABX) and Air Transport International (ATI) provide the crew, maintenance and insurance. Additionally, Amazon acquired a 30% stake in Atlas Air and a 19.9% stake in ATSG (Schäfer, 2023, p. 299). The shares in Atlas Air were later reduced again and more shares in ATSG were obtained in return (Hayward, 2021). In addition, Southern Air, a subsidiary of Atlas Air, joins as a further partner. Sun Country Airlines, a company that only operated passenger aircraft before the collaboration with Amazon, followed in 2020. Sun Country uses B738s branded as Prime Air to fly for Amazon Air (Schwieterman and Walls, 2020, p. 3).

Three more partners followed in the subsequent years: the Canadian cargo airline CargoJet was commissioned to operate two B763s for the Canadian market in 2021 (Dhillon, 2021). From 2021 to 2023, the regional airline Silver Airlines operated five ATR 72-500 turboprop aircraft (AT75) on smaller feeder routes for Amazon (Bodell, 2023). At the end of 2022, it was also announced that Hawaiian Airlines would operate ten A330-300s (A333) leased from Altavair for Amazon Air in its domestic network from the end of 2023 (Jeffrey, 2023b; Kulisch, 2023). As of December 2023, according to the platform planespotter.net (2023), there are 78 aircraft registered in the USA (57x B763; 20x B738; 1x A333 (9 more ordered)).

However, it is important to note that this list may not be complete. Information about the contractual agreements of Amazon with airlines is not publicly available (Schwieterman and Walls et al., 2021, p. 4). It appears likely that Amazon Air relies on relationships with several contractual partners in order to be able to react quickly and flexibly to changes in the market environment (Schwieterman and

Craig, 2023). It is therefore assumed that, in addition to the aircraft branded as 'Prime Air', there are also aircraft in the air for Amazon that are not recognisable as such. The scope of the partnerships and the resulting fleet size are not conclusively assessed in the studies available to date. (Schwieterman and González et al., 2021, p. 7)

Nevertheless, it is evident that the fleet operating for Amazon Air has grown to a considerable size in recent years. In 2020, Amazon has already overtaken global players such as CargoLux and Lufthansa Cargo in terms of the number of its aircraft (Schwieterman and Walls, 2020, p. 4). The studies known to date commonly contain comparisons of the global fleets. However, with 91 aircraft worldwide, the fleet is significantly smaller than the global fleet of FDX (approx. 500), UPS (approx. 290) or DHL (approx. 220) (planespotter.net, 2023). Nevertheless, Amazon Air is increasingly emancipating itself from those integrators that dominate logistics in the e-commerce segment. In addition to the fact that companies are effectively losing out on shipments due to Amazon's in-house transport of goods, thus reducing turnover, it is primarily strategic issues that are causing concern for the established integrators. On the one hand, Amazon is becoming more independent and liberated. Amazon can choose which routes it flies itself and or on which it chooses to rely on other companies. This is putting competitors under price pressure, especially on major trades lanes. Even more disruptive to the harmony, however, is Amazon's announcement that it will enter the business of transporting goods from third parties. This turns Amazon from a customer into direct competitor (Woods 2019). Presumably against this background, FDX announced in 2019 that it would not be renewing contracts with Amazon to transport their shipments (Corkery, 2019; Sheetz, 2018).

As Amazon Air's fleet has grown, so has its network. Initially, the airline focussed primarily on point-to-point (P2P) connections in North America. The network appears to be designed to connect warehouses and fulfilment or sorting centres, rather than connecting cities to a hub like DHL, UPS or FDX. Amazon Air's network appears to be more of an augmentation of the integrator's networks,

taking over critical connections missing in their network from Amazon's perspective. Quite early on, Amazon managed to build a network in which the majority of the US population can be reached within one trucking day. (Schwieterman, Walls and Morgado, 2020)

It therefore seems reasonable that Amazon has set up sorting centres at numerous airports (Schwieterman and Walls, 2020, p. 2). Initially, Amazon chose rather secondary airports which were less congested (Bowen, 2022, p. 113). Later, Amazon Air also became active at larger commercial airports (Schwieterman and Walls et al., 2021, p. 8). To some extent it also operates simultaneously at several airports, which obviously serve the same region (Schwieterman and Walls et al., 2021, p. 8). In addition, under 10% of the route network consists of international destinations or destinations on islands such as Hawaii and Puerto Rico (Schwieterman, Walls and Morgado, 2020).

The route network has also become increasingly dense over the years (Bowen, 2022, p. 113). In April 2020, 54% of the U.S. mainland's population was within a radius of 100 miles around an Amazon Air airport. This figure rose steadily to around 75% at the beginning of 2023 (Schwieterman and Craig, 2023). This 100 nm radius is used by Schwieterman et al. to determine the regions where Amazon Air can deliver items within a few hours around the airport to customers who have opted for same-day or next-day delivery.

In addition to the 2P2 connections, Amazon Air also worked to establish a hub in the USA. The geographical location – compared to Cincinnati for DHL, Louisville for UPS and Indianapolis for FDX – is similarly centralised in the Mainland (Bowen, 2022, p. 103). The first tests took place at the end of 2015 in Wilmington, Ohio (ILN), the former US hub of DHL (Greene and Gates, 2015; Morrell, 2019, p. 45). ATSG, one of the first major ACMI partners, is based in ILN. However, as early as 2017, Amazon Air announced its intention to use Cincinnati (CVG) as its hub and to invest \$1.5 billion in a 3 million square foot building there in order to establish its own hub (Wetterich, 2018). During this construction period, Amazon Air was mainly active during the day in CVG and at night – when the existing infrastructure in CVG is used by DHL – primarily in ILN. During the day, Amazon

Air was allowed to use DHL's infrastructure as a result of an agreement (Schwieterman and Walls, 2020, p. 9). Following the opening of the hub in August 2021, flight schedules became increasingly synchronised in terms of arrival and departure times at CVG (Schwieterman and González et al., 2021, p. 8). This facilitates its use as a hub, as cargo can be transferred from one aircraft to another and then transported directly onwards. With a wave of arrivals in the evening and a wave of departures between midnight and the early hours of the morning, the assumption that Amazon also uses the fleet for next-day delivery is well founded. (Schwieterman, Craig and Mader, 2022)

In their latest report, Schwieterman, Craig and Mader (2023) state that some P2P connections in favour of hub traffic have been dropped from the flight schedules. However, the flights that do not fly to or from CVG/ILN continue to operate mainly during the day. They do not appear to be important for prioritised next-day shipments (Schwieterman and Craig, 2023). Amazon flies significantly more during the day compared to the classic integrators, such as DHL, FDX or UPS (Schwieterman and Walls et al., 2021, p. 3). Flight schedule adjustments also take place much more frequently (Schwieterman, Craig and Mader, 2022).

A catalyst for the rapid growth of Amazon Air – in addition to the already steep growth of the e-commerce market in the USA with double-digit growth rates even before 2020 – was the coronavirus pandemic itself. E-commerce sales in the USA rose by 32% in 2020 (Bowen, 2022, p. 103). Amazon Air grew on a rich fertile ground due to the government-imposed lockdowns and stay-at-home initiatives (Bowen, 2022, p. 113).

However, a sudden turnaround occurred at the beginning of 2023. Rising inflation rates and an associated economic slowdown led to a rapid drop in the previously high demand. Among many cargo airlines and integrators, ATSG announced that it would deploy its aircraft with fewer block hours per aircraft for its main customers DHL and Amazon Air (Jeffrey, 2023; Schwieterman, Craig and Mader, 2023). A look at the network of fulfilment centres and warehouses reveals a broadly similar picture: some locations have been closed and planned facilities have been dropped (MWPVL, 2023). Schwieterman, Craig and Mader (2022)

expect that Amazon Air will now settle into a 'new normal' after the peak phase of the coronavirus period with the dampening factors of the post-coronavirus period.

This section highlights the expansion of Amazon Air in the USA, emphasizing its pivotal role in Amazon's supply chain control. Commencing operations in 2016, the airline experienced rapid growth, particularly during the COVID pandemic. Key partnerships with Atlas Air and ATSG facilitated fleet expansion. Despite a slowdown in 2023, Amazon Air has a great strategic value as a key component in Amazon's logistics, providing flexibility and control in its supply chain operations and posing a risk for established integrators, like DHL, FDX and UPS.

2.3 Current State of Research on Amazon Air in Europe

At the time of preparation of this paper, the information on Amazon in Europe is much less supported by academic publications. Rather, the following section refers to limited information from the Chaddick Amazon Air Briefs and company press releases. There is also information from business reports, industry magazines and consultancies included, which are used solely as a research approach.

According to a report of the platform Air Cargo News (2017), which cites an article in the Standard (a UK magazine), Amazon has been operating a temporary air freight network in Europe since November 2015 to cover the Christmas season (Goodway, 2015). A Boeing 737-400 (B734) was leased via the German logistics company DB Schenker and operated by ASL Airlines France. The network consisted of flights five or six days a week from Katowice, Poland (KTW) to London Luton. Later, Doncaster and East Midlands (EMA) were the British destinations. On the flight back to Poland, a stop in Kassel, Germany was made. The airport selection is presumably linked to Amazon fulfillment centres located near these airports. The platform Air Cargo News refers to these activities as "network tests", similar to ILN in the USA at the same time.

In an article in the German Transport Newspaper (DVZ), Link (2019) reports that the DHL subsidiary European Air Transport (EAT) is operating a little part of its fleet exclusively for Amazon during daytime. The Boeing 757-200 (B752) freighters, which are unused during the day anyway, would fly from East Midlands (EMA) and Madrid (MAD) to Leipzig/Halle (LEJ) and back. Paris (CDG) is also mentioned as a served destination. The cooperation between DHL and Amazon had already been in place for more than a year at that time and also included the use of the infrastructure at the DHL hub in LEJ (Brett, 2020a). Handling at LEJ would be carried out by Portground GmbH – a subsidiary of Mitteldeutsche Flughafen AG. However, none of the companies mentioned have publicly confirmed or denied this to date.

At the beginning of 2020, KfW IPEX-Bank published a report (Brett, 2020a) stating that Amazon is increasingly active in European aviation industry and that it would be 'only a matter of time' before Amazon Air comes to Europe. Another article confirms that Amazon is being supplied in Europe by EAT (Brett, 2020c). According to the report, however, this is not a permanent arrangement, as Amazon itself wants to gain greater control over its network.

In November 2020, the first official press release from Amazon followed (Amazon.com, 2020). Amazon announces that it has "opened the first regional air freight centre in Europe" in Leipzig and is currently handling two daily flights in the 20,000 square metre freight facility. It is noteworthy that Amazon does the handling in Leipzig itself (Schwieterman and Walls, 2020, p. 4). The leasing of two Boeing B738s from GE Capital Aviation Services (GECAS), which are operated by ASL Airlines, is also reported. The aircraft carry the branding typical for Amazon Air.

ASL (meaning „Airlines, Support and Leasing“) is an aviation company based in Dublin, Ireland, with numerous branches in European countries and elsewhere. The French subsidiary (ASL Airlines France (FPO)) and later the Irish subsidiary (ASL Airlines Ireland (ABR)) operate for Amazon. ASL is a well-known provider in the European air freight industry and also serves DHL and FDX, among others. (Schwieterman and Walls et al., 2021, p. 2)

In addition to the reports on activity at LEJ, there are also indications of significant operations at Cologne/Bonn (CGN) in western Germany. In its annual report for 2019, Flughafen Köln/Bonn GmbH writes that Amazon has been operating 26 flights a week since April 2019, mainly during the day. Boeing 737s and British Aerospace ATPs were used. (Flughafen Köln/Bonn GmbH, 2020, p. 23, 2020, p. 23)

The consultancy firm Apex Insight (2019) mentioned in a report in October 2019 that Amazon would start activities at Southend Airport near London. According to 'The Times' (UK), these activities ended in September 2022 (Robert, 2022).

Capuzzo reports on Amazon Air's activities in Italy via the portal 'Air Cargo Italy'. His information indicate that Amazon Air has been active in Milan (MXP) with ASL Airlines aircraft since March 2020 at the latest and flies from there to London Southend (SEN), EMA, CGN, Madrid (MAD) and Hanover (HAJ). According to the airline, flights from Rome (FCO) to SEN are also being offered since June 2020. A further round trip will also be made to Barcelona (BCN) and then on to Paris (CDG). A connection from FCO to LEJ has been predicted for October 2020. (Capuzzo, 2020a, 2020b)

According to Capuzzo's reports, connections to the Italian islands of Sicily and Sardinia would also be added to the route network in 2021. Since January 2021, there has been a daily late evening service from MXP to Cagliari (CAG) (Capuzzo, 2021a) and, since February 2021, an early morning service from MXP to Catania (CTA) (Capuzzo, 2021b). Throughout Italy, handling is not carried out by Amazon itself, but by external providers (Capuzzo, 2020b).

In the research by Bowen (2022) and Schwieterman et al. (2020-2023) already cited in the previous chapters, the European activities of Amazon Air are generally only mentioned briefly. They assess that the European network is decentralised, with LEJ as a strategic spot. The B738s with Amazon Air branding are utilised more intensively than in the USA, with up to four segments per day. Similar to the American flight schedule, Amazon Air in Europe mainly operates during the day. In addition, there is probably a number of unreported flights in the

reports that are operated by partners with aircraft that are not branded as Amazon Air (Brett, 2022).

Following these announcements of steady growth in Europe, there were reports of a reduction in the number of flights from the beginning of 2023, which is in line with the reports in the USA. ASL Airlines confirmed to Air Cargo News that "ASL Airlines is reducing [...] contracted pilot support in Europe" and Amazon Air also confirmed a reduction in the number of flights: "At Amazon we are constantly evaluating and refining our network to ensure we can provide customers fast, reliable delivery. We are reducing some Amazon Air flights in Europe, which won't have any impact on the existing delivery experience that customers can expect from Amazon in the region" (Brett, 2023b).

In autumn 2023, Amazon Air finally announces that it will close the base in LEJ again. Newspaper articles speculate about the reasons behind this: Amazon would become increasingly active in southern Europe and switch to "alternative transport routes" (Mescher, 2023). Even if Amazon emphasises to the press that it will remain active at LEJ Airport, the regional air freight centre will still be closed. LEJ Airport now intends to commercialise the warehouse with apron access to other customers (Deutschmann, Fischer and Liebenberg, 2023).

Amazon hasn't clarified what the expression "alternative transport routes" means exactly. It could be that Amazon is returning to increasingly relying on integrators again. Another possible interpretation would be other modes of transport, such as rail or road. It should also be mentioned that so-called Road Feeder Services (RFS) are a well-known alternative in the European air freight market. Compared to the US air freight market, the European air freight market is already smaller (Morrell, 2019, p. 23). Due to the good road infrastructure in Europe and open borders in the Schengen area the margins within which transport by plane is worthwhile in terms of time and money are tighter than in the USA (Morrell, 2019, pp. 40-41).

This section on Amazon Air in Europe provides insights into Amazon Air's European expansion from 2015 to 2023. Initial activities in 2015 evolved into

collaborations with DHL, and Amazon's heightened European aviation involvement was predicted. The official announcement in 2020 of the Leipzig-based air freight center marked a significant milestone. Reports suggested reduced flights in 2023, and Amazon later announced the Leipzig base closure, hinting at a shift to "alternative transport routes." The exact nature of these alternatives remains uncertain. It is noteworthy that the information in this chapter primarily is derived from the consultancies or press releases and only serves as a base for further research in this paper.

2.4 Fleet and Network Analysis in the Academic Study of Aviation

2.4.1 Potential data sources associated challenges

In preparation for the following Chapter 3 on methodology, in this subchapter research is carried out concerning the tools and methods employed in network design and fleet analysis. It is already evident at an early stage that there is no publicly accessible database from which Amazon Air flights can be retrieved. In the USA, the Bureau of Transportation Statistics holds a database for flight statistics. Bowen was able to extract flights of established integrators such as UPS and FDX from this database, but not those of Amazon. This is due to the complex relationships with lessors and ACMI providers (as described in the previous subchapters). (Bowen, 2022, p. 105)

In addition to official databases, flight tracking applications have increasingly evolved in recent years and "represent an innovative and welcome source of empirical data that has the potential to strengthen, if not revolutionise, the conventional understanding of aircraft and airline operations by making once 'hidden' information accessible" (Budd, 2012, p. 56).

Schwieterman et al. & Bowen use flight schedule data from publicly accessible websites as a basis for their research: above all flightradar24.com (FR24). They search FR24 for aircraft branded as "Prime Air", e.g. by means of the registration (REG) of these aircraft. Bowen then uses, for example, the data from one year of

flight operations from FR24 and excludes flights according to the following criteria:

- „flights with incomplete data,
- flight that duplicates other entries,
- flights for which the elapsed distance was so short,
- flights on airport pairs served less than 10 times per year, as this may be due, to maintenance problems or other irregular circumstances (Bowen, 2022, p. 106).

Schwieterman and Walls (2020, p. 1) select representative days (max. one week) for the respective dates considered in their papers. They state to primarily use the following data sources:

- „Data on flight operations from flightaware.com and flightradar24.com,
- Analysis of the proximity of Amazon Air airports to 170 fulfillment centers,
- Fleet registration info from various sources, including planespotters.net”.

As part of the literature review, three further peer-reviewed scientific papers were identified that use data from FR24 as the basis for their research:

1. Sun et al. (2021, p. 1) discuss the "impact COVID-19 had on three aviation centres of the world – the United States, Europe, and China". They use time series analysis based on FR24 data.
2. Ersoz, Kilic and Aldemi (2022, p. 2509) use three "7-day samples [of the same week of each month] of scheduled passenger domestic and international flight data were gathered from FlightRadar daily" to analyse Turkey's airport network structure and centrality in the opening-out period after the first wave of COVID-19.
3. Cruz et al. (2021, p. 1) use "six months of aircraft tracking data from FlightRadar24 [of] flights between ten of the major airports of the European Union air transportation network" as the data basis for the creation of a "linear programming model for the integrated airline fleet and network optimisation under [Air Traffic Management] constraints".

Furthermore, Krawczyńska and Karsznia (2020, p. 174) concluded in their "analysis of the functionality of selected websites presenting data on air traffic", that websites such as FR24 and others (e.g. radarbox24.com, flightaware.com and planefinder.com) are suitable for examining air traffic and its regularities. In their comparison, FR24 scored best of all the platforms analysed. It had the "highest functionality in accordance with the methodology adopted in this research" (Krawczyńska and Karsznia, 2020, p. 168). FR24 is considered credible and accurate. Nevertheless, as with all providers, typical errors occur. These include disconnections, which result in incorrect flight times or missing route records (Krawczyńska and Karsznia, 2020, p. 175). However, the process of data export might be inconvenient, the researchers summarise. Nevertheless, FR24 scored 24/25 points in their analysis, ending up as the most reliable platform (Krawczyńska and Karsznia, 2020, p. 169).

Flight tracking apps such as FR24 use data from Automatic Dependent Surveillance-Broadcast technology (ADS-B). Aircraft use this to transmit their position and various other data, such as the flight altitude and the flight's callsign. FR24 operates over 40,000 ground-based receivers worldwide, from which the live website and the historical data in the database are fed. The receivers have a range of 250 to 450 kilometres, depending on the flight altitude. In order to offer flight tracking over oceans and other remote areas, satellite-based ADS-B data has also been used since 2016. This data can have a latency of up to 10 minutes and is therefore only used by FR24, if terrestrial contact has been lost. (Dobruszkes and Peeters, 2019, pp. 3-4; Petchenik, 2020).

However, the literature points out that there are also aircraft that are not equipped with ADS-B technology or may have it switched off. In turn, these cannot be detected by FR24 with this technology (Budd, 2012, p. 55; Kalagireva and Radkov, 2016, p. 266). As it can be assumed that Amazon Air's fleet is equipped with ADS-B across the board, this will not be discussed in more detail. Nevertheless, FR24 regularly generates incorrect or incomplete data records. The reasons for this are diverse (Budd, 2012, pp. 55-56).

In order to filter out and, if necessary, correct erroneous data records from FR24, Zintl (2017, p. 49), for example, uses ADS-B data from another source (in this case ADSBexchange) for corrections in his bachelor thesis. The aircraft are identified either by their callsign or the REG as a unique data set (Zintl, 2017, p. 50). A comparable methodology could be used for the present paper.

The Frankfurt University of Applied Sciences can provide the author of this paper with a data set from Spire. This "Global Flight Report v2.1" includes both terrestrial and satellite ADS-B data collected in the period from 01/01/2022 at 00:00:00 UTC to 31/12/2022 at 23:59:59 UTC. Thus, the data from FR24 could be validated for the period of 2022. (Spire Aviation, 2022 - 2022)

FR24 provides access to a limited set of data. Even in the most expensive – the commercially usable "Business" subscription – data is not available for more than three years retrospectively (flightradar24.com, 2023). One database was found by the author of this paper that reaches back as far as 2002. The European Aircraft Noise Service (EANS) records aircraft movements at individual airports with the original aim of increasing compliance with noise emission regulations at airports. Using this data, it is often possible – although apparently not with a high degree of reliability – to trace which aircraft movements which took place at a particular airport on a particular day. The REG and callsign of the aircraft are stored together with the time of take-off or landing. Some countries relevant to this thesis – Italy, Spain, Poland, Belgium and Cyprus – are not listed by EANS. In the UK only London Heathrow Airport, in Austria only Salzburg and Vienna are covered. EANS can therefore not be used for any of these countries. In France, CDG is technically covered, but the data set is only fragmentary and therefore impossible to use. The subsidiary organisation Deutsche Lärmdienst e.V. (DFLD; German Aircraft Noise Service) appears to provide more comprehensive data. The airports CGN, HAJ and LEJ are covered. Kassel Airport is not included. The extent to which this limited source of data can be used for the three German airports is discussed in Chapter 3.

Just as there is no official publication of the flights operated by Amazon Air, there is also no public database of the aircraft operating for Amazon Air. Both Bowen

and Schwieterman et al. use the planespotters.com platform to compile this information for their research. According to their assessment, the data stored there, is correct and corresponds to the officially available information (Bowen, 2022, p. 105). Schwieterman and Craig (2023) also confirm that the database Planespotters.com documents reliably "when an airplane is registered to a particular carrier, both in the United States and abroad. The airframe model (including the production variant), the contractor used to operate the plane, and the date the plane became part (or ceased being part) of the fleet was recorded for each plane associated with Amazon Air."

It is likewise relevant to consider that – as previously described – Amazon utilises the practice of outsourcing at many points in its logistics chains (Schwieterman, Walls and Morgado, 2020). This also applies to air freight. It is assumed that there are also aircraft in operation for Amazon Air that are not branded as such. These are referred as 'shadow flights' by (Schwieterman, Craig and Mader, 2022). In the studies by Schwieterman et al. these flights remain unreported.

For evaluation of fleet utilisation, it is also relevant to factor in the number of aircraft parked on the ground for longer periods of time, for example for maintenance work or regular checks. In a random sample, Schwieterman and Craig (2023) determined that 6.9% of Amazon Air's fleet is parked. In comparison, this proportion is 5.7% for UPS and 3.0% for FDX.

Two approaches are possible to calculate the transport capacity of the fleet of an airline. On the one hand, the capacity (also known as payload in the industry) can be determined in terms of weight and volume. In the industry, the weight – the transported kilograms or pounds – is usually used as an indicator. According to studies by CLIVE Data Services, the density of transported air freight appears to be decreasing, particularly in the context of the growing e-commerce market (Brett, 2020b). As a result, aircraft often do not reach their weight limit when they are already full in terms of volume. According to CLIVE Data Services, the better indicator for the capacity of a cargo aircraft fleet would therefore be the volume of the fleet. Bowen (2022, p. 114) agrees with the assessment that the freight transported by Amazon Air tends to have a lower density. The information on the

capacities of the individual aircraft types is derived from the technical publications, such as manuals, of the aircraft manufacturers or the companies that convert the aircraft into cargo aircraft (Bowen, 2022, p. 105; Schwieterman and Craig, 2023).

Bowen and Schwieterman et al. link the considerations regarding the positioning of the airports served by Amazon Air to two factors: Firstly, with the population in the vicinity of the airport that are served, and secondly with Amazon's existing infrastructure, such as sorting and fulfilment centres. Schwieterman and Craig (2023) calculate the people living within 100nm of an airport served by Amazon Air. The data for the geographical location of the airports as well as the information on the population at the respective locations is provided by data from the U.S. Census. For Europe, information is available from EUROSTAT (Batista e Silva F., Dijkstra and Poelman, 2021). However, findings of Bombelli, Santos and Tavasszy (2020) suggest that the catchment area of a cargo airport is much larger. Here, 400 trucking kilometres is assumed, as the use of RFS is common in the industry. Bowen (2022, p. 111) therefore uses the 400 kilometres as a reference value in his observations. In both studies, the people in the catchment area are calculated using a Geographic Information System (GIS). Both Bowen and Schwieterman et al. decide to use ArcGIS.

Just as there are few publicly available sources on Amazon Air's flight schedule or fleet, information on the company's distribution network is equally limited. Bowen (2022, p. 108), indicated that he used the records of MWPVL for his research. MWPVL International is a consulting firm that specialises in supply chain and logistics networks. They claim not to represent Amazon. On their website they publish regularly updated lists with addresses of the worldwide infrastructure operated by or for Amazon for the distribution network. Whether this data is completely accurate cannot be ascertained. (MWPVL, 2023)

The mentioned data sources that could be used in this study are diverse and of varying quality. The use of FR24 with the additional option of validation by the Spire data set represents a solid basis.

2.4.2 Potential methodology for the analysis

The previous subchapter 2.4.1. describes which data sources are accessible. Subsequently this section outlines how these were evaluated and analysed.

The analysis by Bowen (2022, p. 105) focuses primarily on the spatial configuration of Amazon Air. For this purpose, he examines data of one year of flight operations (1 September 2018 to 31 August 2019). Schwieterman et al. began analysing the fleet and the network in 2020. They commenced the study using data from a single day in April 2020 (Schwieterman and Walls 2020). Since then, the study team has resumed collecting data twice a year (every 5-7 months): "For each period from 2021 onwards, six days of flights were sampled (with every day of the week except Sunday represented), recording origin and destination, arrival and departure times, aircraft type and the contracted operator" (Schwieterman and Craig, 2023).

The following analyses are conducted with the collected data. For each representative period, the number of take-offs and landings at each destination in the network is determined. Schwieterman, Craig and Mader (2022) define the sum of take-offs and landings at an airport as 'flights'.

Bowen (2022, p. 106) conducted his analyses using Ucinet 6 for Windows. He calculated the following five values for the network:

1. "diameter: the topological distance (number of links) between the most widely separated nodes in a network;
2. density: the proportion of possible links in a network with flights during the review period;
3. degree centralization: a measure of how centralized a network's connections are in a hub or hubs;
4. average degree: the mean number of links per node; and
5. reciprocity: the proportion of network links that are served in both directions."

This calculations are undertaken to compare the Amazon Air network with the network of integrators (FDX & UPS). This method is based on Milighetti et al. (2019a; 2019b). With his analysis, he concludes that the Amazon Air network has a lower network density than FDX and UPS. It also tends to be more aligned with the locations of Amazon's distribution centres (Bowen, 2022, p. 103).

Schwieterman, Walls and Morgado (2020) calculate whether Amazon Air's network is more hub-centred or more focused on P2P connections based on the proportion of take-offs and landings at the hubs. They use the definition of a hub according to Jaillet, Song, and Yu (1996) for their considerations: A hub is "an intermediate node where traffic from different origins is consolidated for onward carriage to the same destination or where traffic from the same origin is deconsolidated for onward carriage to different destinations". They also analyse flight schedules for so-called time banks. These are time intervals in which several arrivals or departures operate after each other. During the time in which they are all at the hub at the same time, goods can then be reloaded from one aircraft to another.

As part of a spatial analysis, the relationship between the position of the warehouses and the airports served by Amazon Air was also analysed using GIS software (Schwieterman and Walls, 2020, p. 5). Also, the number of people living within a certain radius of the Amazon destinations is being calculated using a GIS software (Schwieterman and Craig, 2023).

Furthermore, both Bowen and Schwieterman et al. analyse the Amazon Air fleet. For each period analysed, they quantify the number of aircraft by aircraft type and subsequently calculate the capacity of the fleet by weight and by volume. Growth rates are calculated within different time intervals. Neither of them includes a proportion of 'shadow flights' in the analyses. There is no data available on how much weight or how much volume Amazon Air's flights actually carried.

The methods mentioned in this chapter represent potential approaches for the analyses to be implemented in the present paper. In the following chapter, the actual methodologies are comprehensively outlined.

3 Methodology

3.1 Methodology of the Data Collection

Based on the findings of the literature research in Chapter 2, in particular the findings in subchapter 2.4, a data collection is carried out according to the following procedure. An outline of the sources of data used for each part of the analysis can be found in the Annex (Figure 15).

On the FR24 platform a systematic search for flights from ASL Airlines Ireland (callsign: ABR) is carried out. Starting with the flight number ABR1, every combination up to ABR9999 is searched for. As the data collection only can be carried out during the processing period of this thesis and the data on FR24 being available retroactively for up to three years, the period from 01.09.2020 to 17.12.2023 is covered. The flights available for each callsign are then evaluated according to the following scheme and, if necessary, transferred to a local data collection in Excel. If necessary, the registration of the aircraft can be used to track which flights were completed by this airplane, additionally. The schedule created in this way can be found in the Annex (Figure 16 - Figure 22).

A flight was included to set dataset, if

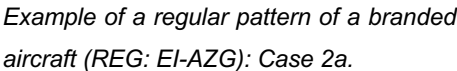
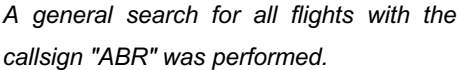
1. None of the following exclusion criteria is met:
 - a. Flight has a similar trip-number and/or scheduled departure time, like the flight of another company ABR is also operating for (e.g., BCS, FDX, TAY) on same routes;
 - b. Flights that seem to be irregular or event-based flights for e.g. repositing or maintenance (see Figure 23);
 - c. Flight contains incorrect and incomplete data; and
2. The flight was operating at least over a month with at least three rotations per month and one of the following inclusion criteria was met as well:
 - a. Flight operated by 'Prime Air' branded plane;

- b. Flights operated by a not 'Prime Air' branded plane, but was operating under the same trip-number, like a 'Prime Air' branded was ever before or thereafter.
- c. Flights operated by a not 'Prime Air' branded plane, but operating under a trip-number and a route that can be assigned to the Amazon Air network based on its systematics.

Below a list of examples for the cases just described can be found.

Case	Example
1a	ABR7511 is operating Brescia-LEJ at 15DEC2023. On 18DEC2023 BCS7511 is operating Brescia-LEJ. This flight was operated for DHL, so it is not included into the dataset.
1b	ABR2301 is operating LGG-LEJ on 10DEC2023. The same trip number was use for LGG-EMA on 25NOV2023 or LGG-KTW on 04NOV2023. Obviously, this is not a service on a regular basis. Therefore it is not included into the dataset.
1c	Flights with incorrect or incomplete data have not been included.
2a	ABR897 is operating LEJ-FCO at 12NOV2023 with a "Prime Air" branded plane (EI-DAC). This flight is included.
2b	ABR897 is operating LEJ-FCO at 31JUL2023 with a not "Prime Air" branded plane (white B734). Obviously, this route is operated for Amazon Air (as proven above). So, this flight is included.
2c	ABR896 is operating SEN-LEJ at 12SEP2022 with a not "Prime Air" branded plane (white B734). Thereafter it is operating as ABR897 LEJ-FCO. ABR897 was proven to be an Amazon Air flight (see above). According to this and the systematic of the trip number, this flight is considered to be operated for Amazon Air and therefore included.

Figure 1: Descriptions of examples of the criteria for which flight was considered to operate for Amazon Air and therefore was included to the dataset.

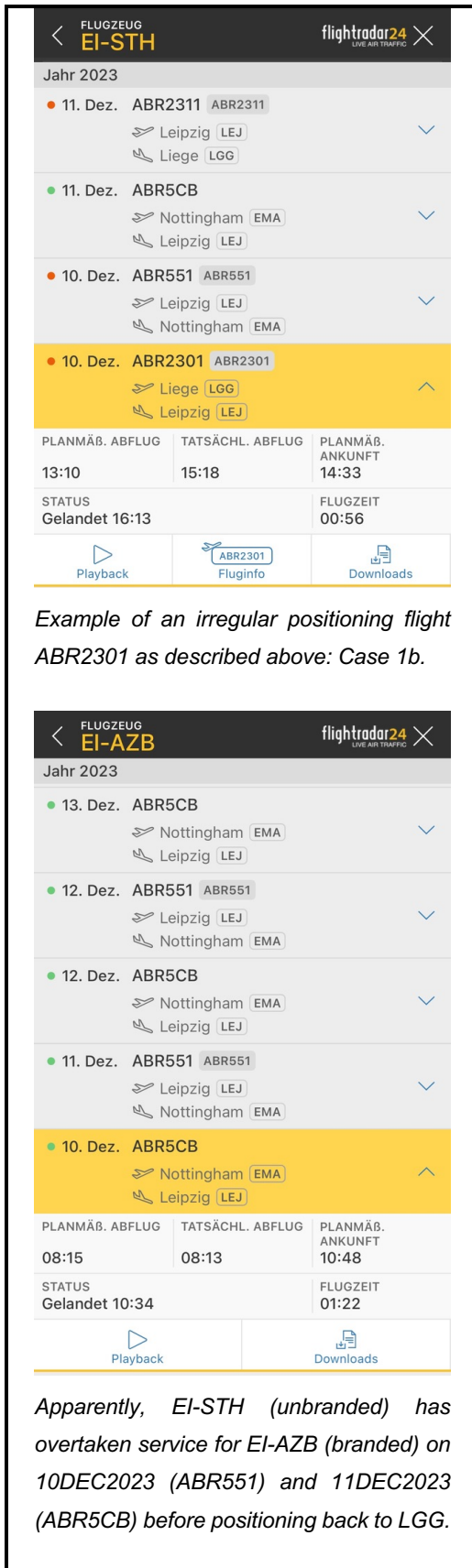


The flights included in the data record after applying the criteria above are listed in the format of a standard flight plan with the following attributes. Several flights that have the same of the following attributes are summarised in a data entry. If an attribute changes (e.g. the regular departure airport), a new data entry is generated. Changes compared to older data entries for the same trip number are highlighted in yellow.

Irregularities in operations, such as diverted flights and flights cancelled or delayed at short notice, are not included in the documentation. Deviating flight schedules for public holidays etc. are also not documented.

The standard flight schedule contains the following information.

- SOURCE of information: DFLD, FR24 and/or SPIRE.
- Update: Date, when the data record was updated last time.
- TRIP: Trip number of the flight.
- OPR: Callsign of the operator.



- ALPHAN.: Alphanumeric callsign, if used on this trip.
- DEP: Departure-Airport (ICAO-Code)
- DEST: Destination-Airport (ICAO-Code)
- STD: Scheduled Time of Departure.
- STA: Scheduled Time of Arrival.
- DAYS: Days of operation (1= Monday, 2= Tuesday, ... , 7 = Sunday)
- 1st OBS: Date of 1st flight observed for this data entry.
- Last OBS: Date of the last flight observed for this data entry.
- A/C: Aircraft-type.
- COMMENT: any comment on the data record, if deemed necessary.

The flight schedule created according to the method described above subsequently forms the basis for the following analyses to be carried out.

Figure 2: Description of examples using screenshots from FR24.

As already mentioned, a data set from Spire is also available for the year 2022. This data set is available as a .csv-file. This allows flights with an ABR callsign to be filtered out of this dataset. The remaining flights are also screened according to the above scheme. The remaining data records are then transferred to the schedule. It turns out that all data records resulting from the Spire data could already be found with the FR24 source. The existing data was therefore confirmed and the validated data entries are marked accordingly. Validated data records have both 'FR24' and 'Spire' entered in the 'Source' category. In the Spire dataset, the search for alphanumeric callsigns (e.g. ABR5CB, which is used instead of ABR552 on the EMA-LEJ route) is considerably less complicated. In FR24, these callsigns cannot be found using the conventional search function. Instead, it is necessary to search for the legs with alphanumeric callsigns in the history of the individual aircraft.

As part of the data collection, the DFLD database was also scanned for older information. However, as already mentioned, this is only possible for the airports CGN, HAJ and LEJ. Therefore, the data collected via DFLD cannot cover the complete network of Amazon Air in Europe. Furthermore, entire days are frequently missing in the DFLD records. The database is therefore considered too unreliable to use this data in the analysis. Nevertheless, they are noted in the flight schedule for information purposes so that they can be used for research purposes if a reliable collection of data can be found to validate the findings. Nevertheless, it was possible to gain some insights when reviewing the older data. This knowledge was used as a research approach. If the data was confirmed by FR24 or Spire, it is mentioned in the schedule and the analysis. Data entries that result solely from the DFLD source may be mentioned in the schedule for information purposes only. However, these data are not used in the analysis due to the inherent nature of the source.

For a comparison with the network operated in the USA, the data from Schwieterman et al. (2020-2023) and information from the paper by Bowen (2022) are used. The details on the fleet were obtained from planespotters.net (2023).

Further data was used to create the analysis below. The GIS (QGIS, 2023) was supplied with data on the population (Batista e Silva F., Dijkstra and Poelman, 2021) and the airports (European Commission (ESTAT), 2015). Data from aircraft manufacturers and conversion firms were primarily used to calculate the capacity of the fleets.

To summarise, a method has been developed for data collection that allows data from FR24 and Spire to be integrated into a standard schedule. This standard schedule represents the foundation for the following analysis. Data that originates exclusively from DFLD is only mentioned in the standard schedule for information purposes due to its unreliability but is not evaluated in the analysis. A full description of all data used can be found in the Annex (Figure 15).

3.2 Methodology of the Analysis

The European network is analysed on the basis of the standard schedule as described in 3.1. Representative weeks are to be identified at half-year intervals. Schwieterman et al. (2020-2023) used the months of February, March or April in spring and the months of August or September in late summer. Bowen (2022)

Period	Dates
Sep 20	14.09.2020 – 20.09.2020
Mar 21	15.03.2021 – 21.03.2021
Sep 21	13.09.2021 – 19.09.2021
Mar 22	14.03.2022 – 20.03.2022
Sep 22	12.09.2022 – 18.09.2022
Mar 23	13.03.2023 – 19.03.2023
Sep 23	11.09.2023 – 17.09.2023
Dec 23	11.12.2023 – 17.12.2023

used data from the beginning of September to the end of August.

In order to apply comparable periods the months of March (from 2021) and September (from 2020) are selected in the present study. An additional observation date was included in December 2023 to provide an up-to-date overview at the time of submission and presentation of the Masterthesis.

Figure 3: Dates of the analysed periods.

Amazon Air only offers a reduced service on public holidays. In order to depict representative weeks in the analysis, the months of March and September are suitable (see Figure 7). There are no public holidays in the middle of the months of March and September in the period 2020 - 2023. Therefore, the week of the 15th of each month from Monday to Friday is analysed. An overview of the analysed dates can be found in Figure 3 above.

The following information was obtained from the schedule for the periods mentioned above to analyse the network.

- Average sum of take-offs and landings per airport per day,
- Average sum of flights per day. This results from the sum of all take-offs and landings per day divided by two. In contrast to the analysis by Schwieterman et al. (2020-2023), the term 'flight' is defined for this analysis as consisting of a take-off and a landing.
- Average sum and the proportion of daytime flights (06:00 a.m. to 09:59 p.m.) and the sum of night flights (10:00 p.m. to 05:59 a.m.), determined by the scheduled departure time (STD).

The spatial analysis is as part of the network analysis. The following information is compiled for each analysed time period for this purpose:

- Which airports were part of the Amazon Air network in Europe and the sum of these airports.
- The population in the catchment areas of the airports (100nm and 300nm respectively) was calculated using QGIS (2023).
- The results of the spatial analysis with QGIS and the data published by MWPVL (2023) are the basis for the investigation of the connection between the Amazon Air network and the centres and stations operated by Amazon in Europe. Due to copyright restrictions, the addresses of the premises cannot be transferred to the QGIS programme; instead, a simplified evaluation was carried out. The sum of fulfilment and sorting centres, delivery stations and other infrastructure is compared per country with the sum of Amazon's daily take-offs and landings in that country.

Smaller neighbouring countries of served countries (such as the Netherlands or Ireland) are assigned as clusters to their larger and served neighbouring countries (such as Germany or the UK).

For the analysis of Amazon Air's fleet in Europe, the following information was analysed:

- Number of B734 (not "Prime Air" branded plane) used to serve the schedule in the respective week.
- Number of B738 ("Prime Air" branded plane) which were used to serve the schedule in the respective week.
- Sum of the two values above to calculate the total fleet in operation. Aircraft that are parked or subject to maintenance were not taken into account. The reason for this is that ASL Airlines' B734s are regularly in service for various customers. It is therefore not clear whether a parked B734 is parked on behalf of FDX, DHL or Amazon Air, for example.
- The average utilisation (number of legs per aircraft per day) per period is calculated by dividing the number of flights per day by the total fleet in operation during that period.
- The capacity values of the fleet are calculated using the number of B734s and B738s in operation with the data provided by the manuals.

The US data presented in this paper, which is used for the comparison with Europe, are compiled as follows.

- To adapt the definition of 'flights' to the methodology introduced above, the sum of take-offs and landings as reported by Schwieterman et al. (2020-2023) is divided by two.
- The calculation of the proportion of daytime flights was undertaken using the original data from Schwieterman et al. (2020-2023). This value was only partially published in the papers.
- The values for the service area (100-miles radius) were taken from the publications of Schwieterman et al. (2020-2023).

- As the information on the fleet of Bowen (2022) and Schwieterman (2020-2023) were partially inconsistent, the information for the analysis is based on the original source cited by both (planespotters.net, 2023).
- For the analysis of the utilisation of the fleet in the USA, it is assumed that 5% of the reported fleet is not active. Schwieterman and Craig (2023) assume 6.9%, while for other integrators values between 3% and 5% are common.
- All aircraft (including those that may be inactive) were used to calculate the capacity of the fleet.

All growth rates stated in the analysis always refer to the value in the period previously analysed (generally half a year).

The methodology and criteria used for the analysis are based on the findings of the literature research, in particular Chapter 2.4, and are described in detail in this chapter. The resulting analysis is presented in the following Chapter 4.

4 Analysis

In the following chapter, the network analysis is outlined first, followed by the fleet analysis. Where relevant, the data is compared with the findings from US research. The complete data, which have been calculated according to the descriptions in Chapter 3, can be found in the Annex (Figure 25 - Figure 27).

4.1 Network Analysis

The following diagram indicates the average number of takeoffs and landings per day of Amazon Air in Europe for each representative period.

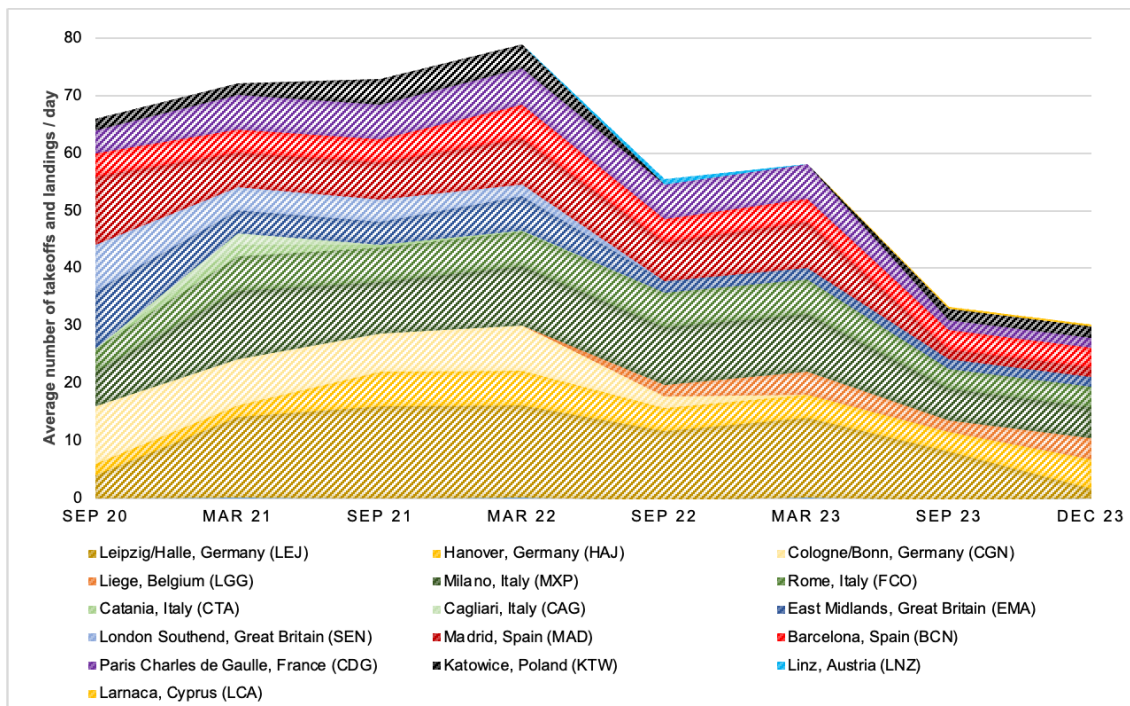


Figure 4: Average number of takeoffs and landings / day of Amazon Air in Europe.

From the beginning of the period under review (September 2020) to March 2022, Amazon Air's network in Europe grew in terms of the number of daily flights. From that point onwards, the number of flights decreases sharply. In both summers of 2022 and 2023, there will each be more cutbacks than in the winter season. The fact that winters are stronger than summers is a familiar pattern in European air freight (Morrell, 2019, p. 38).

The decrease in average flights per day between March 2023 and September 2023 can be explained primarily by the fact that Amazon Air is no longer operating on Saturdays, but only on one route. All other routes are only served from Sunday through Friday since the end of August or beginning of September 2023. This is a common pattern for integrators in Europe (Morell, 2019, p. 40-41).

The diagram above also shows that – representing stability – between nine and thirteen European airports are served per observation period. The exact number of take-offs and landings per airport can be found in the chart or the table in the Annex (Figure 25). The individual countries and airports are analysed in more detail below.

LEJ – Leipzig/Halle, Germany

LEJ Airport appears to fulfil a strategic key role for Amazon Air, as already described in the literature review. Assuming that the partner flights by EAT for Amazon mentioned by Link (2019) actually took place, Amazon has been active here since 2017. It could be the following legs of two EAT B752s and one FPO B734, that are mentioned in the data of DFLD:

- (1) BCS6891 EMA-LEJ from 15.05.2017 until 15.04.2022;
- (2) BCS6892 LEJ-EMA from 15.05.2017 until 26.03.2022;
- (3) BCS6823 MAD-LEJ from 30.10.2017 until 11.03.2023;
- (4) BCS6824 (BCS38F) LEJ-MAD from 30.10.2017 until 27.10.2022;
- (5) FPO1255 (später ABR1255) CDG-LEJ since 17.11.2017;
- (6) FPO1256 (später ABR1256) LEJ-CDG since 17.11.2017.

However, as the data from DFLD was deemed too unreliable and the use of EAT cannot be proven, these operations are not considered further in the analysis. They are only briefly considered in the following analysis of LEJ's role as a potential hub in the Amazon Air network.

The choice of LEJ as Amazon Air's central location in Europe is comparable to the choice of CVG as a hub for the USA. This is because DHL operates its largest hub of Europe at LEJ. The fact that Amazon cooperates with the postal subsidiary

is an undisputed fact. How far-reaching this partnership actually is, is not publicly known. However, the choice of Leipzig as a location suggests that synergy effects of the cooperation between DHL and Amazon can be realised here. LEJ was also the headquarters of CargoLogic Germany GmbH (GCL). Some of its fleet, consisting of four B734s, was also deployed for Amazon Air in 2020.

Arrivals at LEJ			Departures from LEJ		
TRIP	DEP	STA	STD	DES	TRIP
			04:30	MAD	ABR592
ABR554	MXP	05:30			
ABR896	SEN	05:45			
			06:45	EMA	ABR551
			07:25	FCO	ABR897
BCS6891	EMA	08:50			
ABR467	CDG	08:50			
BCS6823	MAD	09:20			
			10:20	MXP	ABR468
			11:05	MAD	BCS6824
ABR738	BCN	10:30			
			11:40	EMA	BCS6892
ABR593	MAD	11:25			
ABR552	EMA	11:50			
ABR898	FCO	12:30			
			13:30	SEN	ABR540
			13:30	FCO	ABR739
			13:40	MXP	ABR553
ABR469	MXP	15:10			
			17:15	CDG	ABR470

Figure 5: Analysis of arrivals & departures at LEJ as of March 2022

*Operation for Amazon by EAT can not be proven.

According to press releases, LEJ is repeatedly referred to as a European hub for Amazon Air. To assess this, the definition of a hub according to Jaillet, Song, and Yu (1996) is considered. Similar to Schwieterman et al. (2020-2023), a search for time banks is carried out. As a sample the busiest phase of Amazon Air in LEJ (March 2022) is chosen. The connection options for freight in the Amazon Air network shown in the graphic (Figure 5) are obtained.

This analysis shows three small 'inbound' and three small 'outbound' time banks, each consisting of two to three aircraft. Assuming a turnaround time of 60 minutes, theoretically it would be possible to transfer freight from the inbounds to the outbounds. However, it would hardly be possible to deconsolidate and reconsolidate freight in this time frame. At the Amazon Air hub in CVG, there are several hours between arrivals and departure time banks. It could be that cargo was also 'transferred' in LEJ during the more active months, but no evidence of clear hub patterns can be proven here, even during the most active period. Incidentally, this is also not the case for any other European airport operated by Amazon Air.

From early 2023, Amazon Air is to reduce its services at LEJ from 14 average daily take-offs and landings in March to less than two in December. This strategic decision is further outlined in the literature review and further discussed in Chapter 5.

HAJ – Hanover, Germany

This is not the first time that LEJ has lost routes 'in favour' of HAJ. The airport in the north of Germany has an overlapping catchment area with both LEJ and CGN. Amazon Air is also active here early on: flights could be found in the DFLD database as from May 2019.

CGN – Cologne/Bonn, Germany

Amazon Air has also been active in CGN since the early days. Flughafen Köln/Bonn GmbH (2020) stated in its annual report of 2019 that Amazon Air has been active at CGN with Boeing 737s and ATP since April 2019. Flights from FPO (see flight schedule) as well as operations of an ATP of West Atlantic Sweden (SWN) could be identified. The ATP flew the following routes before a B734 on behalf of Amazon Air took over the same routes one day after the last flight of SWN.

- (1) SWN642P CGN-KTW from 02.06.2019 until 24.05.2020;
- (2) SWN641 KTW-CGN from 03.06.2019 until 25.05.2020.

However, the data obtained from DFLD will not be included in the analysis for the known reasons.

Since the beginning of this analysis, Amazon Air has continuously reduced its services from CGN. No more flights to or from CGN have been offered since November 2022. Furthermore, CGN also serves as a minor hub for DHL, UPS and FDX.

LGG – Liege, Belgium

When the MAD-service from CGN was discontinued in July 2022, it was resumed the following day to and from LGG. This pattern repeated when the CGN-MXP route was discontinued. After the weekend, this route was operated to and from LGG as well. These observation and the proximity between CGN and LGG suggest that LGG has taken over CGN's role in Amazon Air's network since mid-2022. Capacity has become available at the Belgian airport in 2021 after FDX announced that it would downgrade LGG in favour of CDG as its only European hub (Wunderlich, 2021). Compared to CGN, LGG is located somewhat more centrally in the so-called 'golden triangle' of Europe: the economically and demographically strong region in the triangle between Amsterdam, Frankfurt and Paris. LGG is also the base of the Belgian ASL subsidiary ASL Airlines Belgium.

MLP – Milano Malpensa, Italy

Milan has been part of Amazon's European network since the beginning of this analysis and has always been the busiest Amazon Air airport in Italy. In a Europe-wide comparison of traffic figures, MLP is typically in second position after LEJ; after the decline of LEJ, MLP is even the airport with the most Amazon Air take-offs and landings in Europe at the end of 2023. It is worth mentioning that the two islands of Sicily and Sardinia were served from here during the night time in 2021. For these connections, cargo from Amazon Air could even have been reloaded at MLP. In the press, MLP was often labeled as a second hub alongside Leipzig. Apart from the two island flights for a rather short period of time, there is no evidence for a hub activity based on the flight patterns. DHL is also very active in MLP and operates a minor hub for Southern Europe here.

FCO – Rome Fiumicino, Italy

As the second busiest destination in Italy, the airport on the Italian capital was constantly represented in the network with 3.4 to 6.0 daily take-offs and landings.

CAG – Cagliari & CTA – Catania, Italy

CAG Airport in the south of the Mediterranean island of Sardinia was served daily from MXP in the second half of the night from January 2021 to July 2021. After that, only irregular flights by Amazon Air to or from CAG could be found. According to MWPVL (2023), a warehouse was opened in Cagliari as a delivery station (DSG1) in November 2020. This may be related to the flights.

The Sicilian island city of Catania in the south of the country was served slightly after CAG from February 2021 to August 2021 daily in the first half of the night. Similar to CAG, Amazon Air flights to or from CTA could only be found irregularly thereafter. According to MWPVL (2023), Amazon also opened a delivery station (DSI2) in Sicily shortly before the launch of the flights (September 2020).

According to the aircargoitaly portal, Amazon has an agreement with Poste Italiane, which uses its airline (MSA, formerly Mistral Air, now Poste Air Cargo) to transport e-commerce products in Italy. MSA flies daily to CTA and CAG from Brescia in northern Italy as well as from FCO. The flights of Amazon Air may have been terminated again in the context of this cooperation (Capuzzo, 2018, 2019).

EMA – East Midlands, Great Britain

EMA is centrally located in the UK. Against this background, it is also a minor hub for the UK-region of DHL. In the first period under review in September 2020, Amazon Air was still very active here. 10 take-offs and landings per day operated at EMA. However, this fell to four at the beginning of 2021. This downturn could possibly be related to the consequences of Brexit. The UK is no longer a member of the EU since 31 January 2020 and consequently no part of the EU's single market and customs union since 1 January 2021. A significant number of connections have been abandoned since the year-end of 2020.

SEN – London Southend, Great Britain

The 'sixth' London airport – located a little further outside the capital – called Southend was part of the Amazon Air network. The number of daily flights here

halved at the turn of the year from 2020 to 2021, possibly also in relation to Brexit. Amazon Air ultimately left SEN entirely in September 2021. At peak times, two British-registered B734s were operated from here by Titan Airways to fly for Amazon Air under ABR call signs.

MAD – Madrid & BCN – Barcelona, Spain

The Spanish capital MAD was always represented with comparatively high traffic figures until the network was reduced in summer 2023. From this point onwards, Madrid appears to be the second most important destination in Spain after BCN. The traffic figures in BCN are comparatively more constant. Amazon has always been operating here with 3.4 to 6.0 daily take-offs and landings per day.

CDG – Paris Charles de Gaulle, France

CDG is the only destination in France served by Amazon Air. The French capital was connected to Amazon Air's European network with 4.0 to 6.3 daily take-offs and landings before the connection was reduced to an average of 1.7 per day in summer 2023. FDX operates its European hub in CDG.

KTW – Katowice, Poland

Poland was integrated into the Amazon Air network in Europe at an early stage, according to the reports mentioned in the literature research. However, there seems to be a break: Based on the analysis, KTW was only served sporadically by Amazon Air from August 2022 to December 2022 and not at all from January 2023 to May 2023. There is a daily connection to MXP again since June 2023.

LNZ – Linz, Austria

While Amazon Air was absent from KTW, the Austrian city of Linz was part of the European Amazon Air network from August 2022 to March 2023. LNZ was connected with a MAD service six times a week. Before and after that, no more Amazon Air activities could be detected in Austria. It remains unclear whether LNZ could have been a substitute for KTW in the network, as the two airports are around 250 nm apart.

LCA – Larnaca, Cyprus

The latest addition to Amazon Air's European network is LCA on the Cypriot Mediterranean island. Since September 2023, LCA is served once a week (Sundays) to and from LGG. With this low frequency, the island airport is a speciality in the network. This could be explained by the fact that both DHL and FDX do not offer flights to/from LCA on Sundays. However, it is also noteworthy that, according to MWPVL, Amazon does not have its own infrastructure (such as warehouses or sorting or delivery centres) in Cyprus. Nevertheless, Amazon deliveries to Cyprus are offered.

Comparing the average number of daily flights with developments in the USA, it can be observed that the number of flights in the USA was already around four times higher when the records for this study began. Growth in the USA also continued at a steeper rate than in Europe. After the figures for Europe declined in March 2022, the rate of growth in the USA slowed considerably, but there was no decline recorded there.

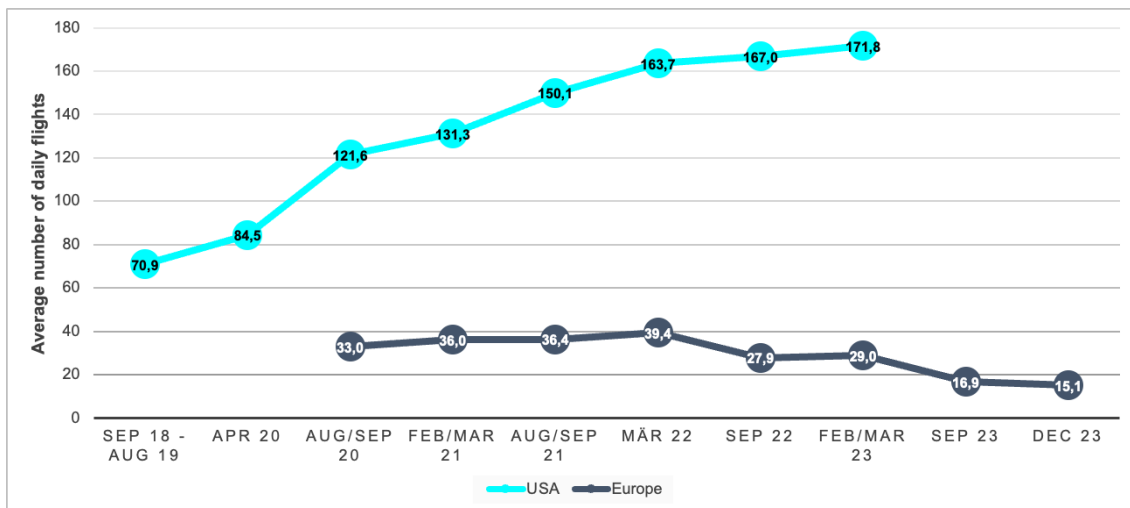


Figure 6: Average number of daily flights of Amazon Air in Europe and in the USA.

A similar picture emerges when analysing the number of airports served in the two regions. The decline in the USA between the first two periods recorded can possibly be explained by the fact that two different sources were used here Bowen (2022) for the first value; Schwieterman et al. (2020-2023) for all other data. The first value includes a sample of one year (Sep 2018 - Aug 2019), the

other values samples spanning from one day to one week. Apart from the effect just described, the number of destinations served in the US is continuously increasing, even if growth has slowed since March 2022.

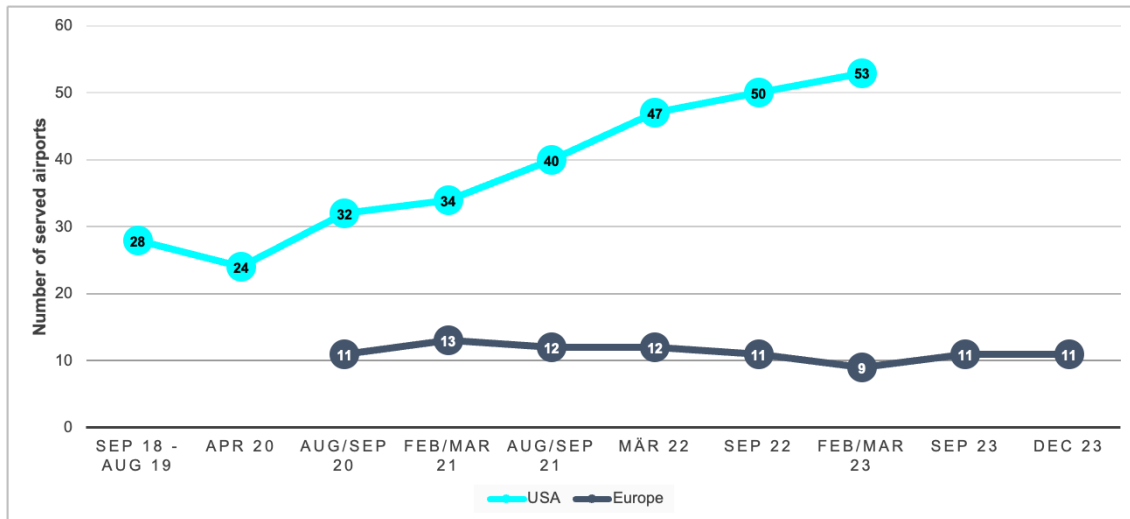


Figure 7: Number of served airports of Amazon Air in Europe and in the USA.

For Europe, the value varies by plus or minus two around 11, as described at the beginning of the chapter.

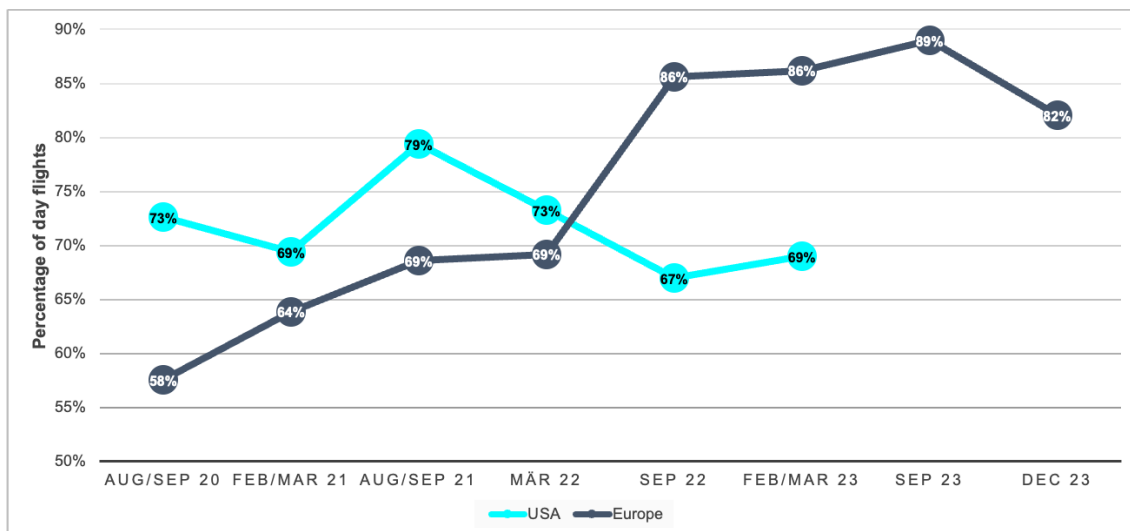


Figure 8: Share of day- and night-flights of Amazon Air in Europe and in the USA

As part of the analysis, the proportion of flights that took off during the day (ATD from 06:00 a.m. to 09:59 p.m.) is also analysed. The proportion of flights is compared with the values achieved for the USA in the diagram above. Until March 2022, there were even more night flights in Europe than in the USA. With the

reduction in the number of flights in Europe in summer 2022, the proportion of daytime flights increased significantly. This is an indication that the focus in Europe is not on hub-centred and next-day delivery-focused network, such as that of the traditional integrators. In the USA, developments since the opening of the hub in CVG in August 2021 have tended to go in the opposite direction. The proportion of day flights is falling here. However, at 69%, the share is still high enough that the focus on P2P flights continue to be evident here too.

The maps (Figure 28 - Figure 35) additionally depict that Amazon in the earlier stages increasingly operated triangular or quadrilateral flights patterns in Europe. These are, for example, the following rotations in September 2020:

- CDG-LEJ-BCN-FCO-CDG (ABR1255, ABR1256, ABR1257, ABR1258),
- EMA-MAD-MXP-EMA (ABR1361, ABR1362, ABR1363) or
- EMA-LEJ-MXP-MAD-EMA (ABR1551, ABR1552, ABR1553, ABR1554).

Due to this, some routes are shown on the maps as 'one-way' routes. In the last period of the analysis (December 2023) there is only one triangular flight (CDG-HAJ-BCN-CDG), all other patterns are return flights. Particularly in the earlier periods, a rotation typically consisted of three to four flights with consecutive callsigns (as in the examples above).

The following section illustrates the population shares that Amazon Air can reach in Europe and the relationship with its own logistics infrastructure; both are then compared with the research from the USA. Further maps on Amazon Air's service area in Europe for all periods analysed can be found in the Annex (Figure 36 – Figure 41).

As the number of airports served is relatively stable, the proportion of the population reached is also constant. Around 210 million people live within a 100nm radius of Amazon Air in the first period under review. With the addition of flights to the two Italian islands, the number of people in the 100nm catchment area increased to a peak of approximately 217 million. In the period that followed, the figure declined again slightly. With the temporary discontinuation of KTW in summer 2022, the value dropped further to around 208 million, and even

bottomed out at 187 million following the termination of flights to LNZ. In the last two periods under review, the figure increased – with the resumption of flights to KTW and the implementation of LCA - to around 207 million people. This value corresponds to between 35% and 40% of the population in Europe (541,946,475 people (Batista e Silva F., Dijkstra and Poelman, 2021)).

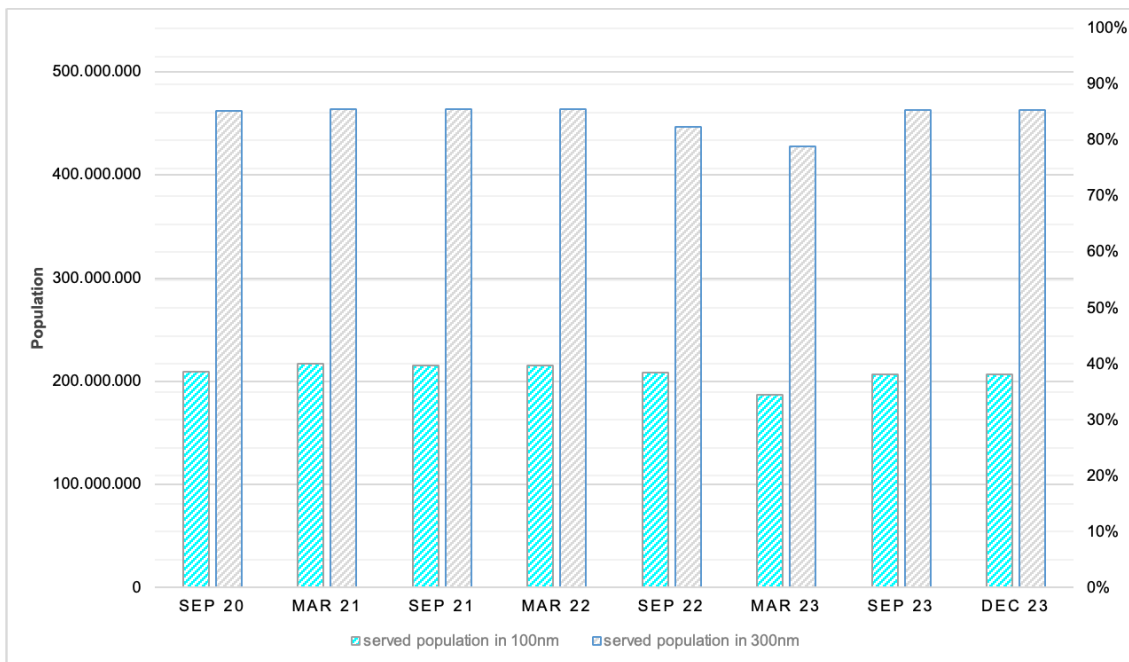


Figure 9: Population of Europe served by the network of Amazon Air in Europe.

The figures for the 300 nm radius are subjected to a comparable variation. This figure is consistently between 464 million and 428 million people. This corresponds to between 79% and 86% of the European population.

No value was determined for a comparably large catchment area in the USA. For this reason, only the 100nm value from Europe in per cent is compared below with the percentage value determined for Amazon Air in the USA. While the graph for Europe describes more of a horizontal line with a dip in the winter of 2022/2023, the population coverage in the USA is significantly higher. From April 2020 to February 2023, it increases steadily from 54% to 75%. Growth rates are marginally higher in the first half of the period and moderately slower in the second half. This is in line with the results of the preceding analyses.

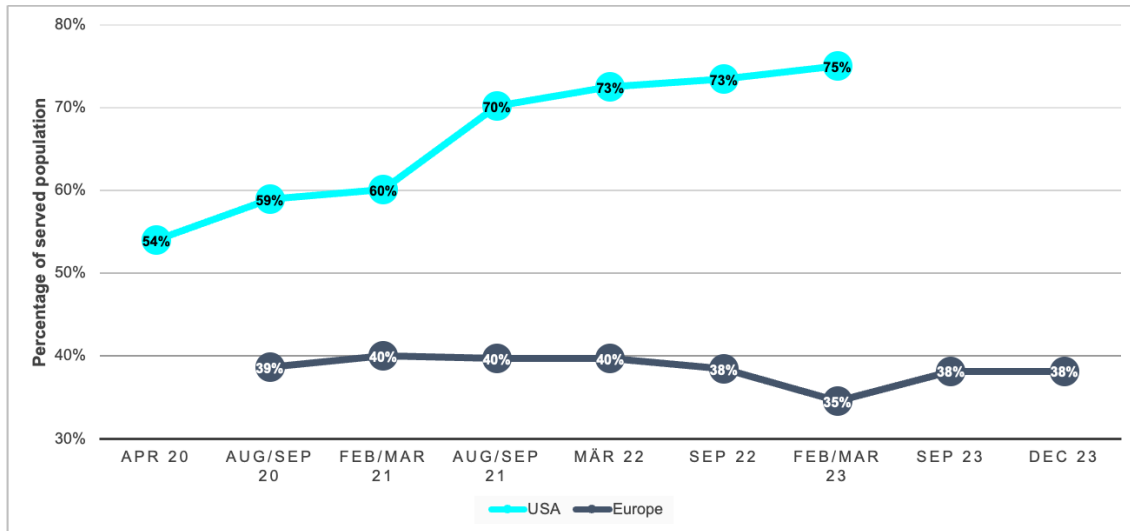


Figure 10: Population served by the network of Amazon Air in Europe and in the USA.

The table below shows the relationship between the Amazon Air network and the centres and stations operated by Amazon in Europe. In the methodology chapter, it is stated that smaller neighbouring countries of countries served (such as the Netherlands or Ireland) are considered together with their larger and neighbouring countries as a cluster for this analysis, as it can be assumed that the catchment area of the airports exceed the national borders. The largest cluster (Germany with Belgium, Netherlands and Austria), which comprises the largest amount of infrastructure, is also served by the highest number of daily flights. However, the UK cluster has a comparatively low number of flights. As already mentioned, this could be related to the fact that trade with EU countries has been restricted since Brexit. The number of flights also varies for Spain, Italy and France, which all have a comparable number of fulfilment or sorting centres or delivery stations or other infrastructure. Italy is served significantly more often than France, with Spain situated between the two. In Poland, the number of daily take-offs and landings is also comparatively high compared to the number of facilities.

By choosing the approach of clustering neighbouring countries with supposed overlapping catchment areas in the evaluation, it can be summarised that Amazon is active with its own infrastructure, such as fulfilment- and sorting centres or delivery stations or other infrastructure in the same countries in which Amazon is also active with its airline. There does not appear to be a direct

correlation between the scope of the infrastructure and the number of flights. An exception is Sweden: this country is not served by Amazon Air, while there currently one fulfilment centre. Cyprus is also a special case, as already described. It is served, although at the time of the analysis there appears to be no Amazon infrastructure in the country.

Cluster	Country	# of Centers and Stations of Amazon as reported by MWPVL				Sum	# of daily takeoffs & landings
		Fulfillment	Sorting	Delivery	Other		
Cluster Germany	Germany	35	14	89	7	161	10,6
	Belgium	0	0	5	0		
	Netherlands	0	0	2	0		
	Austria	0	0	9	0		
Cluster UK	United Kingdom	48	13	76	16	157	1,7
	Ireland	1	3	0	0		
Spain		15	2	41	5	63	5,1
Italy		13	4	42	2	61	8,9
France		13	6	38	1	58	1,7
Cluster Poland	Poland	9	1	0	0	13	2
	Czech Republic	0	1	0	1		
	Slovakia	1	0	0	0		
Cyprus		0	0	0	0	0	0,3
Sweden		1	0	0	0	1	0

Figure 11: Analysis of Amazon Air in Europe and Centers and Stations of Amazon as of 12/2023.

The total number of daily flights in the USA (last known value in February 2023: 171.8) is significantly higher than in Europe relative to the infrastructure available there according to MWPVL (1363 in total). An average of 15.1 flights took place in Europe in December 2023, while there are a total of 514 fulfillment- and sorting centres, as well as delivery stations and other infrastructures.

4.2 Fleet Analysis

The fleet operated for Amazon Air in Europe consists of aircraft belonging to the Boeing 737 family. One exception could be the use of an ATP of West Atlantic Sweden (SWN) between CGN and KTW until May 2020. However, this cannot be proven and in any case is prior to the period considered in this analysis. A complete list of all aircraft operating for Amazon Air during the period analysed can be found in the Annex (Figure 42).

In Europe, Amazon Air predominantly cooperates with ASL. Initially, mainly French-registered aircraft with the callsign FPO were used. Since 17 July 2019, only the callsign of the Irish subsidiary (ABR) has been used. The trip numbers remain unchanged after the change from FPO to ABR. Since the beginning of the year 2021, the digit (always a ,one‘) in all trip number is omitted (e.g. ABR1255 changes to ABR255, as shown in the schedule). In the first three analysis periods (September 2020 - September 2021), French-registered aircraft were still in use. After that, only Irish-registered aircraft were recognised.

However, there are also aircraft from other companies that were used for Amazon Air. They always operated under the call sign ‘ABR’. These include the three B734s operated by LEJ-based CargoLogic Germany (GCL), which flew for Amazon Air until the end of 2020. Two B734s from the British Titan Airways (AWC), based in SEN, also served Amazon Air until September 2021.

The first two B738s, which all feature the Amazon Air livery, joined the fleet at the end of 2020. After that, four more followed in 2021 and another three the year after. In total, there are nine aircraft operating in Europe, which are branded with ,Prime Air‘.

However, even after the branded aircraft had been introduced, the fleet was constantly supplemented by unbranded aircraft until the summer of 2023. The following chart is based on the number of aircraft required to fulfil the schedule.

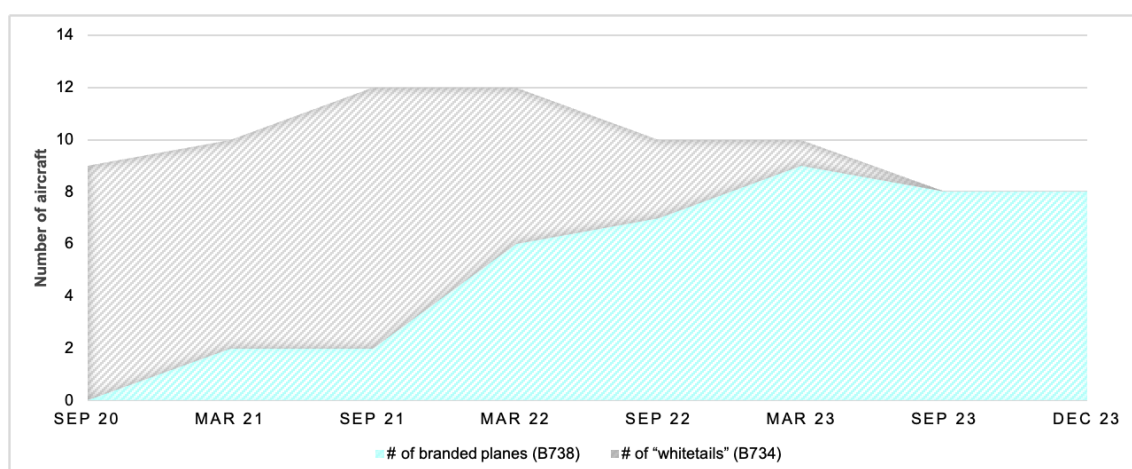


Figure 12: Fleet in operation for Amazon Air in Europe.

In addition, according to the observations made during the compilation of this analysis, at least one additional aircraft is kept parked in Europe (primarily in LEJ, later in LGG), which is repositioned to fulfil the schedule in the event of interruptions to the daily schedule, e.g. technical defects on the originally planned aircraft. It can also be observed that every aircraft in the ASL Ireland fleet positions to Shannon in Ireland at regular intervals, presumably to undergo maintenance or regular checks at the ASL Ireland base.

The diagram illustrates that – comparable to the development in the number of flights – the fleet deployed for this purpose is continuously growing until March 2022. The proportion of unbranded aircraft decreases with each new branded aircraft that is added to the fleet. After a decrease in the fleet from March 2022 to September 2023, the total number of aircraft in service is eight. These eight aircraft are all branded. Even the reserve aircraft can be a branded aircraft as the ninth aircraft in the fleet. Unbranded aircraft are only rarely used at the end of 2023.

Compared to the fleet in the USA, the European fleet is significantly smaller. From September 2016 to September 2022, the fleet in the USA expanded from one to 78 aircraft. The brief decrease in the US fleet to 74 and 77 respectively is due to the five AT75 no longer operating for Amazon Air.

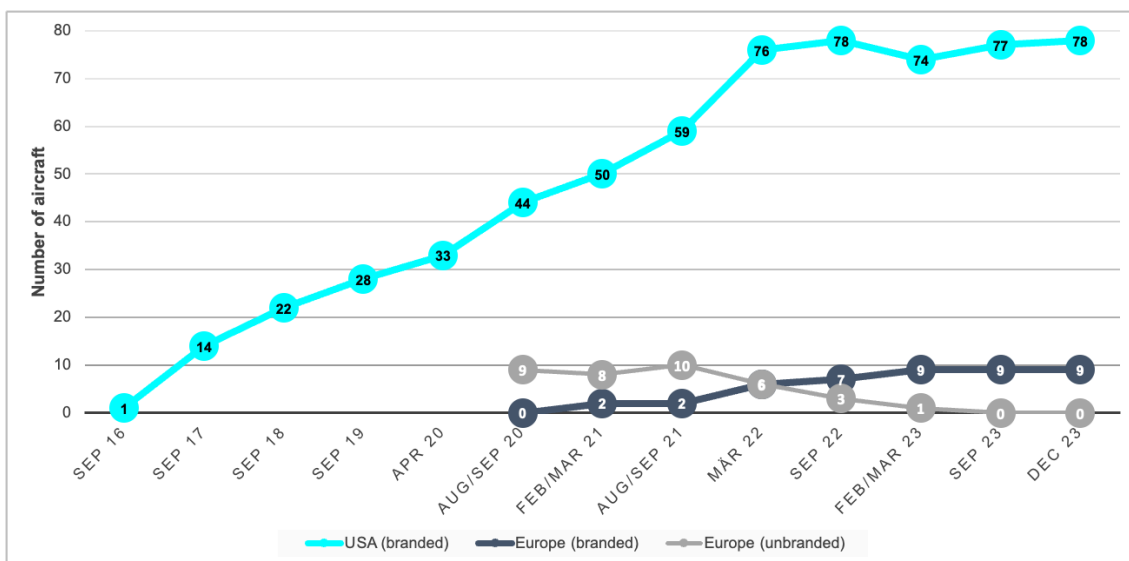


Figure 13: Fleet of Amazon Air in Europe and in the USA

For the US, it is furthermore not yet certain how many unbranded aircraft were or are in operation for Amazon Air. In the diagram, the figure for Europe has been included. The fleet mix in the USA is more diverse. It consists of AT75s, B738s, B763s and A333s. Accordingly, the fleet capacity calculated in the analysis is not only greater in total, but also the average capacity per aircraft. As of December 2023, the European fleet has a cubic volume capacity of 52,320 ft³ and is therefore around 27% higher than the first value in September 2020. This can be explained by the shift from B734 to B738 aircraft. The highest figure during the analysis was reached in March 2022 with 66,672 ft³. At 1,029,025 ft³, the US fleet (as of December 2023) has a total volume, that is almost 20 times the volume of the European fleet. As the payload in volume seems to be the limiting factor compared to the payload in weight for e-commerce goods, this value is emphasised here.

Based on the gained knowledge about the fleets in Europe and the USA and the findings about the number of flights, the utilisation of the fleets was calculated and compared. As explained in the methodology chapter, the number of aircraft used to actively operate in the network is not known for the USA. It is therefore assumed for the analysis of utilisation in the USA that 5% of the fleet is inactive. For Europe, the actual number of aircraft in use is known. The standby aircraft mentioned in the course of the chapter are not included.

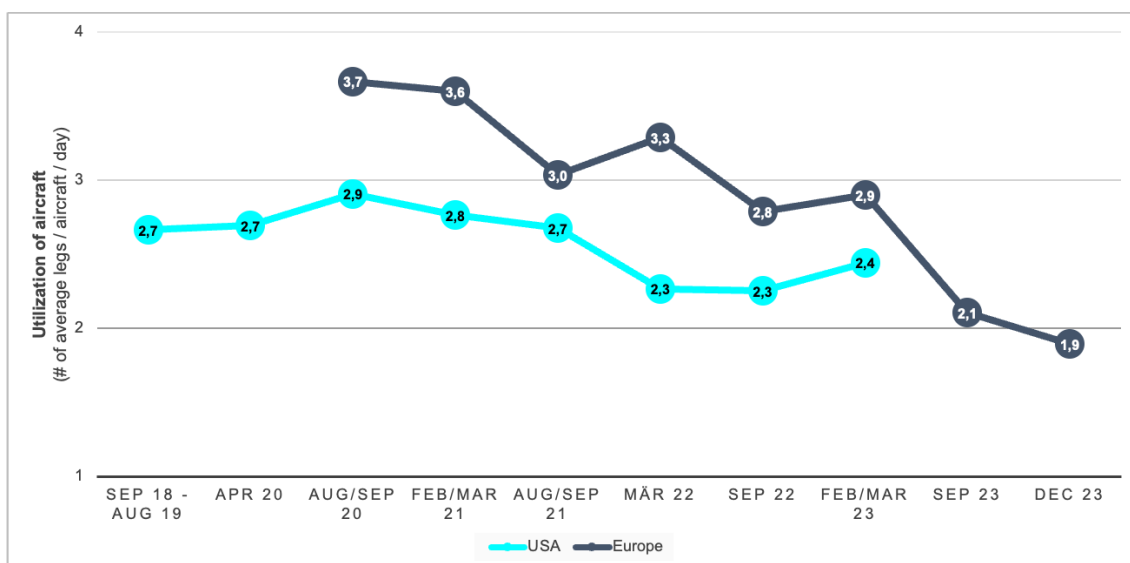


Figure 14: Utilization of the fleet of Amazon Air in Europe and in the USA.

In the diagram, aircraft utilisation in the USA fluctuates between 2.4 and 2.9 legs per day. The utilisation of aircraft in Europe is initially much higher at 3.7 flights per day. However, the value decreases gradually until it is just below an average of two legs per day in December 2023. The figure of less than two flights per day on average can be explained by the fact that all routes, except one, are not operated on Saturdays since summer 2023. As this means that flights are only operated six days a week, but the number of flights per week is divided by seven for the analysis, a value of less than two is therefore possible. It should also be noted that the average utilization in Europe is always lower in the summer than in the preceding winter. This effect is not recognisable in the USA.

The analysis presented in Chapter 3 provides a comprehensive overview about the activities of Amazon Air from September 2020 until December 2023. It concludes that the network and the number of flights were growing until March 2022. Since then, a decline in capacity in Europe has become apparent. The developments at the individual airports were analysed in detail. Amazon Air generally operates in the regions in which it also operates its own logistics infrastructure. In the end of 2023, Amazon Air's fleet in Europe consisted almost exclusively of branded B738s. These aircraft were initially more heavily utilised with more legs per day than the fleet in the USA. However, capacity utilisation fell to a lower level in 2023. In the following discussion, the similarities and differences between Amazon Air's activities in Europe and in the USA are discussed in more detail.

5 Discussion

The discussion in this chapter is based on the insights derived from the literature review, considers the methodological approach applied and is above all supported by the findings from the analysis of this thesis. The discussion is structured on the basis of the four research questions mentioned initially.

Research Question 1: How do the actual flights operated by Amazon Air in Europe compare to those in the USA? What does a network analysis reveal about Amazon Air's strategy in Europe compared to the USA?

The analysis reveals that Amazon Air continuously increased the number of flights it offered in Europe from September 2020 – probably considerably earlier, although no reliable data is available – until March 2022. This growth period is followed by a significant decline in the second half of the time frame analysed. The summer months are slightly less busy than the winter months, also regarding the utilisation of the aircraft. This seasonality is a familiar pattern in the European air freight market. Such seasonality is not reflected in the US data.

As the strongest economy in Europe, Germany is at the centre of Amazon Air's network. LEJ Airport represents a key role in this respect. It is the only airport in Europe where Amazon Air was known to operate its own handling operations. Some similarities exist between the activities at LEJ and CVG. While CVG is the US hub for DHL, LEJ serves this role for Europe. The evaluation of a sample from the busiest period examined indicates that traffic in LEJ is organised in three small time banks. However, as each of these time banks consists of only two to three aircraft and the time frame for transferring cargo tends to be much shorter than at CVG, it is unlikely that LEJ was a significant hub in the European network according to the definition of Jaillet, Song, and Yu (1996). However, it would have been possible to transload cargo using the examined schedule. LEJ could have taken on a comparable role to CVG in the European network if the strategic decision had not been made in 2023 that Amazon Air would largely withdraw from LEJ. Instead, all but one route were moved from LEJ to HAJ and LGG. The proximity of HAJ and LEJ is reminiscent of the relationship between CVG and ILN

compared to the USA. In both cases, the airports are close to each other with largely overlapping catchment areas. While CVG ultimately emerged ahead in the competition for the hub role, LEJ has obviously opted out.

It is known from the US Amazon Air network that the airline chooses to operate on airport pairs with overlapping catchment areas. In Europe, one of the two airports always turned out to 'prevail' during the course of the analysis. Thus, flight operations at CGN were terminated in favour of LGG. It is reasonable to assume that LGG, with its location in the 'golden triangle', has taken over the role of CGN with a catchment area of western Germany and the Benelux countries. The activities at SEN Airport near London have also been discontinued. The airport shares an overlapping catchment area with EMA.

The economic impact of Brexit may have played a role in the reduction of flights in the UK. From the day of leaving the customs and economic union with the EU on, the number of flights was significantly reduced. It appears that the lower remaining number of flights to the UK may be related to the fact that the exchange of goods between the UK and the EU has become more bureaucratic, more expensive and also more time-consuming after Brexit. This could explain a finding from the analysis, which links the locations of fulfilment and sorting centres, delivery stations and other logistics infrastructure with the number of flights going to these countries. The Germany cluster (consisting of Germany, Austria, the Netherlands and Belgium) is of a similar size compared to the UK cluster regarding the number of facilities. In the Germany cluster, however, the analysis recognises six times more flights per day.

Italy is also slightly overrepresented in this analysis, where the infrastructure is as well developed as in France or Spain. Following the withdrawal from LEJ, MXP became the airport in Europe where Amazon Air offers the most flights. The two islands of Sicily and Sardinia were also served from here in 2021. Amazon Air also serves island groups in the USA, such as Hawaii and the Caribbean, from airports on the mainland. It is possible that reloading of cargo for the islands was carried out in MXP, which was regularly discussed in the media as Amazon Air's

second hub in Europe. However, no relevant hub activities can be recognised in the schedule created for this paper.

The explanation for this not being the case at either MXP or LEJ could be that the European network has never grown to a size where a hub in the network would be meaningful. Since 2022 at the latest, it became evident that the European network developed a focus on P2P flights. In the course of the analysis, the proportion of daytime flights has increased to a level exceeding that of the USA, while in the USA the proportion of daytime flights decreased slightly with the launch of hub operations at CVG. This suggests that the European network is not designed for transporting deliveries overnight for immediate delivery on the following day. Against this background, the schedules of traditional integrators are much more night-orientated than those of Amazon Air.

The density of the network also supports this. While the number of destinations served in the USA is expanding so as to increase the proportion of the population within a 100nm radius to 75% by 2023, the number of destinations in Europe – apart from a small number of variations – is remaining comparatively constant. In the 100nm radius, fewer people are reached in this region. The values vary between 35% and 40% of the European population. However, if the values from the analysis of inhabitants within a 300nm radius are analysed, more than 80% of the European population is covered in the majority of cases. Within this radius, airports can be accessed by truck within one day of travelling. Freight transported by plane during the day can potentially reach over 80% of the European population either the following night or a day later. It is known that road feeder services are a commonly used method in Europe to achieve big catchment areas for cargo airports.

The fact that hardly any flights are scheduled on Saturdays in the European network since the summer of 2023 also suggests that the Amazon Air fleet is being used in preparation for the working day following the flight. This pattern has not yet been observed in Amazon Air's data in the USA. However, it is known to occur with European integrators. They also have a very reduced flight schedule on Saturdays. Flight activity then commences again on Sunday evening in order

to be able to deliver goods to customers on Monday morning. On Sundays, there are no deliveries to customers in large parts of Europe because it is a day of rest. It is possible, that the fleet of Amazon Air used to move freight from a warehouse to a fulfilment centre at the other end of Europe in order to make goods available there for the following day.

As Amazon is known as one of the leading technology companies in the sectors of cloud computing and artificial intelligence, it is not only possible that orders that have already been placed are on board the aircraft. It is also realistic, however, that goods are being relocated for which there is a predicted demand in the target region in the coming days. Amazon's usage of emerging technologies for optimization of their logistics is also suspected to happen in the US.

To summarise the similarities between Amazon Air's activities in Europe and the USA, both networks initially have a P2P focus. The flights primarily have the appearance of connecting Amazon's logistics infrastructure. The large proportion of daytime flights – above average compared to integrators – could indicate that Amazon Air's freight is less time-critical. However, it is also possible that time-critical freight is still transported on board DHL and FDX aircraft, which are travelling at night anyway. Amazon Air's network would then be, essentially, a supplement to the services offered by other carriers. The US network appeared to fulfill this function at its early stage.

While the US network has grown in recent years, the number of destinations in Europe has remained stable and the number of flights has grown at a slower rate than in the US. After March 2022, growth in the US slowed, while the number of flights in Europe actually decreased. Another significant difference is that the USA introduced a dedicated hub in the Amazon Air network in summer 2021, CVG. This could not be proven for the two largest airports in the European network: LEJ and MXP.

At the beginning of the analysis in September 2020, the European network corresponded to around a quarter of the US network in terms of the number of daily flights. In spring 2023, it was only one-sixth, as the US network continued

to grow while Europe declined. During the boost for the e-commerce market during the pandemic, Amazon Air was able to develop demanding growth rates in the USA. The comparatively weaker economic environment in Europe in the last two years, which has been characterised by a decline in demand, inflation and rising energy prices due to events such as the war in Ukraine, provides a less fertile basis for growth.

Research Question 2: What is the relationship between Amazon Air and its partners (such as DHL) in Europe compared to the USA? Could these partnerships potentially turn into competitive situations in the future?

In answering the second research question, the closeness and partnership with DHL should certainly be emphasised. Both CVG and LEJ are DHL's hubs for the respective continent. In addition to the favourable geographical location of these airports, the link to the DHL network and the associated synergy effects probably also contributed to their selection. However, EMA; CGN and MXP also serve DHL as minor hubs in Europe.

From the reduction of flights from CGN in 2022 and in particular from LEJ in 2023, the following two hypotheses could arise.

Hypothesis one: Either DHL has taken over the activities for Amazon at these locations, for example because freight prices on board DHL aircraft may have fallen due to the economic situation resulting in a lower demand. In turn, it might not be cost effective for Amazon Air to operate its own flights. The hypothesis already stated earlier that the Amazon Air network is an augmentation in addition to the DHL network would support this. Reports such as the one by Link (2019) suggest that the partnership between Amazon Air and DHL is likely to be rather tight until at least 2022. Link published that aircraft from DHL subsidiary European Air Transport (EAT) were operating during daytime on behalf of Amazon Air.

Hypothesis two: Alternatively, it is possible that Amazon Air is withdrawing from the two DHL airports because it wants to and can become more independent, meaning that the link to DHL is no longer essential. It is also important to bear in

mind that Amazon Air – starting in the USA – is utilising its fleet also for transporting freight from third-party customers. This means that Amazon is mutating from a partner to a direct competitor. Even if Amazon Air is not yet as large or as active in Europe as its big sister in the USA, the strategic decisions in Europe are naturally overshadowed by developments in the USA.

In addition, there are indications for partnerships with other postal companies in Europe. For example, the Poste Air Cargo (MSA) fleet is used to deliver e-commerce goods from Amazon in Italy. The analysis suggests that the flights to CAG and CTA may no longer have been deemed necessary against this background.

Research Question 3: How has the fleet of Amazon Air in Europe developed and how does this development differ from the USA? What role do subcontractors play in Amazon Air's strategy in Europe compared to the USA?

In the USA, Amazon Air cooperates with several lessors and ACMI companies. These includes mainly Atlas Air and ATSG, as well as Sun County Airlines and Hawaiian Airlines. In Europe, cooperation is centred on ASL Airlines and is therefore less complex. The number of different partners in Europe decreased noticeably over the period analysed. In 2020, aircraft from ASL Ireland (ABR), ASL France (FPO), CargoLogic Germany (GCL) and Titan Airways (AWC) operated for Amazon Air in Europe. Therefore, they all used the call sign of ABR. It could not be proven within the scope of this thesis, but probably West Atlantic Sweden (SWN) and European Air Transport (BCS) also provided flights for Amazon Air.

In the early years, the French ASL subsidiary seems to have been the main operator for Amazon Air. From July 2019, the Amazon flights changed their callsign from FPO to ABR, which is the callsign of the Irish subsidiary. All nine aircraft liveried as 'Prime Air' that fly for Amazon Air in Europe are now registered under its flag. These are all Boeing 737-800 (B738) aircraft. Before these aircraft became active in Europe from 2020, unbranded aircraft were flying for Amazon

Air. The proportion of these aircraft fell over the course of the three years observed. A comparison with the USA is not feasible for this analysis, as only the branded aircraft were tracked there.

What is evident however in the USA, is a more diverse fleet mix. The fleet in the USA consists not only of B738s, but mainly of larger B763s, and more recently also A333s. Temporarily, AT75s have also been in service for Amazon Air. Due to the larger aircraft, the average volume – it can be assumed that the volume is more important than the payload in weight – of the US fleet is larger. Overall, the US fleet has more than nineteen times the volume of the European fleet. However, there are 'only' around eight times as many aircraft in operation as in Europe. All these considerations refer to data as of December 2023.

The European fleet's utilisation initially averaged 3.7 legs per day, significantly higher than in the USA (2.9). Nevertheless, utilisation fell to an average of less than two flights per day in 2023. Obviously, short-term adjustments to the capacity offered can be easily recognised in the utilisation.

Research Question 4: Can predictions for future network strategy and fleet planning in Europe be made based on Amazon Air's development in the USA?

In light of the rapid growth of Amazon Air, particularly in the USA, during the coronavirus pandemic, Schwieterman et al. (2020-2023) predict that Amazon Air has reached a state of "new normal" in 2023. This could also be the case for Europe. Until there is no momentum for relevant growth in the e-commerce market, Amazon Air's activity in Europe is unlikely to increase in the near future.

The analysis has shown that Amazon Air adjusts its flight schedule more frequently than traditional integrators. This confirms an observation made by the US researchers. For example, potential growth could be realised by increasing the utilisation of the existing fleet. However, depending on the logistics infrastructure on the ground, changes in demand could also be transported by truck or in aircraft from other providers. If such partnership agreements with

integrators could be confirmed, this would tend to support hypothesis one, which was introduced earlier. It appears, that Amazon Air is used to serve routes on which traditional integrators do not offer enough capacity or charge too high prices. Amazon Air's network would therefore be a supplement to that of FDX, UPS or DHL. This suggests that changes in the services offered by integrators or adjustments to their prices may result in an optimisation of the Amazon Air network.

In the respective locations where Amazon is expanding its own logistics infrastructure, such as fulfilment or sorting centres the activity of Amazon Air is also very likely to increase. After Central Europe, this is currently expected to happen in Scandinavia and South- as well as South-East Europe. However, in the UK there currently seems to be so much logistics infrastructure in relation to the population which means that a lot of goods can be stored locally. This could make logistics there less dependent on flights. Therefore, it could be concluded that flights are a medium-term solution for a period in which there is not enough local infrastructure. In any case, the introduction of a flight can be implemented more quickly than building a new fulfilment centre, for example in response to rapid or unexpected volatility in demand.

Additionally, it will be worth observing if Amazon Air will provide transport services for third-party customers in Europe, as it does in the USA. Whether this is happening already remains uncertain. As a result, Amazon would have to become less dependent on established partnerships, such as that of DHL, as this would lead to increasing competition. Such observations would tend to support the second hypothesis introduced earlier.

Amazon's decision to operate its own airline is a decision of high strategic value in the USA as well as in Europe or India. The ability to operate more independently in air freight seems to be an important strategic tool for Amazon to remain in control of and to cut the costs of its efficient supply chains. The 'tool of Amazon Air' is being utilised very flexibly for this purpose. Observers may find some of these activities surprising or incomprehensible because the patterns are not familiar from other air cargo airlines. This is most probably due to the fact that

Amazon primarily aims to fulfil its own logistical needs, which it most probably knows very well and can predict thanks to the power of its data. Because the Amazon Air phenomenon - an airline that emerged from an e-commerce retailer - is a unique development in the industry, so too are the observations.

Limitations

The major challenge and therefore a relevant limitation of this paper is the limited publicly known information on Amazon Air's activities. In the rarely published press releases, Amazon reveals only few details about its airline. Some specialised reports cover Amazon Air's fleet and network, but generally from a very limited perspective. Reports from consulting firms may be biased by their interests and therefore not be independent. The credibility of those sources is therefore considered to be uncertain. For this reason, as mentioned in the literature review, reports from newspapers and non-peer reviewed journals were only used as a research input for the present analysis.

Only the flights that were identified as Amazon Air flights within the framework of the methodology described in Chapter 3 are included in the analysis. Even though the FR24 data has been rated as a reliable source by peer-reviewed papers, the database may still contain incomplete and missing entries. For 2022, however, the data could be validated with those of a second source (Spire) with a high degree of accuracy. The limited validated period (2022) and the limited period of the FR24 data (09/2020 to 12/2023) represent a further limitation. Although data from the German aircraft noise service (DFLD) is available for the period prior to this, it has been rated as unreliable source of data and is therefore not used in the analysis. As a result of this limitations, there might be activities of Amazon Air's in Europe, which are covered by this paper.

Regarding the comparison of the data with the USA, it must be mentioned that these are largely based on the publications by Bowen (2022) and Schwieterman et al. (2020-2023). As these researchers also use FR24 as their main source, their data is probably just as subject to the same level of error as the European data. An additional area of uncertainty in the US studies is the proportion of

aircraft that operate for Amazon Air but are not branded as 'Prime Air'. These are not included in the statistics provided there.

As no publicly available information is available on the extent of partnerships with integrators such as UPS, FDX or DHL, no reliable conclusion on this topic can be drawn in this study. Therefore, only hypotheses, such as the two in the context of discussion on the third research question, can be made.

Finally, it should be mentioned once again, that Amazon Air's activities in countries outside the USA and Europe were not considered. These include Canada and India, for example.

Recommendations for further research

The limitations just described provide opportunities for further research. For example, with the use of more reliable data sets containing data from before September 2020 in connection with the research methodology mentioned in this paper, it would be potentially possible to investigate Amazon Air's earlier activities in Europe. It is also still open as to whether the decline in the number of flights since March 2022 is also related to a shift in transport to road or rail.

Future research could also focus on the scope of the partnership between integrators, such as DHL and Amazon Air. With more reliable information, for example, the hypothesis put forward in the discussion could be confirmed or negated.

More detailed insights into the relationships between Amazon's ground-based infrastructure and its connection to Amazon Air's network could be undertaken if the data on the locations of fulfilment and sorting centres, delivery stations and other infrastructure were transferred to a GIS and subsequently evaluated.

In addition, the methodology developed as part of this thesis to identify unbranded aircraft operating flights for Amazon Air could also be applied to the US-region. As well, studies on other regions in which Amazon Air is active, such as Canada and India, are pending.

6 Conclusion

The aim of this Masterthesis is to narrow a prevailing research gap. The development of Amazon Air in Europe is analysed with a focus on its network and fleet strategy by processing publicly available data according to a self-developed methodology. These findings are compared with the knowledge obtained from US research. For this purpose, four research questions are introduced, which are discussed in detail in Chapter 5 of the thesis.

The analysis reveals, that the number of Amazon Air flights in Europe grew from September 2020 to March 2022. Typical seasonality for the European air freight market were recognised in the analysis, which are not apparent in the US figures. The growth period is followed by a significant decline from summer 2022 to the end of 2023. Although the number of flights in the USA grew at a slower rate in that period, growth nevertheless persisted there.

Also in contrast to the developments in the USA, where the network features a hub in Cincinnati since summer 2021, no such hub pattern could be identified in Europe. Instead, Amazon Air's network in Europe has an increasing focus on point-to-point connections with a growing number of daytime services. This leads to the conclusion that the network is not primarily used for the transport of goods for next-day delivery. Rather, there is a strong indication that Amazon is using its airline to strategically move goods in Europe in order to place them as close as one trucking day away from the customer. Amazon Air can reach over 80% of the European population with its network, when defining a 300nm radius around the destination airports as their catchment area. It can be assumed that Amazon, as one of the global market leaders in cloud computing and artificial intelligence, uses its deep insight into the data it collects and processes to predict demand in its target markets and to determine the necessary flights to fulfil this demand.

Amazon Air operates a denser network in the USA than in Europe. 75% of the population live within a 100nm radius of the airports served. With a greater proportion of night flights and significant hub activity, the network can increasingly be used for next-day delivery in the USA. In Europe, between 35% and 40% of

the population live in such close proximity to Amazon Air airports. There are no recognisable efforts by Amazon Air to increase this proportion.

The analysis and discussion also focuses on the respective destination markets and airports served in more detail. For example, the correlation between the reduction in the number of flights in the UK in the context of Brexit is analysed. The special role of islands in the US and European network is examined as well.

The discussion of the second research question regarding the relationship between Amazon Air and partners such as DHL in Europe is structured around two hypotheses. The first is based on the assumption that DHL continues to transport a large number of goods for Amazon in Europe. In the European network, a certain proximity to links with the DHL network can be identified. According to unconfirmed reports (Link, 2019), the European DHL airline EAT even operated entire aircraft exclusively for Amazon Air.

The second hypothesis reflects the fact that Amazon – beginning in the USA – is emerging to become a competitor for integrators such as DHL, FDX and UPS as it is increasingly expanding in the market of transporting goods of third parties. This could potentially jeopardise existing partnerships with integrators. A decline in this partnership could explain why Amazon Air has decided to withdraw from Cologne/Bonn and Leipzig/Halle, for example.

What is known, however, is that the Amazon Air fleet is currently operated entirely by ASL Ireland. In the USA, Amazon Air relies on a comparatively large number of partners. Equally less complex is the fleet itself. In Europe, nine Boeing 737-800s with 'Prime Air' livery are in operation. The proportion of unbranded Boeing 737-400s, which flew on behalf of Amazon Air at the beginning of the period of analysis, has decreased over time. It is not known how large the proportion of unbranded aircraft operating for Amazon Air is in the USA. The methodology developed as part of this Masterthesis allows to make these activities more transparent. As of December 2023, the known US fleet has nineteen times the volume of the European fleet. Eight times more aircraft are in operation for Amazon Air in the USA compared to Europe.

It can be assumed that Amazon Air in Europe will not tend to grow significantly in the context of the current economic conditions. However, the expectation is that Amazon Air adjust its activities very frequently, very dynamically and very flexibly in response to varying market conditions, adjustments to integrators' offerings or developments in their own logistics network. Amazon Air is not just a 'tool' which contributes to Amazon's supply chain but represents a high strategic value for Amazon's logistics division.

The findings of this analysis are limited by the availability of data that could only be used for a restricted period of time. Unreliable data and information, like the data of DFLD, is not included to the analysis. However, it could provide valuable approaches for further research. Amazon itself rarely releases information about its logistics to the outside world. This also applies to insights into the cooperation with partners, such as DHL. Any new findings on this could be linked to the results of this Masterthesis or support the formulated hypotheses.

In conclusion, it can be stated that this Masterthesis was able to achieve the aim of providing a deeper academic insight into the activities of Amazon Air in Europe. Focussing on the network and fleet, similarities and differences to the activities in the USA are identified. These findings are discussed in detail. However, not all of the findings could be conclusively explained, mainly as the available data and public information is limited. The quote cited in the introduction, which metaphorises Amazon Air as a "unicorn in the world of air freight" (Schwieterman, Craig and Mader, 2022), can therefore be confirmed.

Annex

Part of the Analysis		Sources
Creation of a schedule (Figure 16 and following)		DFLD, 2023
		FR24, 2023
		Spire Aviation, 2022
Compilation of the Amazon Air fleet in Europe (Figure 42)		FR24, 2023 planespotters.net, 2023
Examination of days with a reduced flight operation (Figure 23)		Spire Aviation, 2022
Analysis of Amazon Air in the US (Figure 26 & Figure 27)	Network	Bowen, 2022 Schwieterman et al., 2020-2023
	Fleet	Bowen, 2022 planespotters.net, 2023 Schwieterman et al., 2020-2023
Network & Spatial Analysis (Figure 25, Figure 36 and following)	GIS	QGIS, 2023
	Airports	European Commission (ESAT), GISCO Airports 2013 Dataset EUROSTAT (ed.), 2015
	Population	Batista, Dijkstra, Poelman. The JRC-GEOSTAT 2018 population grid. EUROSTAT (ed.), 2021
	Amazon	MWPVL, 2023
Capacity calculations (Figure 25, Figure 26 & Figure 27)	AT75	ATR, 2022
	B734	QuikJet Airlines, 2022
	B738	Boeing, 2016
	B763	Boeing, 2014
	A333	Elbe Flugzeugwerke GmbH, 2023

Figure 15: Sources and tools used for the preparation of the analyses.

[illegible]

FR24		02.09.23	ABR	258		LIRF	LFPG	04.20	06.20	1234567	17.02.21	15.08.21	B738	
FR24	SPIRE	02.09.23	ABR	258		LIRF	LFPG	08.45	10.45	1234567	17.08.21	26.03.22	B738	
FR24	SPIRE	02.09.23	ABR	258		LIRF	LFPG	08.15	10.15	1234567	27.03.22	28.08.23	B738	
FR24		17.12.23	ABR	289		EDDV	LEBL	08.45	11.15	12345 7	29.08.23	27.10.23	B738	
FR24		17.12.23	ABR	289		EDDV	LEBL	08.50	11.20	12345 7	29.10.23	17.12.23	B738	
FR24		17.12.23	ABR	290		LEBL	LFPG	16.30	18.25	12345 7	10.11.23	17.12.23	B738	
FR24		15.08.23	ABR	1 361		EGNX	LEMD	05.00	08.30	1234567	01.09.20	30.12.20	B734	
FR24		01.09.23	ABR	361		LEMD	LFPG	09.30	11.30	1234567	16.01.21	22.02.21	B734	
FR24		01.09.23	ABR	361		LEMD	LFPG	06.00	08.00	1234567	23.02.21	19.07.21	B734	
FR24		01.09.23	ABR	361		LEMD	LFPG	11.45	13.45	1234567	17.08.21	16.09.21	B734	
FR24		01.09.23	ABR	361		LEMD	LFPG	11.45	13.45	1234567	17.08.21	30.10.21	B738	
FR24	SPIRE	28.08.23	ABR	361		LEMD	LFPG	11.50	13.50	1234567	31.10.21	26.03.22	B738	
FR24	SPIRE	28.08.23	ABR	361		LEMD	LFPG	10.55	12.55	1234567	27.03.22	29.10.22	B738	
FR24	SPIRE	28.09.23	ABR	361		LEMD	LFPG	10.50	12.50	1234567	30.10.22	25.03.23	B738	
FR24		28.08.23	ABR	361		LEMD	LFPG	10.55	12.55	1234567	26.03.23	18.06.23	B738	
FR24		15.08.23	ABR	1 362		LEMD	LIMC	10.30	12.45	1234567	01.09.20	30.12.20	B734	
FR24		28.08.23	ABR	362		LIMC	LEMD	10.30	15.15	1234567	08.01.21	22.02.21	B734	
FR24		28.08.23	ABR	362		LFPG	LIMC	09.30	11.00	1234567	23.02.21	19.07.21	B734	
FR24		28.08.23	ABR	1 363		LIMC	EGNX	13.55	14.40	1234567	01.09.20	30.12.20	B734	
FR24		01.09.23	ABR	363		LIMC	LEMD	13.00	15.15	1234567	23.02.21	18.07.21	B734	
FR24		01.09.23	ABR	363		LIMC	LEMD	08.00	10.00	1234567	21.08.21	16.09.21	B734	
FR24		01.09.23	ABR	363		LIMC	LEMD	08.00	10.00	1234567	17.08.21	26.03.22	B738	
FR24	SPIRE	01.09.23	ABR	363		LIMC	LEMD	07.20	09.25	1234567	27.03.22	29.10.22	B738	
FR24	SPIRE	28.08.23	ABR	363		LIMC	LEMD	07.15	09.20	1234567	30.10.22	25.03.23	B738	
FR24		28.08.23	ABR	363		LIMC	LEMD	07.30	09.35	1234567	26.03.23	18.06.23	B738	
FR24	SPIRE	28.08.23	ABR	400		LEMD	LOWL	19.30	22.10	1234	12.08.22	05.10.22	B734	
FR24	SPIRE	28.08.23	ABR	400		LEMD	LOWL	21.30	00.10	5 7	10.08.22	02.10.22	B738	
FR24	SPIRE	28.08.23	ABR	400		LEMD	LOWL	19.30	22.10	1234	06.10.22	09.03.23	B738	
FR24	SPIRE	28.08.23	ABR	400		LEMD	LOWL	21.30	00.10	5 7	07.10.22	10.03.23	B738	
FR24	SPIRE	28.08.23	ABR	401		LOWL	LEMD	08.30	11.00	123456	10.08.22	06.10.22	B734	Data incomplete on Callign search, but can be found via Aircraft-registrations.
FR24	SPIRE	28.08.23	ABR	401		LOWL	LEMD	08.30	11.00	123456	07.10.22	11.03.23	B738	Data incomplete on Callign search, but can be found via Aircraft-registrations.
FR24		28.08.23	ABR	402		LEMD	EDDP	06.35	09.25	1234567	12.03.23	25.03.23	B738	
FR24		28.08.23	ABR	402		LEMD	EDDP	06.15	09.05	1234567	26.03.23	31.07.23	B738	
FR24		17.12.23	ABR	402		LEMD	EDDP	08.00	10.40	12345 7	01.08.23	13.11.23	B738	
FR24		17.12.23	ABR	402		LEMD	EDDP	08.00	10.55	12345 7	14.11.23	17.12.23	B738	
FR24		28.08.23	ABR	403		EDDP	LEMD	11.05	13.55	1234567	12.03.23	25.03.23	B738	
FR24		28.08.23	ABR	403		EDDP	LEMD	12.20	15.30	1234567	26.03.23	31.07.23	B738	
FR24		17.12.23	ABR	403		EDDP	LEMD	12.45	15.45	12345 7	01.08.23	13.11.23	B738	
FR24		17.12.23	ABR	403		EDDP	LEMD	12.45	15.50	12345 7	14.11.23	17.12.23	B738	
FR24		17.08.23	ABR	423		LIMC	EDDK	08.30	09.50	1234567	14.09.21	30.10.21	B734	
FR24	SPIRE	17.08.23	ABR	423		LIMC	EDDK	08.20	09.40	1234567	31.10.21	20.03.22	B734	
FR24		17.08.23	ABR	423		LIMC	EDDK	08.25	09.45	1234567	21.03.22	26.08.22	B734	
FR24	SPIRE	17.08.23	ABR	423		LIMC	EDDK	08.25	09.45	1234567	27.08.22	31.10.22	B738	
FR24	SPIRE	17.08.23	ABR	424	ABR/GB	EDDK	LIMC	11.30	13.10	1234567	14.09.21	26.08.22	B734	Data incomplete, due to alphanumeric callign, flights can be found via aircraft-registration.
FR24	SPIRE	17.08.23	ABR	424	ABR/GB	EDDK	LIMC	11.30	13.10	1234567	27.08.22	31.10.22	B738	Data incomplete, due to alphanumeric callign, flights can be found via aircraft-registration.
FR24	SPIRE	17.08.23	ABR	425		LIMC	EBLG	08.00	09.25	1234567	02.11.22	31.07.23	B738	
FR24		17.12.23	ABR	425		LIMC	EBLG	09.30	10.55	12345 7	01.08.23	17.12.23	B738	
FR24	SPIRE	17.08.23	ABR	426		EBLG	LIMC	13.30	15.00	1234567	02.11.22	31.07.23	B738	
FR24		17.12.23	ABR	426		EBLG	LIMC	13.30	15.00	12345 7	01.08.23	17.12.23	B738	
FR24	SPIRE	09.10.23	ABR	440		LEMD	EGNX	01.30	02.50	1234567	28.03.22	29.08.22	B738	
DFLD		09.10.23	ABR	440		LEMD	EGNX	01.30	02.50	1234567	28.03.22	29.08.22	B738	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	FPO	1 441		EDDK	LIMC	06.20	no data	1234567	30.04.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	FPO	1 441		EDDK	LIMC	05.10	no data	1234567	17.07.19	17.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
FR24		17.08.23	ABR	1 441		EDDK	LIMC	05.10	06.50	1234567	18.08.20	25.10.20	B734	
FR24		17.08.23	ABR	1 441		EDDK	LIMC	05.10	06.50	1234567	27.10.20	30.12.20	B738	

Figure 17: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 2/7.

	FR24				17.08.23	ABR	441			EDDK	LIMC	05:10	06:50	1234567	03.01.21	13.09.21	B738	
	FR24			SPIRE	17.08.23	ABR	441			EGNX	LEBL	04:40	07:50	1234567	29.08.21	29.08.22	B738	
	DFLD				28.12.23	FPO	1 442			LIMC	EDDK	no data	09:45	1234567	30.04.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	DFLD				28.12.23	ABR	1 442			LIMC	EDDK	no data	09:30	1234567	17.07.19	20.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	FR24				21.08.21	ABR	1 442			LIMC	EDDK	07:40	09:30	1234567	22.08.20	25.10.20	B734	
	FR24				21.08.21	ABR	1 442			LIMC	EDDK	07:40	09:30	1234567	27.10.20	30.12.20	B738	
	FR24				17.08.23	ABR	442			LIMC	EDDK	07:40	09:30	1234567	03.01.21	13.09.21	B738	
	FR24			SPIRE	21.08.23	ABR	442			LEBL	EDDK	09:10	11:50	1234567	28.09.21	25.07.22	B738	
	DFLD				28.12.23	FPO	1 443			EDDK	LEMD	11:45	no data	1234567	30.04.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	DFLD				28.12.23	ABR	1 443			EDDK	LEMD	10:45	no data	1234567	17.07.19	20.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	FR24				23.08.23	ABR	1 443			EDDK	LEMD	10:15	13:05	1234567	21.08.20	25.10.20	B734	
	FR24				23.08.23	ABR	1 443			EDDK	LEMD	10:15	13:05	1234567	27.10.20	30.12.20	B738	
	FR24				23.08.23	ABR	443			EDDK	LEMD	10:15	13:05	1234567	03.01.21	27.09.21	B738	
	FR24			SPIRE	23.08.23	ABR	443			EDDK	LEMD	13:15	16:05	1234567	28.09.21	26.03.22	B738	
	FR24			SPIRE	23.08.23	ABR	443			EDDK	LEMD	12:45	15:35	1234567	27.03.22	25.07.22	B738	
	DFLD				28.12.23	FPO	1 444			LEMD	EDDK	no data	17:45	1234567	30.04.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	DFLD				28.12.23	ABR	1 444			LEMD	EDDK	no data	16:45	1234567	17.07.19	20.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
	FR24				24.08.23	ABR	1 444			LEMD	EDDK	14:15	16:45	1234567	25.08.20	25.10.20	B734	
	FR24				24.08.23	ABR	1 444			LEMD	EDDK	14:15	16:45	1234567	27.10.20	30.12.20	B738	
	FR24				24.08.23	ABR	444			LEMD	EDDK	14:15	16:45	1234567	03.01.21	26.09.21	B738	
	FR24				24.08.23	ABR	445			LEBL	EBLG	09:10	11:30	1234567	26.07.22	29.08.22	B738	
	FR24			SPIRE	24.08.23	ABR	446			EBLG	LEMD	13:00	15:20	1234567	26.07.22	29.10.22	B738	
	FR24			SPIRE	24.08.23	ABR	446			EBLG	LEMD	13:10	15:30	1234567	30.10.22	25.03.23	B738	
	FR24				24.08.23	ABR	446			EBLG	LEMD	13:00	15:20	1234567	26.03.23	19.06.23	B738	
	FR24				24.08.23	ABR	447			LEMD	EBLG	08:00	10:15	1234567	30.08.22	19.06.23	B738	
	FR24			SPIRE	24.08.23	ABR	447			LEMD	EBLG	08:00	10:15	1234567	30.08.22	19.06.23	B738	
	FR24				17.08.23	ABR	467			LFPG	EDDP	07:15	08:50	1234567	20.07.21	12.12.21	B734	
	FR24			SPIRE	17.08.23	ABR	467			LFPG	EDDP	07:15	08:50	1234567	13.12.21	26.03.22	B738	
	FR24			SPIRE	17.08.23	ABR	467			LFPG	EDDP	07:20	08:55	1234567	27.03.22	28.08.23	B738	
	FR24				14.08.23	ABR	468			EDDP	LIMC	10:20	12:00	1234567	20.07.21	12.12.21	B734	
	FR24			SPIRE	14.08.23	ABR	468			EDDP	LIMC	10:20	12:00	1234567	13.12.21	26.03.22	B738	
	FR24			SPIRE	14.08.23	ABR	468			EDDP	LIMC	10:10	11:50	1234567	27.03.22	28.08.23	B738	
	FR24				17.12.23	ABR	468			EDDP	LIMC	12:15	13:55	12345 7	29.08.23	29.10.23	B738	
	FR24				17.12.23	ABR	468			EDDV	LIMC	13:55	15:40	12345 7	14.11.23	17.12.23	B738	
	FR24				17.08.23	ABR	469			LIMC	EDDP	13:35	15:10	1234567	21.07.21	12.12.21	B734	
	FR24				17.08.23	ABR	469			LIMC	EDDP	13:35	15:10	1234567	13.12.21	26.03.22	B738	
	FR24			SPIRE	17.08.23	ABR	469			LIMC	EDDP	13:25	15:00	1234567	27.03.22	28.08.23	B738	
	FR24			SPIRE	17.08.23	ABR	469			LIMC	EDDP	13:25	15:00	1234567	27.03.22	28.08.23	B738	
	FR24				17.12.23	ABR	469			LIMC	EDDP	15:40	17:15	12345 7	29.08.23	29.09.23	B738	
	FR24				17.12.23	ABR	469			LIMC	EDDV	10:15	11:55	12345 7	14.11.23	17.12.23	B738	
	DFLD				28.12.23	ABR	1 470			EDDK	EGNX	09:00	no data		25.06.19	30.08.20	B734	
	FR24				17.08.23	ABR	1 470			EDDK	EGNX	09:00	09:00	1234567	01.09.20	19.10.20	B734	
	FR24				17.08.23	ABR	1 470			EDDP	LFPG	22:45	00:15	1234567	21.10.20	30.12.20	B734	
	FR24				22.07.23	ABR	470			EDDP	LFPG	22:45	00:15	1234567	03.01.21	04.02.21	B734	
	FR24				22.07.23	ABR	470			EDDP	LFPG	17:15	18:55	1234567	05.02.21	12.12.21	B734	
	FR24			SPIRE	17.08.23	ABR	470			EDDP	LFPG	17:15	18:45	1234567	13.12.21	25.03.23	B738	
	FR24				22.07.23	ABR	470			EDDP	LFPG	17:10	18:45	1234567	26.03.23	01.09.23	B738	
	FR24				17.12.23	ABR	470			EDDP	LFPG	17:10	18:45	12345 7	03.09.23	09.11.23	B738	
	DFLD				28.12.23	ABR	1 471			EGNX	EDDK	no data	07:30	1234567	25.06.19	30.08.20	B734	
	FR24				26.08.23	ABR	1 471			EGNX	EDDK	05:00	07:30	1234567	01.09.20	19.10.20	B734	
	FR24				26.08.23	ABR	1 471			LFPG	EGNX	05:00	06:30	1234567	21.10.20	28.12.20	B734	
	FR24				24.08.23	ABR	471			LFPG	LEMD	05:00	07:00	1234567	02.02.21	19.07.21	B734	
	FR24				24.08.23	ABR	471			LFPG	LEMD	15:15	17:25	1234567	24.08.21	16.09.21	B734	
	FR24			SPIRE	24.08.23	ABR	471			LFPG	LEMD	15:15	17:10	1234567	17.09.21	26.03.22	B738	
	FR24			SPIRE	24.08.23	ABR	471			LFPG	LEMD	14:55	17:05	1234567	27.03.22	29.10.22	B738	
	FR24			SPIRE	24.08.23	ABR	471			LFPG	LEMD	15:00	17:10	1234567	30.10.22	25.03.23	B738	
	FR24				24.08.23	ABR	471			LFPG	LEMD	14:55	17:05	1234567	26.03.23	18.06.23	B738	

Figure 18: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 3/7.

FR24		27.08.23	ABR 1 472		EGNX	LIMC	08:05	12:00	1234567	21.10.20	30.12.20	B734	
FR24		28.08.23	ABR 472		LEMD	LIMC	09:00	11:30	1234567	19.07.21	19.07.21	B734	
FR24		28.08.23	ABR 472		LEMD	LIMC	04:30	07:00	1234567	24.08.21	16.09.21	B734	
FR24	SPiRE	28.08.23	ABR 472		LEMD	LIMC	04:30	07:00	1234567	17.09.21	26.03.22	B738	
FR24	SPiRE	28.08.23	ABR 472		LEMD	LIMC	03:45	06:00	1234567	27.03.22	19.06.23	B738	
FR24	SPiRE	28.08.23	ABR 1 473		LIMC	EDDP	12:45	14:15	1234567	21.10.20	30.12.20	B734	
FR24		28.08.23	ABR 473		LIMC	EDDP	12:45	14:15	1234567	03.01.21	19.07.21	B734	
DFLD		28.12.23	ABR 1 480		EDDK	EGNX	06:00	06:30	1234567	25.06.19	28.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
FR24		28.12.23	ABR 1 480		EDDK	EGNX	06:00	06:30	1234567	29.08.20	30.12.20	B734	
FR24		28.08.23	ABR 480		EDDK	EGNX	06:00	06:30	1234567	04.01.21	23.08.21	B734	
FR24		28.08.23	ABR 480		EDDK	EGNX	08:00	08:30	1234567	24.08.21	05.11.21	B734	
FR24	SPiRE	28.08.23	ABR 480		EDDK	EGNX	08:00	08:30	1234567	07.11.21	05.05.22	B738	
DFLD		28.12.23	ABR 1 481		EGNX	EDDK	10:20	12:50	1234567	25.06.19	27.08.20	B734	
FR24		28.08.23	ABR 1 481		EGNX	EDDK	10:20	12:50	1234567	28.08.20	30.12.20	B734	
FR24		28.08.23	ABR 481		EGNX	EDDK	10:10	12:40	1234567	04.01.21	05.11.21	B734	
FR24		28.08.23	ABR 481		EGNX	EDDK	10:10	12:40	1234567	07.11.21	25.03.22	B738	
FR24	SPiRE	28.08.23	ABR 481		EGNX	EDDK	10:30	12:30	1234567	27.03.22	05.05.22	B738	
DFLD		28.12.23	SWN 642P		EDDK	EPKT	irregular	no data	1234567	02.06.19	24.05.20	ATP	It is assumed that this flight was operating for Amazon on this route before ABR1482. Not included in the analysis, as operation for Amazon by SWN can not be proven.
DFLD		28.12.23	ABR 1 482		EDDK	EPKT	19:45	no data	1234567	25.05.20	27.08.20	B734	
FR24		28.08.22	ABR 1 482		EDDK	EPKT	19:45	21:30	1234567	28.08.20	29.12.20	B734	
FR24		28.08.22	ABR 482		EDDK	EPKT	19:45	21:30	1234567	02.01.21	19.07.21	B734	
FR24		28.08.22	ABR 482		EDDK	EPKT	23:00	00:45	1234567	21.07.21	05.11.21	B734	
FR24		28.08.22	ABR 482		EDDK	EPKT	23:00	00:45	1234567	06.11.21	08.11.21	B738	
FR24	SPiRE	28.08.22	ABR 482		EDDK	EPKT	20:15	22:00	1234567	09.11.21	10.01.22	B738	
FR24	SPiRE	28.08.22	ABR 482		EDDK	EPKT	23:00	00:45	1234567	11.01.22	25.04.22	B738	
FR24	SPiRE	28.08.22	ABR 482		EDDK	EPKT	14:15	16:00	1234567	26.04.22	26.07.22	B738	
DFLD		28.12.23	SWN 641		EPKT	EDDK	no data	04:40	1234567	03.06.19	25.05.20	ATP	It is assumed that this flight was operating for Amazon on this route before ABR1483. Not included in the analysis, as operation for Amazon by SWN can not be proven.
DFLD		28.12.23	ABR 1 483		EPKT	EDDK	02:30	1234567	26.05.20	28.08.20	28.08.20	B734	
FR24		28.08.22	ABR 1 483		EPKT	EDDK	00:45	02:30	1234567	29.08.20	30.12.20	B734	
FR24		28.08.22	ABR 483		EPKT	EDDK	00:45	02:30	1234567	03.01.21	20.07.21	B734	FR24-data indompete on Callsign search, but can be found via aircraft-registrations.
FR24		28.08.22	ABR 483		EPKT	EDDK	02:30	04:15	1234567	22.07.21	06.11.21	B734	
FR24		28.08.22	ABR 483		EPKT	EDDK	02:30	04:15	1234567	07.11.21	09.11.21	B738	
FR24	SPiRE	28.08.22	ABR 483		EPKT	EDDK	23:00	00:45	1234567	10.11.21	10.01.22	B738	
FR24	SPiRE	28.08.22	ABR 483		EPKT	EDDK	02:30	04:15	1234567	12.01.22	27.07.22	B738	
DFLD		28.12.23	FPO 1 537		EDDV	LIMC	04:00	no data	1234567	28.05.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	ABR 1 537		EDDV	LIMC	04:00	no data	1234567	17.07.19	14.08.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	ABR 1 537		EDDV	EGNX	04:00	no data	1234567	17.08.19	30.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
FR24		02.09.23	ABR 1 537		EDDV	EGNX	04:30	04:30	1234567	01.09.20	08.09.20	B734	
FR24		02.09.23	ABR 1 537		EDDV	EGNX	01:00	01:30	1234567	09.09.20	30.12.20	B734	
FR24		04.09.23	ABR 537		EGMC	EDDP	23:30	02:00	1234567	22.03.21	12.09.21	B734	
FR24		02.09.23	ABR 1 538		EGNX	LIMC	06:00	09:00	1234567	01.09.20	08.09.20	B734	
FR24		02.09.23	ABR 1 538		EGNX	LFPG	03:55	06:00	1234567	09.09.20	30.12.20	B734	
FR24		04.09.21	ABR 538		EDDV	LFPG	04:10	05:30	1234567	23.01.21	22.02.21	B734	
FR24		04.09.23	ABR 538		EDDP	EGMC	04:45	05:20	1234567	23.03.21	13.09.21	B734	
DFLD		28.12.23	FPO 1 539		EGNX	EDDV	no data	12:00	1234567	28.05.19	16.07.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	ABR 1 539		EGNX	EDDV	no data	12:00	1234567	17.07.19	14.08.19	B734	Not included in the analysis, as data is from DFLD is too unreliable.
DFLD		28.12.23	ABR 1 539		LIMC	EDDV	no data	12:00	1234567	17.08.19	30.08.20	B734	Not included in the analysis, as data is from DFLD is too unreliable.
FR24		02.09.23	ABR 1 539		LIMC	EDDV	10:30	12:00	1234567	01.09.20	08.09.20	B734	
FR24		02.09.23	ABR 1 539		LFPG	LEMD	09:30	11:30	1234567	09.09.20	24.10.20	B734	
FR24		02.09.23	ABR 1 539		LFPG	LEMD	11:00	13:00	1234567	25.10.20	30.12.20	B734	
FR24		04.09.21	ABR 539		LFPG	LEMD	22:30	00:30	1234567	03.01.21	22.02.21	B734	
FR24		04.09.21	ABR 539		EGMC	EDDP	07:00	09:30	1234567	23.02.21	11.10.21	B734	
FR24		02.09.23	ABR 1 540		LEMD	EDDV	13:15	15:45	1234567	09.09.20	24.10.20	B734	

Figure 19: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 4/7.

FR24		02.09.23	ABR 1 540		LEMD	EDDV	14.15	16.45	1234567	25.10.20	30.12.20	B734	
FR24		04.09.21	ABR 540		LEMD	EDDV	16.15	1234567	03.01.21	22.02.21		B734	
FR24		04.09.21	ABR 540		EDDP	EGMC	13.30	14.00	1234567	23.02.21	11.09.22	B734	
FR24		02.09.23	ABR 1 551		EGNX	EDDP	00.30	03.15	1234567	01.09.20	30.12.20	B734	
FR24		15.08.23	ABR 551		LEMD	EDDP	03.30	05.00	1234567	15.01.21	01.03.21	B734	
FR24		15.08.23	ABR 551		EDDP	EGNX	03.50	04.45	1234567	02.03.21	27.09.21	B734	
FR24		15.08.23	ABR 551		EDDP	EGNX	06.45	07.40	1234567	28.09.21	26.11.21	B734	
FR24	SPIRE	15.08.23	ABR 551		EDDP	EGNX	06.45	07.40	1234567	27.11.21	25.03.22	B738	
FR24	SPIRE	15.08.23	ABR 551		EDDP	EGNX	07.00	08.05	1234567	27.03.22	31.07.23	B738	
FR24		17.12.23	ABR 551		EDDP	EGNX	13.15	14.05	12345 7	01.08.23	17.12.23	B738	
FR24		02.09.23	ABR 1 552		EDDP	LIMC	05.30	07.00	1234567	01.09.20	30.12.20	B734	
FR24		04.09.23	ABR 552		EDDP	LIMC	05.30	07.00	1234567	15.01.21	01.03.21	B734	
FR24		04.09.23	ABR 552		EGNX	EDDP	06.40	09.20	1234567	02.03.21	19.08.21	B734	
FR24		04.09.23	ABR 552	ABR5CB	EGNX	EDDP	06.40	09.20	1234567	20.08.21	27.09.21	B734	
FR24		04.09.23	ABR 552	ABR5CB	EGNX	EDDP	09.20	11.50	1234567	28.09.21	26.11.21	B734	
FR24	SPIRE	04.09.23	ABR 552	ABR5CB	EGNX	EDDP	09.20	11.50	1234567	27.11.21	25.03.22	B738	
FR24	SPIRE	04.09.23	ABR 552	ABR5CB	EGNX	EDDP	09.25	11.55	1234567	27.03.22	31.07.23	B738	
FR24		17.12.23	ABR 552	ABR5CB	EGNX	EDDP	08.15	10.45	12345 7	01.08.23	17.12.23	B738	
FR24		02.09.23	ABR 1 553		LIMC	LEMD	09.00	11.10	1234567	01.09.20	30.12.20	B734	
FR24		04.09.23	ABR 553		LIMC	LEMD	09.00	11.10	1234567	03.01.21	28.02.21	B734	
FR24		17.12.23	ABR 553		EDDP	LIMC	13.40	15.10	1234567	01.03.21	25.11.21	B734	
FR24	SPIRE	04.09.23	ABR 553		EDDP	LIMC	13.40	15.10	1234567	26.11.21	29.10.22	B738	
FR24	SPIRE	04.09.23	ABR 553		EDDP	LIMC	13.45	15.15	1234567	30.10.22	25.03.23	B738	
FR24		04.09.23	ABR 553		EDDP	LIMC	13.40	15.10	1234567	26.03.23	31.07.23	B738	
FR24		02.09.23	ABR 1 554		LEMD	EGNX	13.05	14.25	1234567	01.09.20	30.12.20	B734	
FR24		04.09.23	ABR 554		LIMC	EDDP	00.30	02.00	1234567	02.03.21	27.09.21	B734	
FR24		04.09.23	ABR 554		LIMC	EDDP	04.05	05.35	1234567	28.09.21	30.10.21	B734	
FR24		04.09.23	ABR 554		LIMC	EDDP	04.00	05.30	1234567	31.10.21	25.11.21	B734	
FR24	SPIRE	04.09.23	ABR 554		LIMC	EDDP	04.00	05.30	1234567	26.11.21	26.03.22	B738	
FR24	SPIRE	04.09.23	ABR 554		LIMC	EDDP	03.55	05.25	1234567	27.03.22	25.03.23	B738	
FR24		04.09.23	ABR 554		EDDV	EPKT	22.00	23.20	1234567	20.07.21	08.11.21	B734	
FR24		05.09.23	ABR 580		EDDV	EPKT	19.30	20.50	1234567	09.11.21	10.01.22	B734	
FR24	SPIRE	05.09.23	ABR 580		EDDV	EPKT	22.00	23.20	1234567	11.01.22	25.03.22	B734	
FR24	SPIRE	05.09.23	ABR 580		EDDV	EPKT	21.55	23.15	1234567	26.03.22	14.06.22	B734	
FR24	SPIRE	05.09.23	ABR 580		EDDV	EPKT	21.55	23.15	1234567	16.06.22	31.07.22	B738	
FR24		05.09.23	ABR 581		EPKT	EDDV	01.00	02.20	1234567	20.07.21	09.11.21	B734	
FR24	SPIRE	05.09.23	ABR 581		EPKT	EDDV	22.00	23.20	1234567	10.11.21	10.01.22	B734	
FR24	SPIRE	05.09.23	ABR 581		EDDV	EPKT	01.00	02.20	1234567	12.01.22	15.06.22	B734	
FR24		05.09.23	ABR 581		EDDV	EPKT	01.00	02.20	1234567	17.06.22	01.08.22	B738	ABR851 included, as a mixup of number is suggested here.
FR24		05.09.23	ABR 582		EDDV	LIMC	07.45	09.25	1234567	21.07.21	16.06.22	B734	
FR24	SPIRE	05.09.23	ABR 582		EDDV	LIMC	07.45	09.25	1234567	17.06.22	29.10.22	B738	
FR24	SPIRE	05.09.23	ABR 582		EDDV	LIMC	07.40	09.20	1234567	01.11.22	28.08.23	B738	ABR852 included, as a mixup of number is suggested here.
FR24		05.09.23	ABR 583		LIMC	EDDV	11.00	12.40	1234567	22.07.21	16.06.22	B734	
FR24	SPIRE	05.09.23	ABR 583		LIMC	EDDV	11.00	12.40	1234567	17.06.22	28.08.23	B738	ABR853 included, as a mixup of number is suggested here.
FR24	SPIRE	05.09.23	ABR 592		EDDP	LEMD	04.40	07.30	1234567	13.10.21	06.12.21	B734	
FR24	SPIRE	05.09.23	ABR 592		EDDP	LEMD	04.30	07.20	1234567	07.12.21	25.07.22	B734	
FR24		05.09.23	ABR 593		LEMD	EDDP	08.50	11.40	1234567	13.10.21	06.12.21	B734	
FR24	SPIRE	05.09.23	ABR 593		LEMD	EDDP	08.35	11.25	1234567	07.12.21	26.03.22	B734	
FR24	SPIRE	05.09.23	ABR 593		LEMD	EDDP	09.00	11.50	1234567	27.03.22	24.07.22	B734	
FR24		02.09.23	ABR 1 623		EGMC	LIRF	22.55	02.15	1234567	01.09.20	30.12.20	B734	
FR24		05.09.23	ABR 623		LIMC	LICC	22.10	23.50	1234567	08.02.21	12.04.21	B734	
FR24		05.09.23	ABR 623		LIMC	LICC	21.10	22.50	1234567	13.04.21	30.07.21	B734	
FR24		05.09.23	ABR 623		LIMC	LICC	22.10	23.50	1234567	01.08.21	23.08.21	B734	

Figure 20: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 5/7.

FR24	SPIRE	26.09.23	ABR	623		LIMC	LICC	22:10	23:50	irregular	28.08.21	19.10.22	B734	Example Dates in 2022: 09.01., 12.01., 16.01., 17.01., 13.02., 28.02., 20.03., 30.03., 31.03., 11.06., 12.06., 13.06., 18.10.2022
FR24		02.09.23	ABR	1 624		LIRF	EGMC	05:05	06:40	1234567	01.09.20	30.12.20	B734	
FR24		05.09.23	ABR	624		LICC	LIMC	00:50	02:30	1234567	08.02.21	13.04.21	B734	
FR24		05.09.23	ABR	624		LICC	LIMC	23:50	01:30	1234567	30.07.21	30.07.21	B734	
FR24		05.09.23	ABR	624		LICC	LIMC	00:50	02:30	1234567	01.08.21	02.08.21	B734	
FR24		05.09.23	ABR	624		LICC	EPKT	00:50	03:20	1234567	03.08.21	24.08.21	B734	
FR24		02.09.23	ABR	1 625		EGMC	LIMC	09:40	12:35	1234567	01.09.20	30.12.20	B734	
FR24		05.09.23	ABR	625		LIMC	LIEE	04:00	05:20	1234567	26.01.21	13.04.21	B734	
FR24		05.09.23	ABR	625		LIMC	LIEE	03:00	04:20	1234567	14.04.21	05.07.21	B734	
FR24		05.09.23	ABR	625		EPKT	LEMD	07:30	11:00	1234567	03.08.21	24.08.21	B734	
FR24	SPIRE	05.09.23	ABR	625		EPKT	LEMD	irregular	irregular	irregular	28.08.21	15.12.22	B734	Example Dates in 2022: 17.01., 18.01., 23.01., 03.02., 05.02., 11.02., 13.02., 01.03., 21.03., 31.03., 01.04., 04.04., 05.04., 06.04., 20.04., 28.04., 23.05., 24.05., 25.05., 11.06., 13.06., 14.06., 22.06., 23.06., 21.08., 24.08., 11.09., 26.09., 29.09., 11.10., 13.10., 23.10.,
FR24		02.09.23	ABR	1 626		LIMC	EGMC	14:25	15:10	1234567	01.09.20	30.12.20	B734	
FR24		05.09.23	ABR	626		LIEE	LIMC	06:50	08:10	1234567	26.01.21	13.04.21	B734	
FR24		05.09.23	ABR	626		LIEE	LIMC	05:50	07:10	1234567	14.04.21	05.07.21	B734	
FR24		05.09.23	ABR	626		LEMD	LIMC	12:30	14:30	1234567	03.08.21	23.08.21	B734	
FR24	SPIRE	05.09.23	ABR	626		LEMD	LIMC	12:30	14:30	irregular	28.08.21	18.06.23	B734	Example Dates in 2022: 17.01., 18.01., 03.02., 05.02., 11.02., 13.02., 17.02., 01.03., 21.03., 31.03., 01.04., 04.04., 05.04., 06.04., 20.04., 28.04., 23.05., 24.05., 25.05., 11.06., 13.06., 14.06., 22.06., 23.06., 21.08., 24.08., 11.09., 26.09., 29.09., 11.10., 13.10., 23.10.,
FR24		05.09.23	ABR	736		LEBL	EDDP	12:45	15:15	12345 7	29.08.23	29.09.23	B738	
FR24		02.09.23	ABR	1 737		EGMC	LEBL	00:45	03:45	1234567	01.09.20	30.12.20	B734	
FR24		02.09.23	ABR	1 738		LEBL	EGMC	05:25	06:40	1234567	01.09.20	30.12.20	B734	
FR24		09.10.21	ABR	738		LEBL	EDDP	06:00	08:30	1234567	07.09.21	06.09.21	B734	
FR24	SPIRE	06.09.23	ABR	738		LEBL	EDDP	08:00	10:30	1234567	19.01.21	26.03.22	B734	
FR24	SPIRE	06.09.23	ABR	738		LEBL	EDDP	08:15	10:45	1234567	19.09.22	29.10.22	B738	
FR24	SPIRE	06.09.23	ABR	738		LEBL	EDDP	08:15	10:45	1234567	27.03.22	17.09.22	B738	
FR24	SPIRE	06.09.23	ABR	738		LEBL	EDDP	08:10	10:40	1234567	30.10.22	25.03.23	B738	
FR24		06.09.23	ABR	738		LEBL	EDDP	08:15	10:45	1234567	26.03.23	31.07.23	B738	
FR24		02.09.23	ABR	1 739		EGMC	LEMD	09:05	12:20	1234567	01.09.20	30.12.20	B734	
FR24		09.10.21	ABR	739		EDDP	LIRF	14:00	15:50	1234567	19.01.21	06.09.21	B734	
FR24	SPIRE	28.09.23	ABR	739		EDDP	LIRF	13:30	15:20	1234567	07.09.21	17.09.22	B734	
FR24	SPIRE	28.09.23	ABR	739		EDDP	LIRF	13:30	15:20	1234567	18.09.22	31.07.23	B738	
FR24		02.09.23	ABR	1 740		LEMD	EGMC	14:35	15:50	1234567	01.09.20	30.12.20	B734	
FR24		06.09.23	ABR	740		LIRF	LEBL	03:20	05:00	1234567	19.01.21	06.09.21	B734	
FR24	SPIRE	06.09.23	ABR	740		LIRF	LEBL	05:10	06:50	1234567	07.09.21	17.09.22	B734	
FR24	SPIRE	06.09.23	ABR	740		LIRF	LEBL	05:10	06:50	1234567	18.09.22	29.10.22	B738	
FR24	SPIRE	06.09.23	ABR	740		LIRF	LEBL	05:05	06:45	1234567	30.10.22	25.03.23	B738	
FR24		06.09.23	ABR	740		LIRF	LEBL	05:10	06:50	1234567	26.03.23	31.07.23	B738	
FR24		02.09.23	ABR	1 895		EDDP	EGMC	01:00	01:40	1234567	10.11.20	30.12.20	B734	
FR24		06.09.23	ABR	895		EDDP	EGMC	01:00	01:40	1234567	03.01.21	16.08.21	B734	
FR24		06.09.23	ABR	895		EDDP	EGMC	02:00	02:40	1234567	17.08.21	11.10.21	B734	
FR24		02.09.23	ABR	1 896		EGMC	EDDP	03:20	06:00	1234567	10.11.20	30.12.20	B734	
FR24		02.09.23	ABR	896		EGMC	EDDP	03:20	06:00	1234567	03.01.21	16.08.21	B734	
FR24	SPIRE	06.09.23	ABR	896		EGMC	EDDP	04:15	07:00	1234567	17.08.21	11.10.21	B734	
FR24	SPIRE	06.09.23	ABR	896		EGMC	EDDP	03:00	05:45	1234567	13.10.21	20.03.22	B734	
FR24		02.09.23	ABR	896		EGMC	EDDP	03:45	06:30	1234567	21.03.22	12.09.22	B734	
FR24		02.09.23	ABR	1 897		EDDP	LIRF	09:00	10:50	1234567	10.11.20	30.12.20	B734	
FR24		06.09.23	ABR	897		EDDP	LIRF	08:45	10:35	1234567	03.01.21	06.09.21	B734	
FR24		06.09.23	ABR	897		EDDP	LIRF	08:10	10:10	1234567	07.09.21	11.10.21	B734	
FR24	SPIRE	06.09.23	ABR	897		EDDP	LIRF	07:25	09:25	1234567	12.10.21	29.10.22	B734	
FR24	SPIRE	06.09.23	ABR	897		EDDP	LIRF	06:55	08:55	1234567	30.10.22	25.03.23	B734	
FR24		06.09.23	ABR	897		EDDP	LIRF	06:20	08:20	1234567	26.03.23	31.07.23	B734	
FR24		17.12.23	ABR	897		EDDP	LIRF	16:00	18:00	12345 7	01.08.23	12.11.23	B738	

Figure 21: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 6/7.

FR24		17.12.23	ABR	897		EBLG	LIRF	15:40	18:00	12345 7	14.11.23	17.12.23	B738	
FR24		02.09.23	ABR	1 898		LIRF	EDDP	12:30	14:20	1234567	10.11.21	30.12.20	B734	
FR24		06.09.23	ABR	898		LIRF	EDDP	12:15	14:05	1234567	03.01.21	29.04.21	B734	
FR24		06.09.23	ABR	898		LIRF	EDDP	13:25	15:15	1234567	03.05.21	06.09.21	B734	
FR24		06.09.23	ABR	898		LIRF	EDDP	11:45	13:45	1234567	07.09.21	11.10.21	B734	
FR24	SPIRE	06.09.23	ABR	898		LIRF	EDDP	10:30	12:30	1234567	12.10.21	29.10.22	B734	
FR24	SPIRE	06.09.23	ABR	898		LIRF	EDDP	10:10	12:10	1234567	30.10.22	25.03.23	B734	
FR24		06.09.23	ABR	898		LIRF	EDDP	09:55	11:55	1234567	26.03.23	31.07.23	B734	
FR24		06.09.23	ABR	898		LIRF	EDDP	12:20	14:20	12345 7	01.08.23	20.08.23	B738	
FR24		17.12.23	ABR	898		LIRF	EDDP	11:50	13:50	12345 7	21.08.23	12.11.23	B738	
FR24		17.12.23	ABR	898		LIRF	EBLG	09:50	12:10	12345 7	14.11.23	17.12.23	B738	
FR24	SPIRE	28.09.22	ABR	949		LIMC	LIEE	03:30	04:50	irregular	11.11.21	22.03.23	B734	Example Dates in 2022: 10.01., 19.01., 24.01., 16.02., 20.04., 22.06., 16.09., 31.10., 14.11., 29.12.22
FR24	SPIRE	28.09.22	ABR	951		EPKT	LFPG	09:35	11:45	irregular	12.09.21	07.06.23	B734	Example Dates in 2022: 09.01., 10.01., 19.01., 23.01., 24.01., 14.03., 27.05., 12.06., 25.07., 14.08., 31.10., 10.11., 25.11., 13.12., 28.12.22
FR24	SPIRE	28.09.22	ABR	952		LFPG	LIMC	14:25	16:05	irregular	12.09.21	17.05.23	B734	Example Dates in 2022: 09.01., 10.01., 19.01., 23.01., 24.01., 09.02., 17.02., 14.03., 20.03., 27.05., 12.06., 11.07., 25.07., 14.08., 23.08., 25.09., 29.10., 31.10., 25.11., 13.12., 28.12.22
DFLD		07.09.23	BCS	6823		LEMD	EDDP	no data	09:45	123456	30.10.17	20.10.18	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6823		LEMD	EDDP	no data	09:45	1234567	21.10.18	30.12.21	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
FR24	SPIRE	07.09.23	BCS	6823		LEMD	EDDP	06:35	09:20	1234567	03.01.22	11.03.23	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6824		EDDP	LEMD	11:05	no data	123456	30.10.17	20.10.18	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6824		EDDP	LEMD	11:05	no data	1234567	21.10.18	30.12.21	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
FR24		07.09.23	BCS	6824	BCS38F	EDDP	LEMD	11:05	13:50	1234567	03.01.22	27.10.22	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven. FR24-data incomplete, due to alphanumeric callsign, flights can be found via aircraft-registration. No SPIRE data on this callsign available.
DFLD		07.09.23	BCS	6891		EGNX	EDDP	no data	09:45	123456	15.05.17	20.10.18	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6891		EGNX	EDDP	no data	09:45	1234567	21.10.18	30.12.21	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
FR24	SPIRE	15.08.23	BCS	6891		EGNX	EDDP	06:15	08:50	1234567	03.01.22	15.04.22	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6892		EDDP	EGNX	11:40	no data	123456	15.05.17	20.10.18	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
DFLD		07.09.23	BCS	6892		EDDP	EGNX	11:40	no data	1234567	21.10.18	30.12.21	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.
FR24	SPIRE	15.08.23	BCS	6892		EDDP	EGNX	11:40	12:30	1234567	03.01.22	26.03.22	B752	Not included in the analysis, as operation for Amazon by EAT can not be proven.

Figure 22: Schedule of Amazon Air in Europe from 09/2020 until 12/2023. Part 7/7.

ABR2001	ABR2112	ABR2201	ABR2300	ABR2401	ABR707P
ABR2070	ABR2130	ABR2202	ABR2301	ABR2402	ABR734P
		ABR2203	ABR2302	ABR2403	ABR735P
		ABR2204	ABR2303	ABR2411	ABR736P
		ABR2205	ABR2304	ABR2412	ABR737P
		ABR2206	ABR2305	ABR2441	ABR770P
		ABR2207	ABR2306	ABR2443	ABR771P
		ABR2208	ABR2307		ABR772P
		ABR2209	ABR2308		
		ABR2210	ABR2309		
		ABR2211	ABR2310		
		ABR2212	ABR2311		
		ABR2213	ABR2312		
		ABR2214	ABR2313		
		ABR2216	ABR2314		
		ABR2217	ABR2316		
		ABR2220	ABR2319		
		ABR2221	ABR2320		
		ABR2223	ABR2321		
		ABR2224	ABR2323		
		ABR2226	ABR2324		
		ABR2227	ABR2325		
		ABR2230	ABR2327		
		ABR2231	ABR2328		
		ABR2240	ABR2329		
		ABR2255	ABR2330		
		ABR2258	ABR2331		
		ABR2273	ABR2349		
		ABR2297	ABR2350		
			ABR2355		
			ABR2366		
			ABR2382		
			ABR2392		
			ABR2393		
			ABR2395		
			ABR2397		

Figure 23: List of callsigns excluded from the analysis.

DATE	# of FLIGHTS	HOLIDAY
01.01.22	0	New Year's Day
02.01.22	4	
06.01.22	20	Revelation
07.01.22	14	
14.04.22	21	
15.04.22	11	
16.04.22	10	
17.04.22	3	Easter
18.04.22	3	Easter
01.05.22	18	Labour Day
02.05.22	21	
26.05.22	18	Ascension
04.06.22	24	
05.06.22	12	Pentecost
06.06.22	16	
15.08.22	6	Assumption of Mary
16.08.22	8	
01.10.22	15	
02.10.22	11	German Unity Day
03.10.22	15	
21.10.22	13	
30.10.22	22	
31.10.22	25	Reformation Day (Germany, Slovenia)
01.11.22	11	All Saints' Day
02.11.22	25	
06.12.22	23	Constitution Day (Spain)
24.12.22	0	Christmas holidays
25.12.22	0	Christmas holidays
26.12.22	0	Christmas holidays
27.12.22	1	
31.12.22	1	New Year's Eve
	LEGEND	
	0 - 6 (1/6 of 39 or less)	
	13 - 7 (1/3 of 39 or less)	
	26 - 13 (2/3 of 39 or less)	

Figure 24: Reduced flight operation of Amazon Air in Europe during holidays in 2022.

EUROPE								
NETWORK	Sep 20	Mar 21	Sep 21	Mar 22	Sep 22	Mar 23	Sep 23	Dec 23
av. number of daily flights	33,0	36,0	36,4	39,4	27,9	29,0	16,9	15,1
daily takeoffs & landings / airport								
growth rates, compared to previous period	no data	9%	1%	8%	-29%	4%	-42%	-10%
Leipzig/Halle, Germany (LEJ)	4,0	14,0	16,0	16,0	12,0	14,0	8,6	1,7
Hanover, Germany (HAJ)	2,0	2,0	6,0	6,0	4,0	4,0	3,4	5,1
Cologne/Bonn, Germany (CGN)	10,0	8,0	6,6	8,0	2,0			
Liege, Belgium (LGG)					2,0	4,0	2,0	3,7
Milano, Italy (MXP)	6,0	12,0	9,0	10,3	10,0	10,0	5,4	5,4
Rome, Italy (FCO)	4,0	6,0	6,0	6,0	6,0	6,0	3,4	3,4
Catania, Italy (CTA)		2,0	0,4	0,1				
Cagliari, Italy (CAG)		2,0						
East Midlands, Great Britain (EMA)	10,0	4,0	4,0	6,0	2,0	2,0	1,7	1,7
London Southend, Great Britain (SEN)	8,0	4,0	4,0	2,0				
Madrid, Spain (MAD)	12,0	6,0	6,4	8,0	6,9	8,0	1,7	1,7
Barcelona, Spain (BCN)	4,0	4,0	4,0	6,0	4,0	4,0	3,4	3,4
Paris Charles de Gaulle, France (CDG)	4,0	6,0	6,0	6,3	6,0	6,0	1,7	1,7
Katowice, Poland (KTW)	2,0	2,0	4,4	4,1			2,0	2,0
Linz, Austria (LNZ)					0,9			
Larnaca, Cyprus (LCA)							0,3	0,3
day vs. night flights								
day (6 a.m. – 9:59 p.m.)	19,0	23,0	25,0	27,3	23,9	25,0	15,0	12,4
night (10 p.m. - 5:59 a.m.)	14,0	13,0	11,4	12,1	4,0	4,0	1,9	2,7
percentage of day flights	58%	64%	69%	69%	86%	86%	89%	82%
service area								
# of served airports	11	13	12	12	11	9	11	11
served population in 100nm	209.662.783	216.909.108	215.372.023	215.372.023	208.355.538	187.348.456	206.947.317	206.947.317
percentage of total population*	39%	40%	40%	40%	38%	35%	38%	38%
served population in 300nm	461.980.914	464.105.923	464.105.923	464.105.923	446.662.743	428.240.502	462.963.726	462.963.726
percentage of total population*	85%	86%	86%	86%	82%	79%	85%	85%
FLEET	Sep 20	Mar 21	Sep 21	Mar 22	Sep 22	Mar 23	Sep 23	Dec 23
planes in operation								
total # of planes	9	10	12	12	10	10	8	8
# of branded planes (B738)	0	2	2	6	7	9	8	8
# of "whitetails" (B734)	9	8	10	6	3	1	0	0
percentage of branded planes	0%	20%	17%	50%	70%	90%	100%	100%
growth rates, compared to previous period	no data	11%	20%	0%	-17%	0%	-20%	0%
utilization								
av # of legs/plane/day	3,7	3,6	3,0	3,3	2,8	2,9	2,1	1,9
capacity								
cubic volume of the fleet (in ft³)	41.148	49.656	58.800	66.672	59.496	63.432	52.320	52.320
growth rates, compared to previous period	no data	21%	18%	13%	-11%	7%	-18%	0%
payload of the fleet (in lbs)	423.900	477.420	571.620	584.460	493.470	499.890	402.480	402.480
growth rates, compared to previous period	no data	13%	20%	2%	-16%	1%	-19%	0%

*The total number of inhabitants considered as europe as of EUROSTAT (ed.), 2021 is 541.946.475.

Figure 25: Analysis of Amazon Air in Europe: Network & Fleet.

UNITED STATES		Sep 18 -						
NETWORK	Aug 19	Apr 20	Aug 20	Feb 21	Aug 21	Mär 22	Sep 22	Feb 23
av. number of daily flights	70,9	84,5	121,6	131,3	150,1	163,7	167,0	171,8
daily takeoffs & landings / airport								
growth rates, compared to previous period	no data	19%	44%	8%	14%	9%	2%	3%
Albuquerque International Sunport (ABQ)	no data					4,8	1,9	2,0
Allentown Lehigh Valley Intl (ABE)	no data	6,0	5,0	4,3		1,4	2,3	4,6
Anchorage Ted Stevens Intl (ANC)	no data	4,0	2,0	2,0	1,8	2,0	2,0	2,0
Atlanta Hartsfield-Jackson Intl (ATL)	no data		2,0	2,5	2,3	3,2	4,0	4,9
Austin-Bergstrom International (AUS)	no data		4,0	4,2	3,7	5,8	6,1	5,9
Baltimore-Washington Marshall Intl (BWI)	no data	6,0	9,0	10,5	19,5	19,2	18,0	14,6
Boise (BOI)	no data							2,0
Charlotte Douglas Intl (CLT)	no data				1,7	5,0	3,7	4,3
Chicago O'Hare International (ORD)	no data		2,7	3,5	7,5	7,2	6,0	4,6
Chicago Rockford International (RFD)	no data	15,0	16,5	15,8	10,2	9,2	11,7	12,0
Cincinnati/Northern Kentucky Intl (CVG)	no data	24,0	25,7	27,8	21,5	25,6	43,9	57,7
Denver International (DEN)	no data	4,0	3,7	4,2	1,0	2,2	3,9	6,0
Des Moines International (DSM)	no data					1,6	2,0	1,9
El Paso (ELP)	no data						1,7	
Fairbanks Intl (FAI)	no data				2,0	1,8	1,7	1,7
Fort Worth Alliance (AFW)	no data	8,0	16,7	17,2	26,3	36,6	29,9	34,1
Honolulu Daniel K. Inouye Intl (HNL)	no data	4,0	4,3	3,8	5,2	5,6	3,1	4,0
Houston G. Bush Intercontinental (IAH)	no data	9,0	10,2	10,0	7,3	3,2	3,6	3,3
Kahului (OGG)	no data	2,0	2,2	1,8	2,2	2,0	1,7	2,0
Kailua-Kona/Kona International (KOA)	no data		1,7	2,0	2,5	2,0	1,7	2,0
Kansas City International (MCI)	no data				3,7	2,2	6,1	4,9
Lakeland Linder International (LAL)	no data		11,5	11,5	21,2	16,2	17,9	20,3
Las Vegas (LAS)	no data						2,6	4,0
Liuhue (LI H)	no data						2,0	2,0
Los Angeles International (LAX)	no data			2,0	3,8	6,0	3,7	2,0
Manchester-Boston Regional (MHT)	no data							3,3
Miami International (MIA)	no data	6,0	7,3	6,7	5,7	6,8	8,1	4,7
Minneapolis-Saint Paul International (MSP)	no data	2,0	3,7	2,0	6,3	6,0	4,4	6,0
Mobile Regional Airport (BFM)	no data							1,9
Nashville International (BNA)	no data					3,8	4,0	2,0
New Orleans, Louis Armstrong Intl (MSY)	no data			2,0	2,0	2,0	2,0	2,0
New York John F. Kennedy Intl (JFK)	no data		8,0	8,8	10,0	8,2	4,0	6,0
Omaha Ebbey (OMA)	no data					2,4	2,0	1,4
Ontario International (ONT)	no data	13,0	21,5	20,5	12,8	12,0	12,4	9,3
Phoenix Sky Harbor International (PHX)	no data	4,0	6,5	9,5	9,5	6,2	4,0	4,0
Pittsburgh International (PIT)	no data				3,8	6,2	2,0	2,0
Portland International (PDX)	no data	6,0	8,2	10,5	15,3	13,8	12,4	9,3
Richmond International (RIC)	no data		5,0	4,0	3,7	2,0	3,7	5,9
Riverside March Air Reserve Base (RIV)	no data	4,0	5,7	6,5	9,3	9,2	5,4	4,1
Sacramento International (SMF)	no data	4,0	6,2	4,5	6,0	2,0	2,0	0,6
San Antonio/Kelly Field (SKF)	no data	2,0	3,2	2,0	2,0	2,0	4,1	1,7
San Bernardino International (SBD)	no data				8,0	11,0	10,3	17,1
San Francisco International (SFO)	no data	2,0	2,8	7,0	4,0	3,8	5,7	4,3
San Jose (Mineta) International (SJO)	no data							2,9
San Juan Luis Muoz Marin Intl (SJO)	no data		2,7	2,0	2,0	1,8	1,7	0,1
Seattle-Tacoma International (SEA)	no data	9,0	9,3	11,2	11,3	16,0	10,3	10,0
Spokane International (GEG)	no data					1,8	2,0	4,0
St. Louis Lambert International (STL)	no data				3,6	1,8	4,3	1,9
Stockton Metropolitan (SCK)	no data	4,0	4,0	6,2	5,3	4,8	4,0	4,0
Tampa International (TPA)	no data	16,0	11,3	13,2	7,7	6,0	8,1	4,7
Toledo Express (TOL)	no data				3,7	4,0	4,0	4,0
Wichita (Eisenhower National) (ICT)	no data					1,2	1,4	4,0
Wilmington Air Park (ILN)	no data	13,0	13,7	14,8	20,5	24,2	20,4	15,3
Windsor Locks Bradley (Hartford) (BDL)	no data	2,0	6,8	8,0	4,2	5,6	10,0	4,3
day vs. night flights								
percentage of day flights	no data	no data	72,6%	69,4%	79,4%	73,3%	67,0%	69,0%
service area								
# of served airports	28	24	32	34	40	47	50	53
served population in 100nm	no data	54,0%	58,9%	60,1%	70,2%	72,5%	73,4%	75,0%

Figure 26: Analysis of Amazon Air in the USA: Network.

UNITED STATES FLEET												
	Sep 16	Sep 17	Sep 18	Sep 19	Apr 20	Aug 20	Feb 21	Aug 21	Mär 22	Sep 22	Feb 23	Dez 23
planes in fleet												
# of branded planes (AT75)	0	0	0	0	0	0	0	0	0	5	0	0
# of branded planes (B738)	0	0	0	0	0	9	12	12	20	20	20	20
# of branded planes (B763)	1	14	22	28	33	35	38	47	51	53	54	57
# of branded planes (A333)	0	0	0	0	0	0	0	0	0	0	0	1
total # of planes	1	14	22	28	33	44	50	59	76	78	74	78
growth rates, compared to previous period		1300%	57%	27%	18%	33%	14%	18%	29%	3%	-5%	1%
utilization												
av # of legs/plane*/day	no data	no data	no data	2,7	2,7	2,9	2,8	2,7	2,3	2,3	2,4	no data
capacity												
cubic volume of the fleet (in ft³)	15.469	216.566	340.318	433.132	510.477	600.275	666.302	805.523	932.964	963.902	966.126	1.013.556
growth rates, compared to previous period	no data	1300%	57%	27%	18%	18%	11%	21%	16%	3%	0%	5%
payload of the fleet (in lbs)	116.200	1.626.800	2.556.400	3.253.600	3.834.600	4.519.790	5.019.320	6.065.120	7.022.900	7.255.300	7.281.000	7.850.087
growth rates, compared to previous period	no data	1300%	57%	27%	18%	18%	11%	21%	16%	3%	0%	5%
*95% of the total fleet are considered being "active" for calculating the utilization.												

Figure 27: Analysis of Amazon Air in the USA: Fleet.

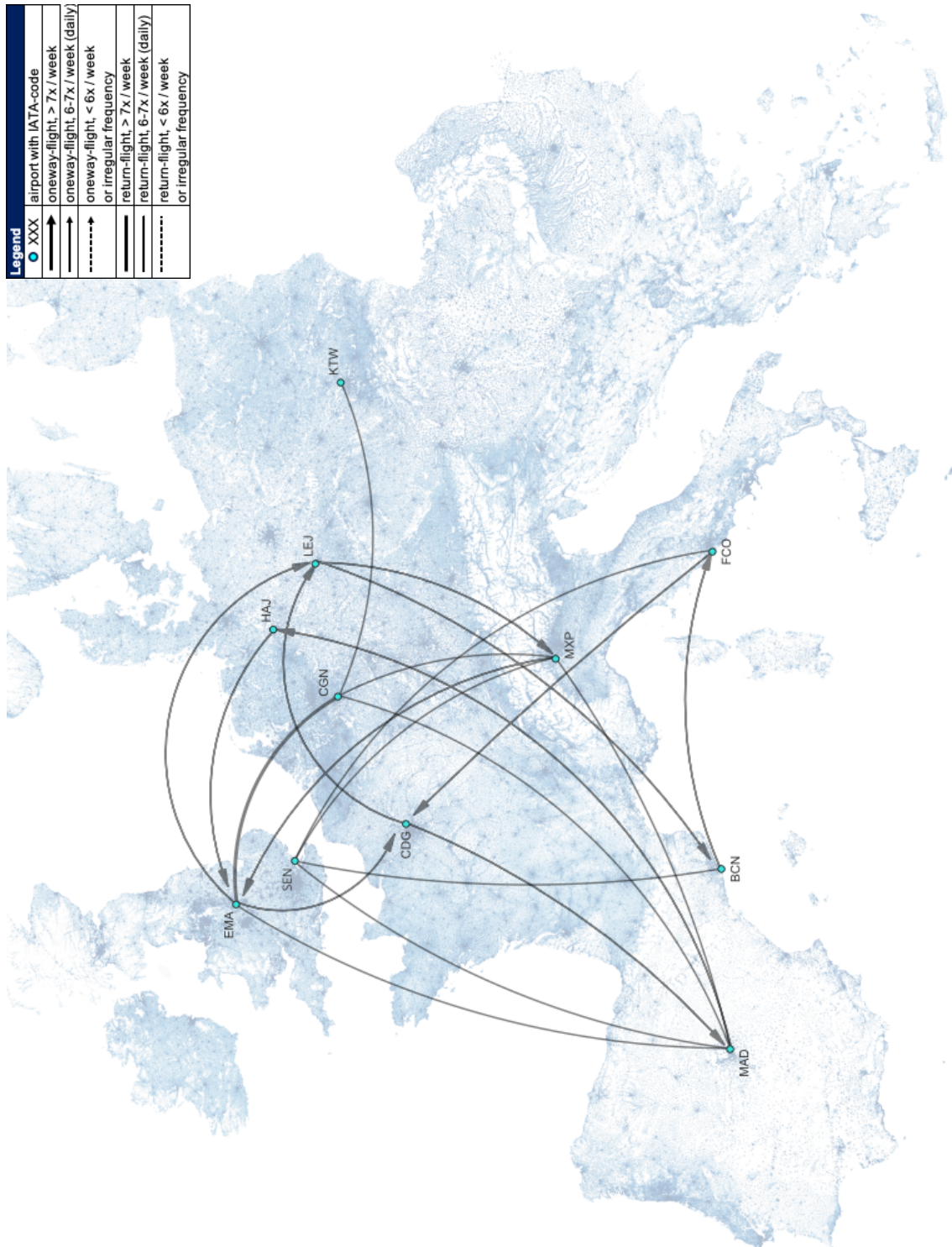


Figure 28: Routes of Amazon Air in Europe in 09/2020.

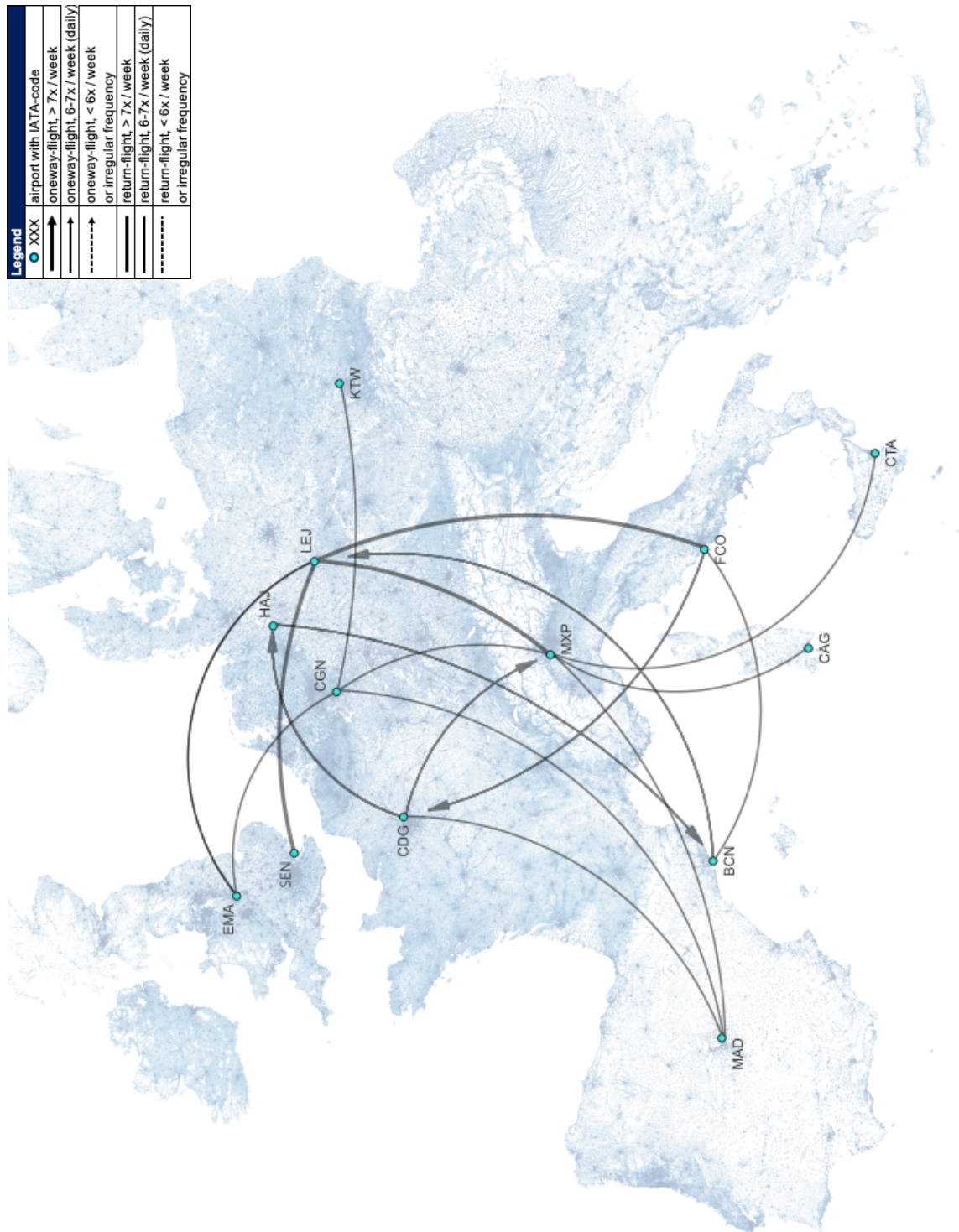


Figure 29: Routes of Amazon Air in Europe in 03/2021.

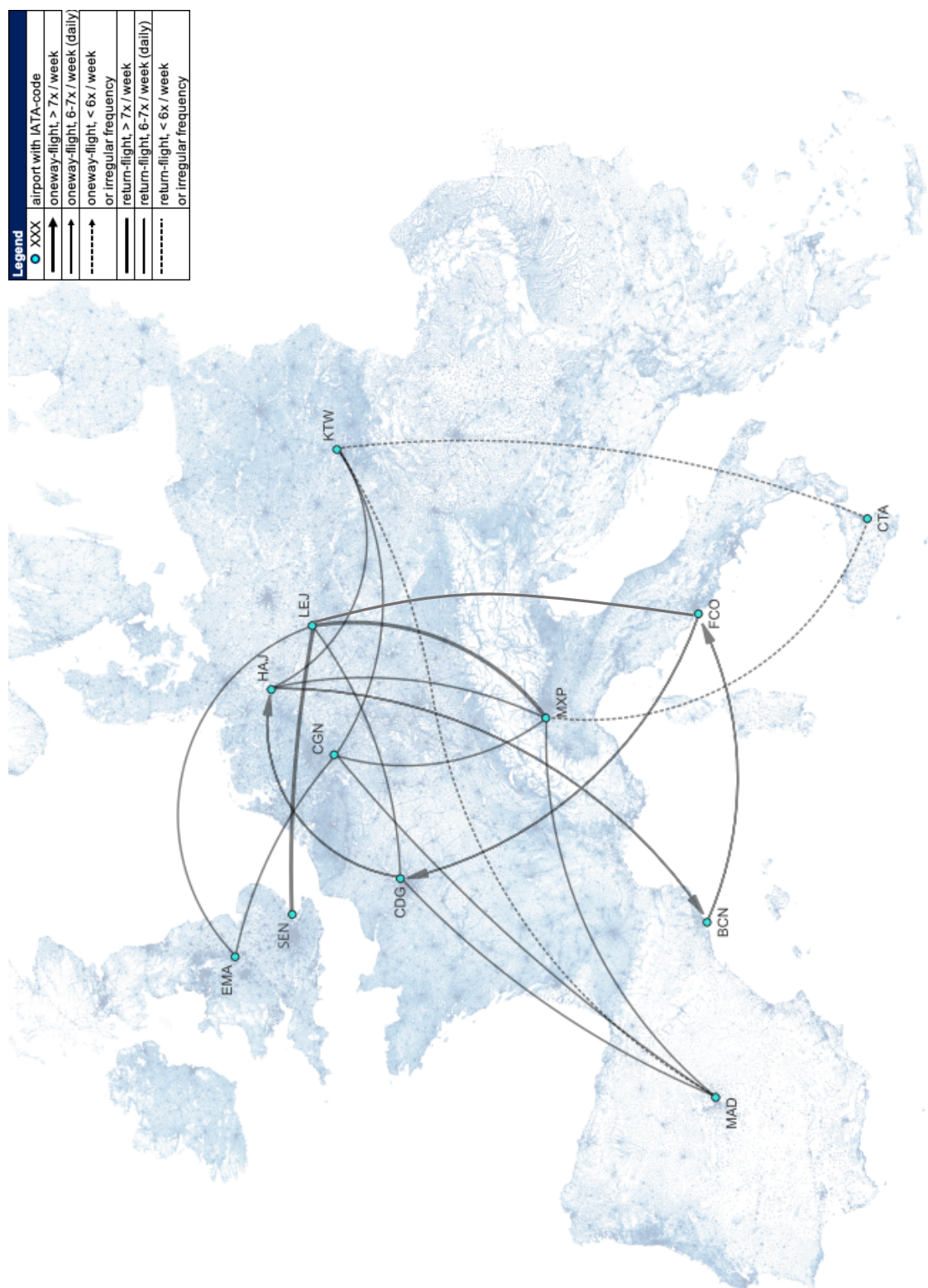


Figure 30: Routes of Amazon Air in Europe in 09/2021.

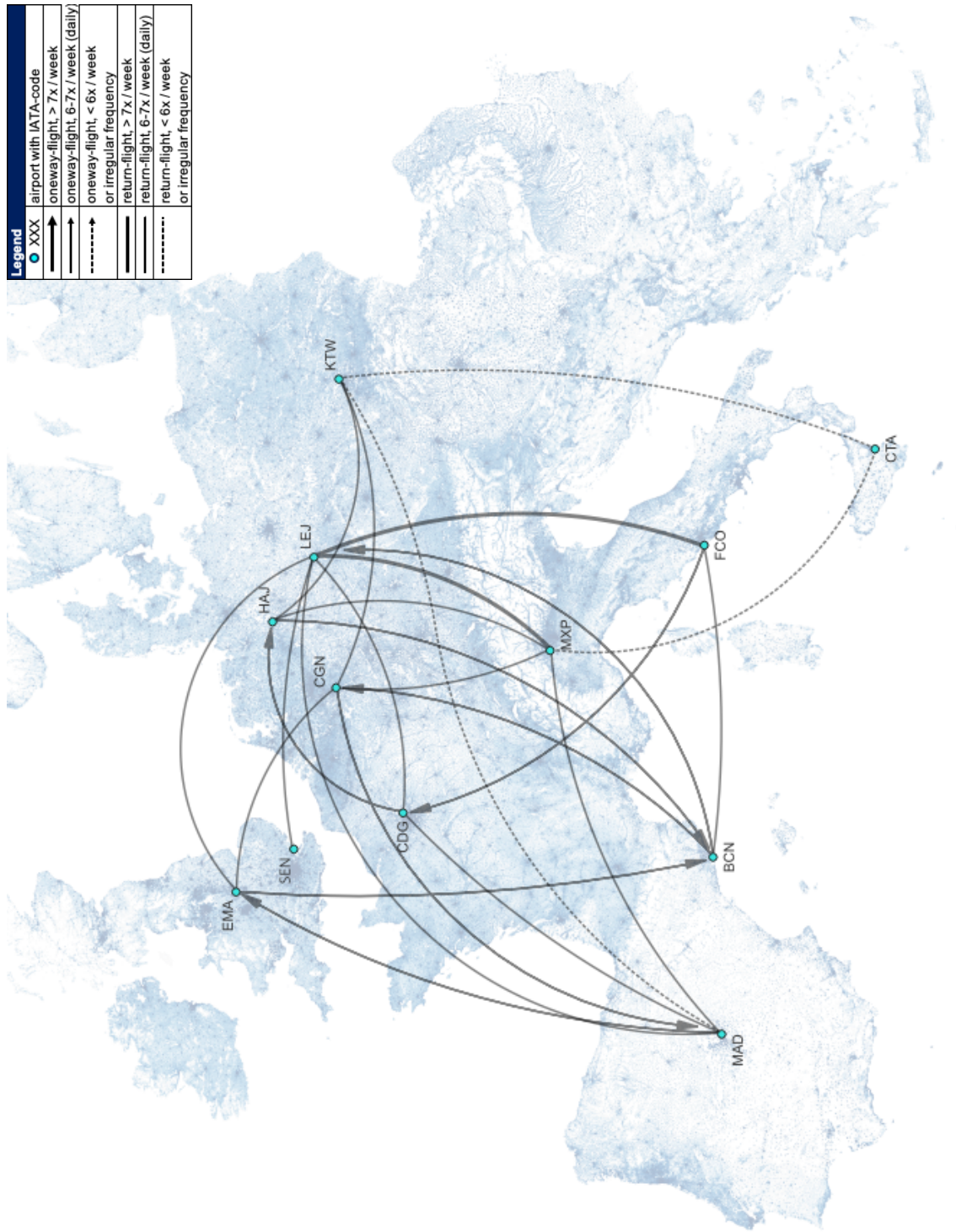


Figure 31: Routes of Amazon Air in Europe in 03/2022.

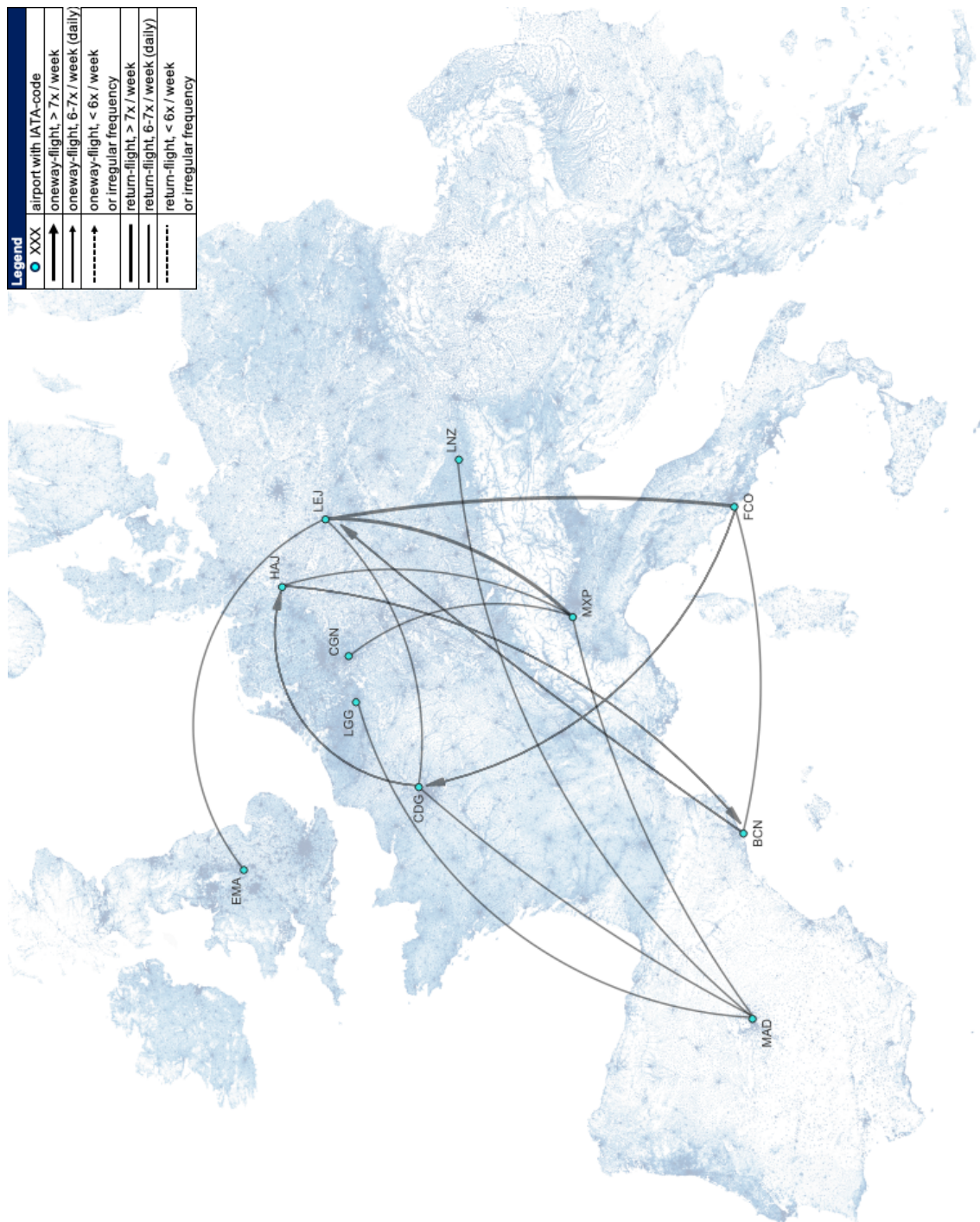


Figure 32: Routes of Amazon Air in Europe in 09/2022.

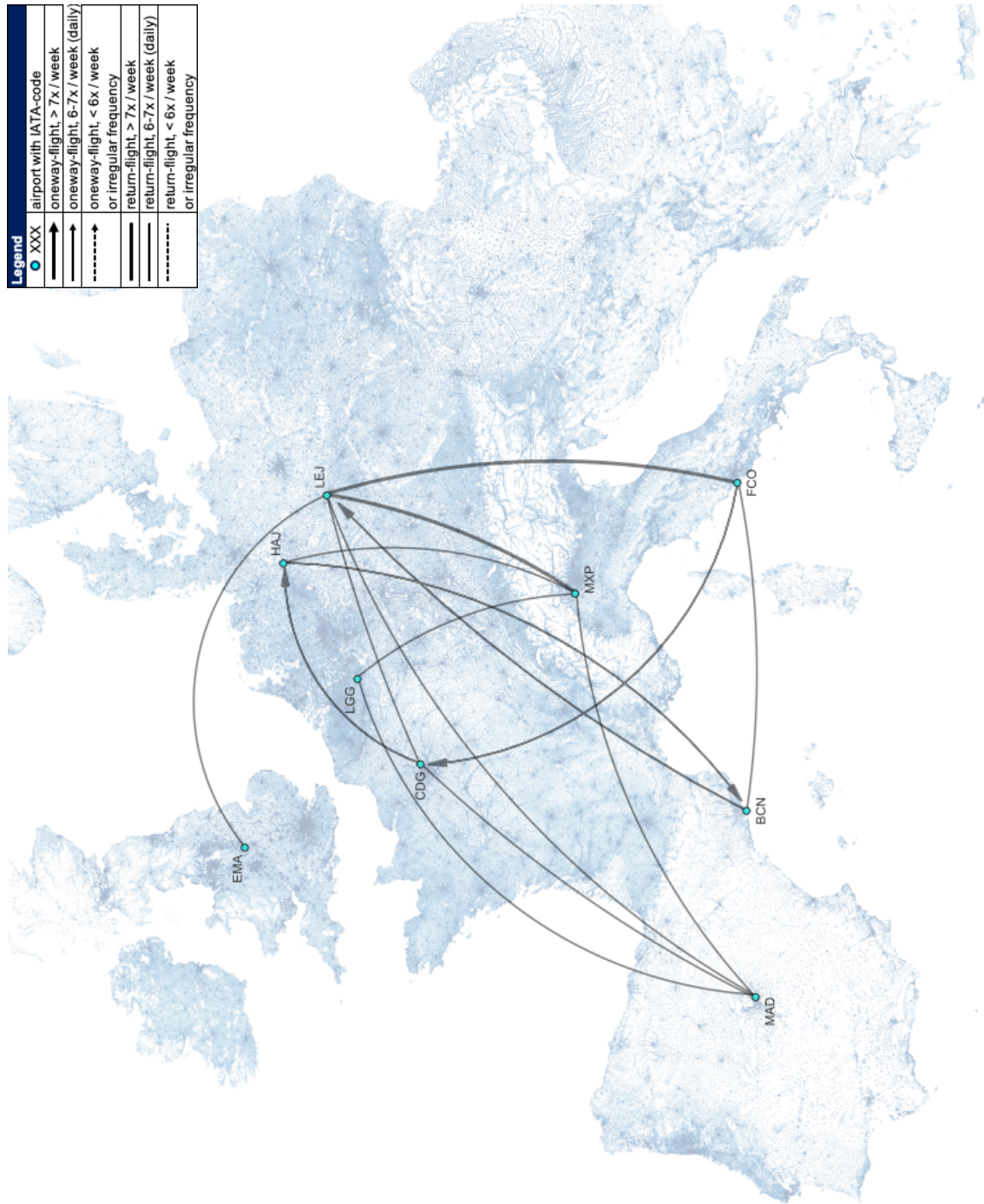


Figure 33: Routes of Amazon Air in Europe in 03/2023.

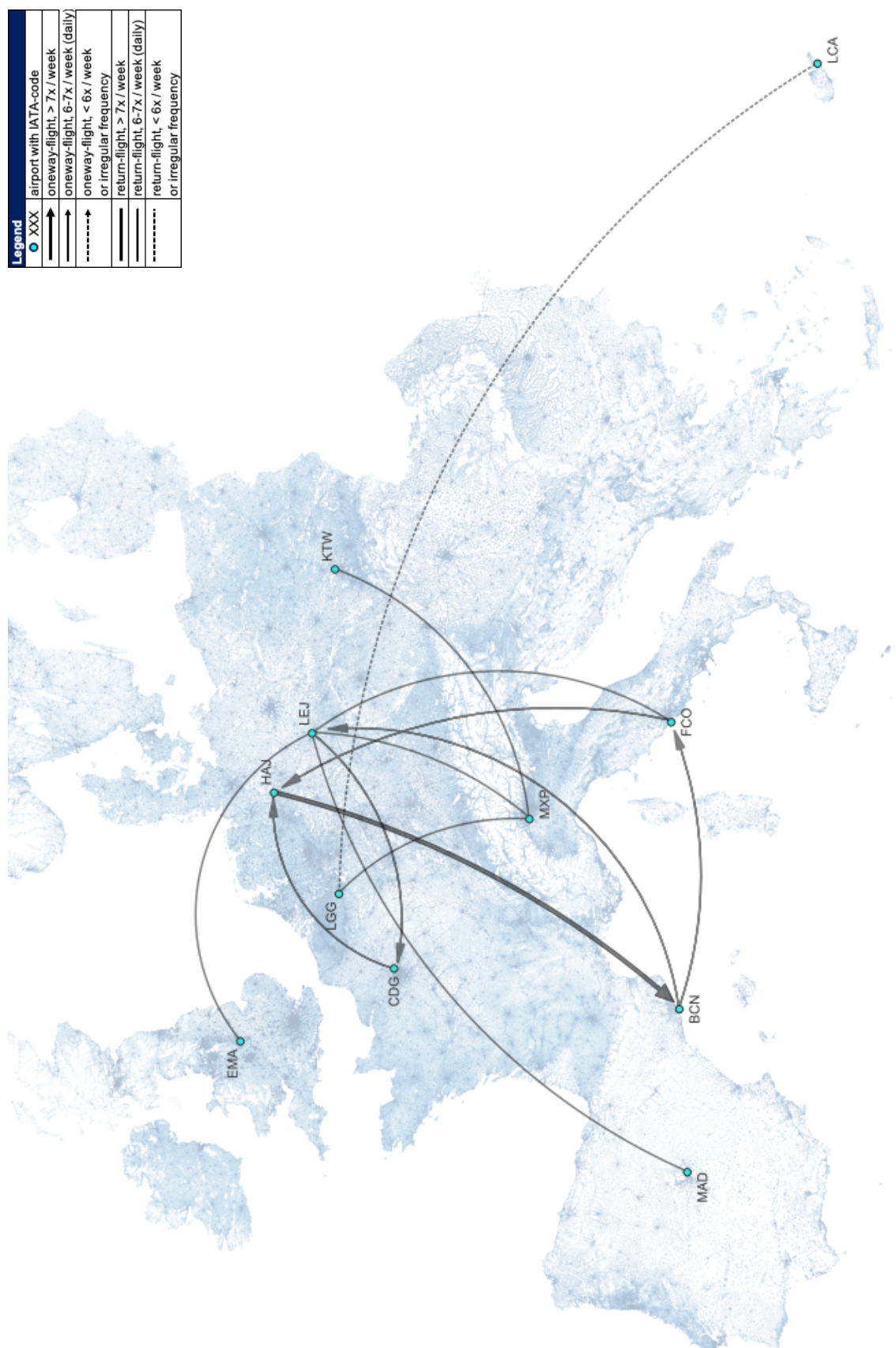


Figure 34: Routes of Amazon Air in Europe in 09/2023.



Figure 35: Routes of Amazon Air in Europe in 12/2023.

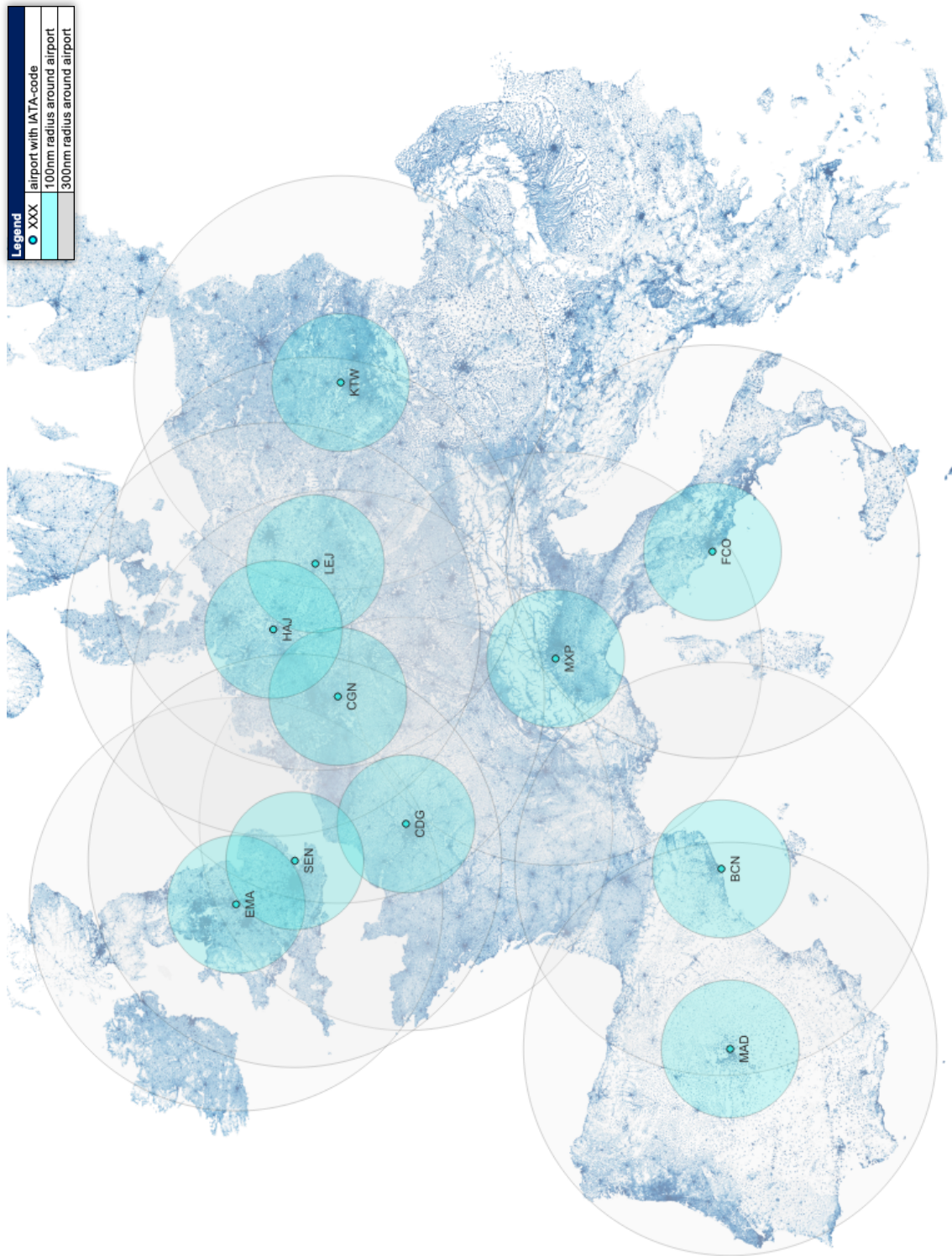


Figure 36: Service Area of Amazon Air in Europe in 09/2020.

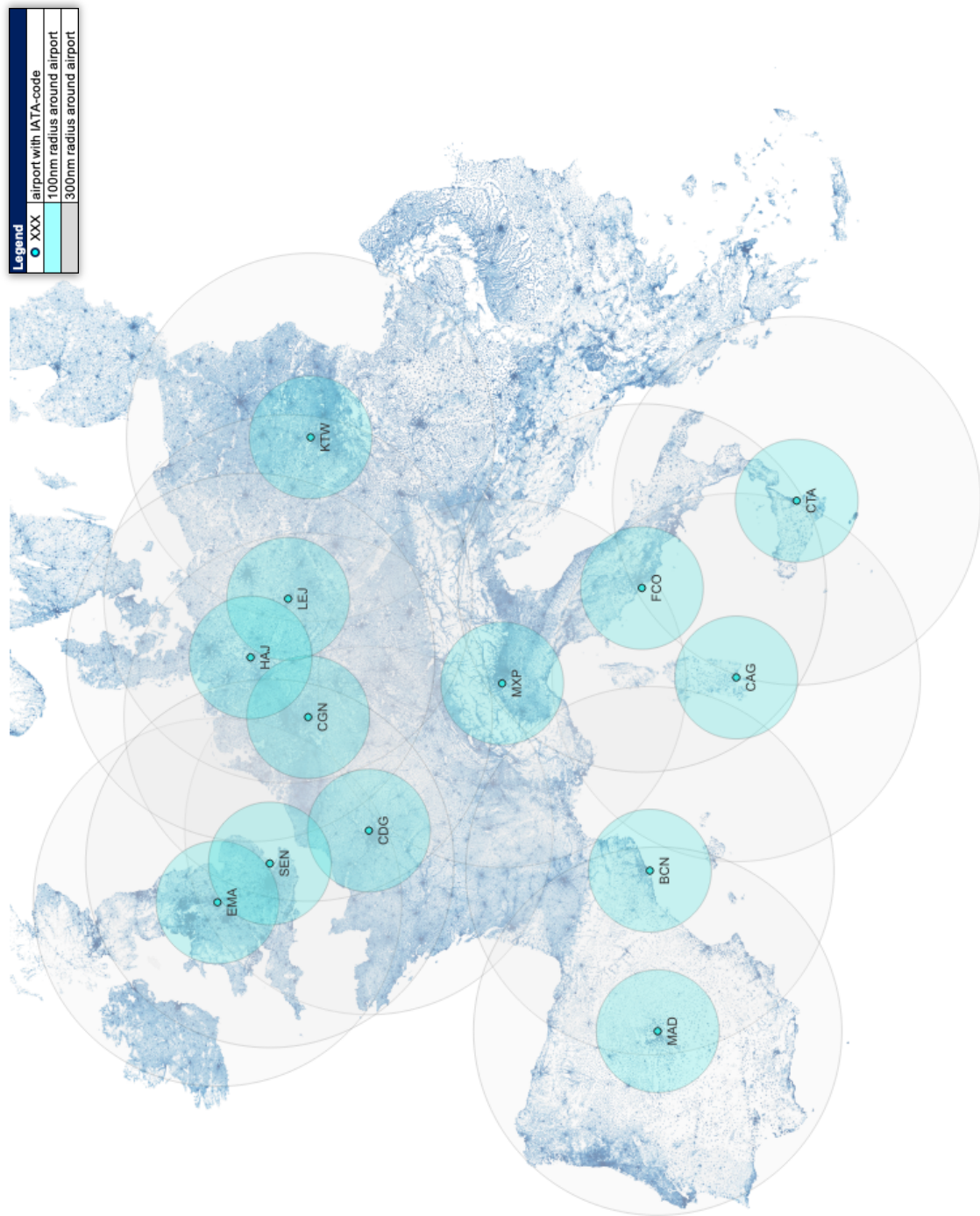


Figure 37: Service Area of Amazon Air in Europe in 03/2021.

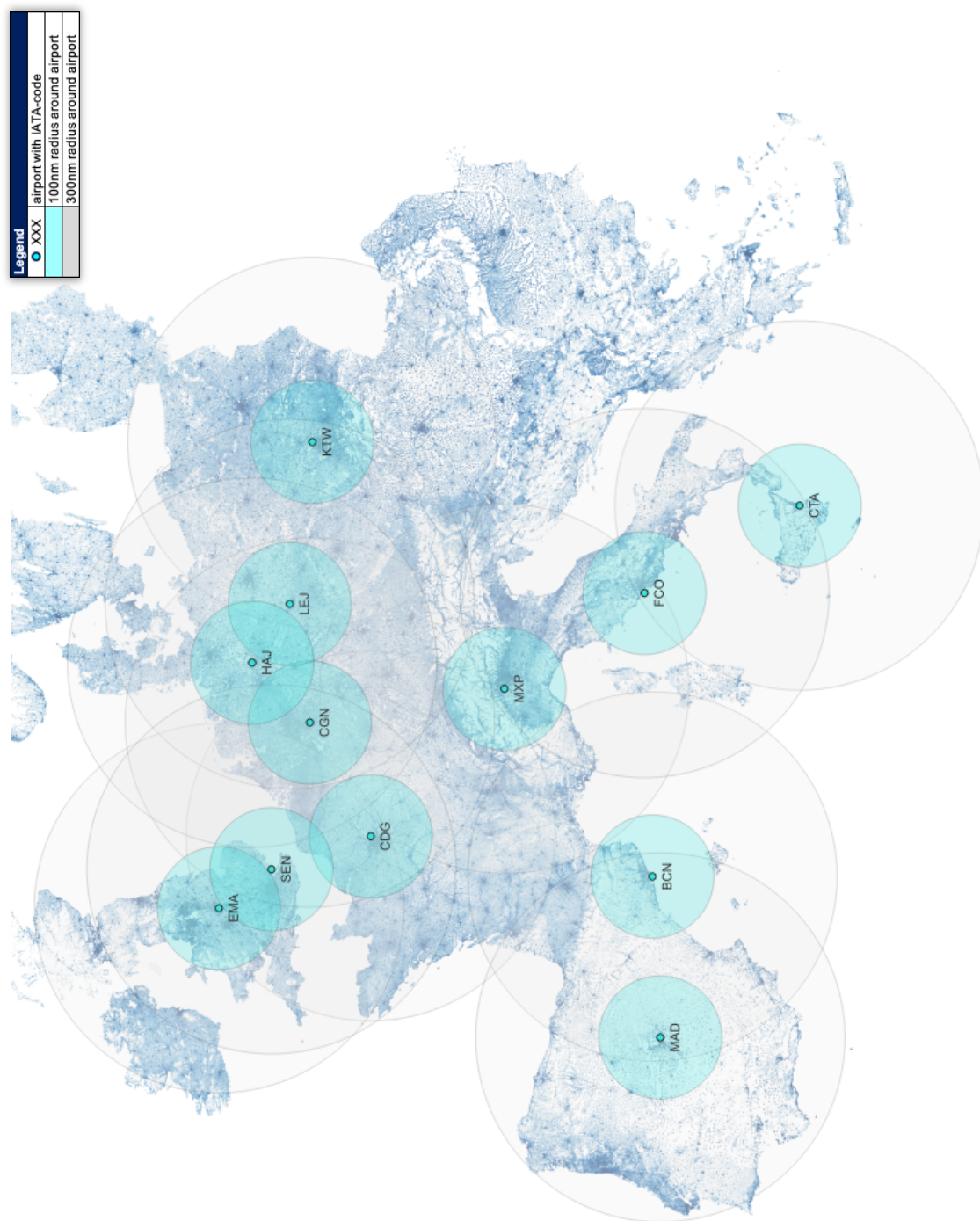


Figure 38: Service Area of Amazon Air in Europe in 09/2021 and 03/2022.

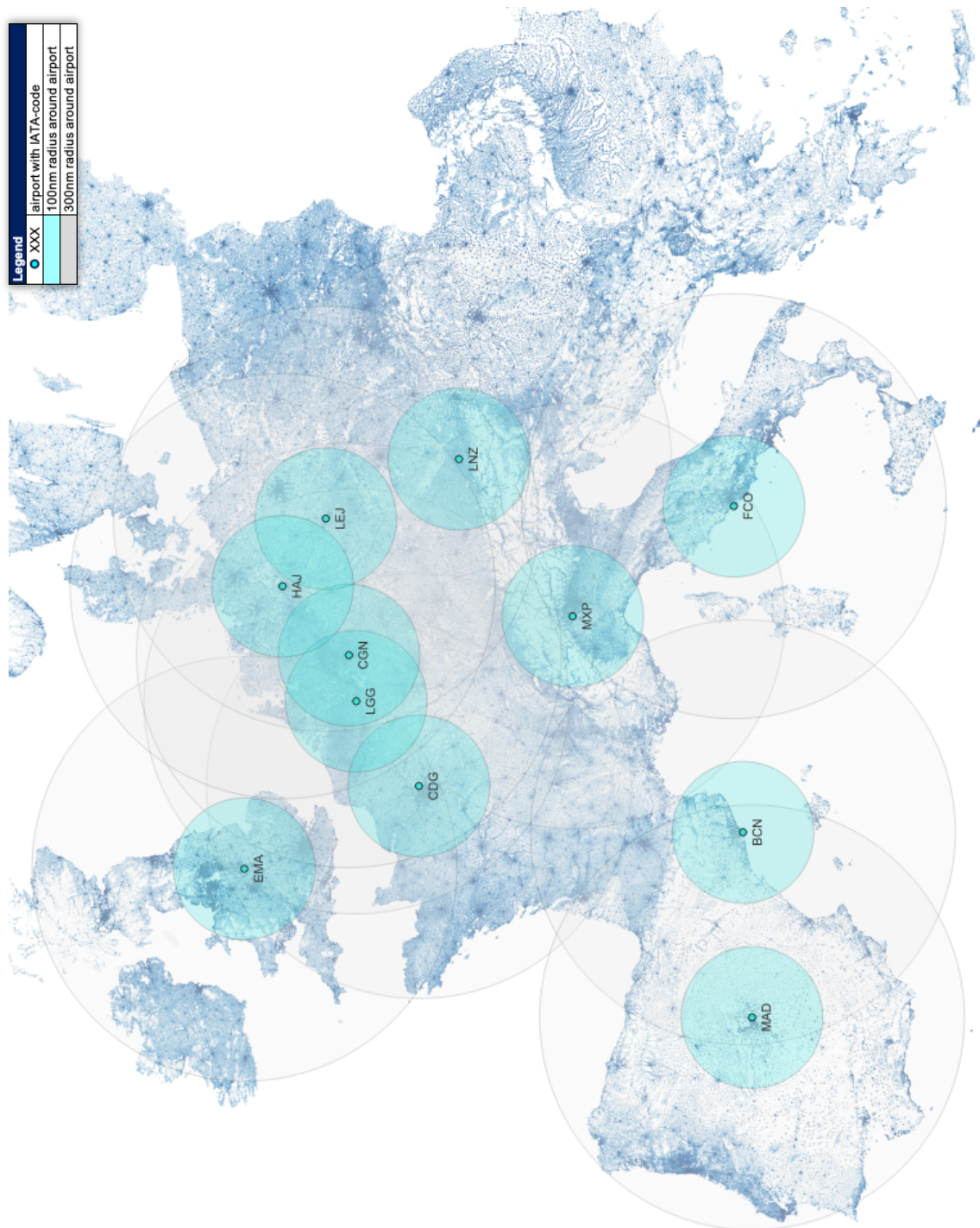


Figure 39. Service Area of Amazon Air in Europe in 09/2022.

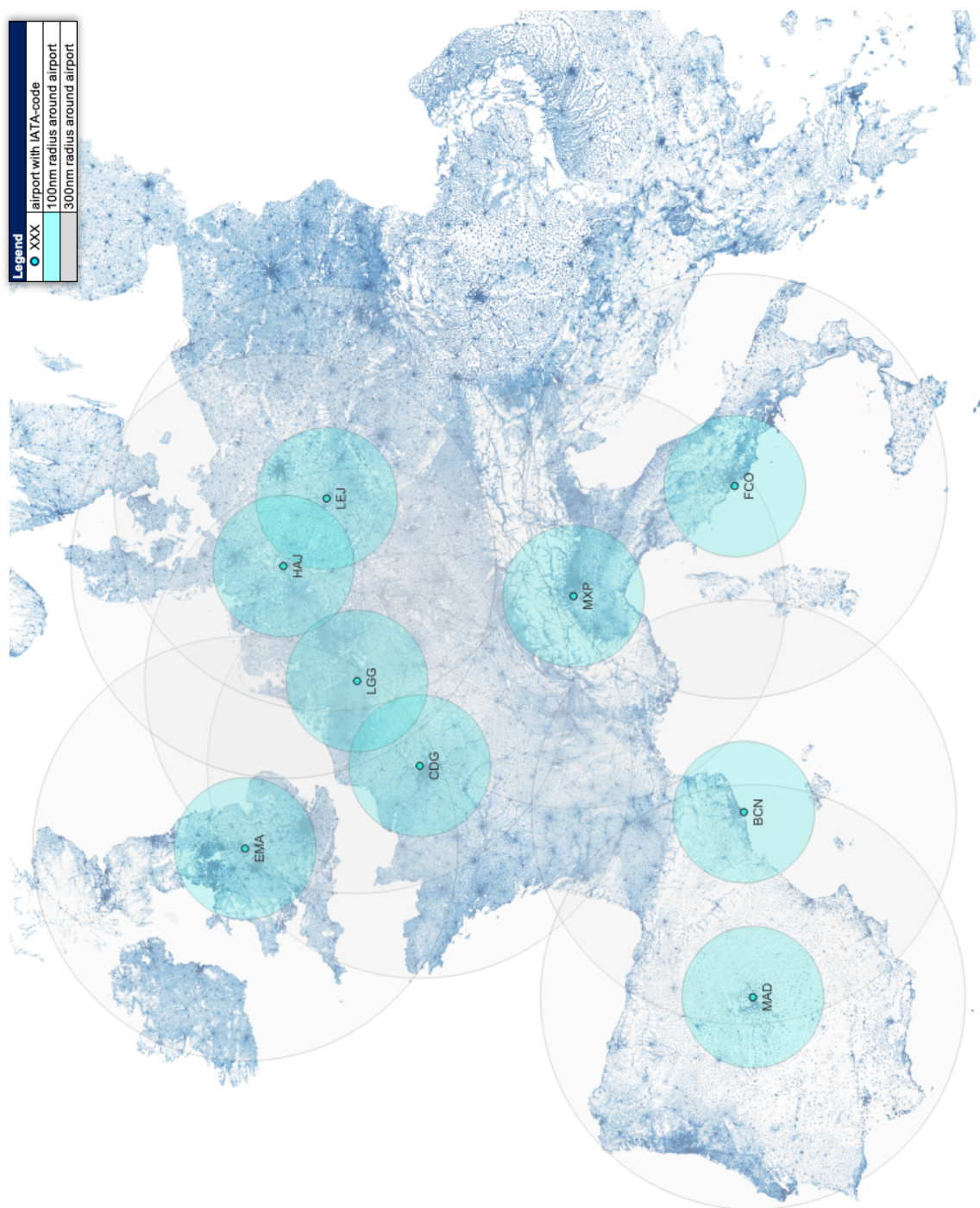


Figure 40: Service Area of Amazon Air in Europe in 03/2023.

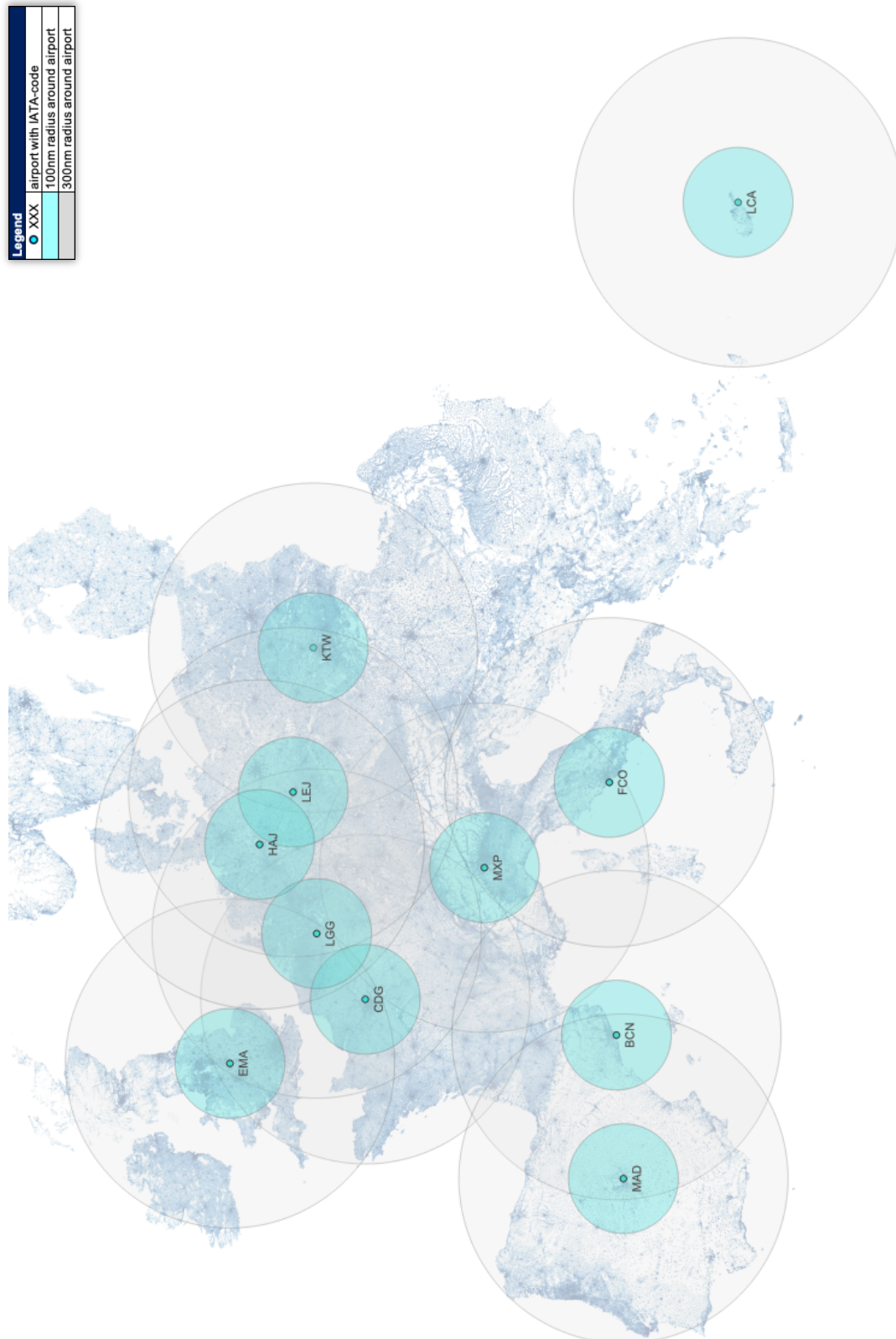


Figure 41: Service Area of Amazon Air in Europe in 09/2023 and 12/2023.

UPDATED	REG	TYPE	OPR	1st AMZ leg	last AMZ leg	Also operating for...
11.09.23	D-ACW	Boeing 737-48E(SF)	B734 CargoLogic Germany	Sep 20	17.09.20	GCL
11.09.23	D-ACLG	Boeing 737-46J(SF)	B734 CargoLogic Germany	Sep 20	25.10.20	GCL
11.09.23	D-ACLO	Boeing 737-4H6(SF)	B734 CargoLogic Germany	Sep 20	15.11.20	GCL
11.09.23	G-POWP	Boeing 737-436(SF)	B734 Titan Airways	Sep 20	03.09.21	NPT/AWC
11.09.23	G-POWS	Boeing 737-436(SF)	B734 Titan Airways	Sep 20	30.09.21	NPT/AWC
11.09.23	F-GZTT	Boeing 737-48E(SF)	B734 ASL France	Okt 20	05.07.21	FPO
11.09.23	F-GZTJ	Boeing 737-4S3(SF)	B734 ASL France	Nov 20	15.10.21	FPO/TAY
11.09.23	F-GIXU	Boeing 737-4Y0(SF)	B734 ASL France	Jan 21	26.10.21	FPO/TAY
11.09.23	F-GIXN	Boeing 737-4Y0(SF)	B734 ASL France	Sep 20	14.11.21	FPO/TAY/FDX
11.09.23	F-GZTI	Boeing 737-408(SF)	B734 ASL France	Okt 20	25.11.21	FPO/TAY/MSA/FDX
11.09.23	F-GZTK	Boeing 737-4Q8(SF)	B734 ASL France	Dez 20	06.12.21	FPO/MSA/TAY
11.09.23	F-GZTX	Boeing 737-4Y0(SF)	B734 ASL France	Sep 20	12.12.21	FPO/TAY/AFR
17.12.23	EI-STO	Boeing 737-43Q(SF)	B734 ASL Ireland	Sep 20	16.09.21	BCS
17.12.23	EI-STJ	Boeing 737-490(SF)	B734 ASL Ireland	Sep 20	28.07.22	BCS
17.12.23	EI-STK	Boeing 737-448(SF)	B734 ASL Ireland	Sep 20	28.10.22	MSA/TAY/BCS
17.12.23	EI-STS	Boeing 737-48E(SF)	B734 ASL Ireland	Sep 20	30.12.22	BCS
17.12.23	EI-STN	Boeing 737-4Q8(SF)	B734 ASL Ireland	Sep 20	16.06.23	NPT/TAY/BCS
17.12.23	EI-STC	Boeing 737-476(SF)	B734 ASL Ireland	Sep 20	21.07.23	NPT/BCS/ABR/SWN
17.12.23	EI-STL	Boeing 737-42C(SF)	B734 ASL Ireland	Sep 20	31.07.23	only AMZ
17.12.23	EI-STW	Boeing 737-4M0(SF)	B734 ASL Ireland	Jan 21	14.08.23	BCS/SWN
17.12.23	EI-STP	Boeing 737-4Q8(SF)	B734 ASL Ireland	Sep 20	25.08.23	BCS
17.12.23	EI-STV	Boeing 737-43Q(SF)	B734 ASL Ireland	Jan 21	05.09.23	TAY/FPO/BCS/NPT
17.12.23	EI-STM	Boeing 737-4Z9(F)	B734 ASL Ireland	Sep 20	29.09.23	MSA/TAY/BCS/FDX
17.12.23	EI-STU	Boeing 737-4M0(SF)	B734 ASL Ireland	Sep 20	30.10.23	BCS/TAY/FDX
17.12.23	EI-STH	Boeing 737-476(SF)	B734 ASL Ireland	26.11.23	11.12.23	BCS
17.12.23	EI-DAC	Boeing 737-8AS(BCF)	B738 ASL Ireland	10.11.20	17.12.23	only AMZ
17.12.23	EI-DAD	Boeing 737-8AS(BCF)	B738 ASL Ireland	27.10.20	17.12.23	only AMZ
17.12.23	EI-AZA	Boeing 737-86N(SF)	B738 ASL Ireland	14.09.21	17.12.23	only AMZ
17.12.23	EI-AZB	Boeing 737-8AS(SF)	B738 ASL Ireland	30.10.21	17.12.23	only AMZ
17.12.23	EI-AZC	Boeing 737-86J(SF)	B738 ASL Ireland	26.11.21	17.12.23	only AMZ
17.12.23	EI-AZD	Boeing 737-86Q(SF)	B738 ASL Ireland	13.12.21	17.12.23	only AMZ
17.12.23	EI-AZE	Boeing 737-86Q(SF)	B738 ASL Ireland	16.06.22	17.12.23	only AMZ
17.12.23	EI-AZF	Boeing 737-84P(SF)	B738 ASL Ireland	27.08.22	17.12.23	only AMZ
17.12.23	EI-AZG	Boeing 737-86Q(SF)	B738 ASL Ireland	22.10.22	17.12.23	only AMZ

Figure 42: Fleet operating for Amazon Air in Europe from 09/2020 until 12/2023.

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Eidesstattliche Erklärung

Hiermit versichere ich, dass ich die vorliegende Arbeit selbstständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten und nicht veröffentlichten Schriften entnommen sind, sind als solche kenntlich gemacht. Die Arbeit hat in gleicher Form noch keiner anderen Prüfbehörde vorgelegen.

Frankfurt am Main, den 17.01.2024

Unterschrift

Statutory declaration

I herewith declare that I have completed the present report independently, without making use of other than the specified literature and aids. All parts that were taken from published and non-published texts either verbally or in substance are clearly marked as such. This report has not been presented to any examination office in the same form.

Frankfurt am Main, dated 17.01.2024

Signature