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“Parcel locker stations: The future of e-commerce delivery?”

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Diverging trends in letter and parcel volumes (including small packages containing merchandise) are driving the transformation of national postal operators into more parcel-oriented services. Some national postal operators have distanced themselves from the daily delivery of letters to all households by switching to alternate-day (or even less frequent) delivery models. In contrast, quality of parcel delivery (particularly B2C) has improved with next-day delivery as the new standard in many countries. The European Regulators Group for Postal Services (ERGP) reported that, since 2015, the total number of parcels have increased from 5.07 billion to 7.15 billion, or by 9.2% p.a. on average, while letter post volume declined by 5.3% p.a. across the ERGP member countries (2015-2019).³ The COVID-19 pandemic and resulting lockdowns have further boosted e-commerce sales as well as the number of online shoppers. Eurostat reports that the share of individuals with online purchases during the last 12 months increased from 60% to 65% between 2019 and 2020 in the European Union (EU-27).⁴ This jump in online purchases resulted in growing B2C parcel volumes for national postal operators as well as parcel and express carriers in 2020.

- Many national postal operators (universal service providers) reported significant increases in parcel volumes: e.g. Deutsche Post DHL (‘DPDHL’) reported a 15% increase in 2020⁵; PostNL’s parcel volume increased by 19%⁶; La Poste (colissimo),⁷ Royal Mail,⁸ and Austrian Post⁹ achieved growth rates between 28% and 30%; PostNord Sweden reported an increase of 23%; and PostNord Denmark had a growth rate of 37%.¹⁰

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³ ERGP (2020b), p. 41.

⁴ Based on Eurostat, until 2019 [isoc_ec_ibuy] and 2020 [ISOC_EC_IB20].

⁵ Deutsche Post DHL (2021), p. 14.

⁶ PostNL (2020) and PostNL (2021).

⁷ CEP Research (2021a).

⁸ Royal Mail Group (2021).

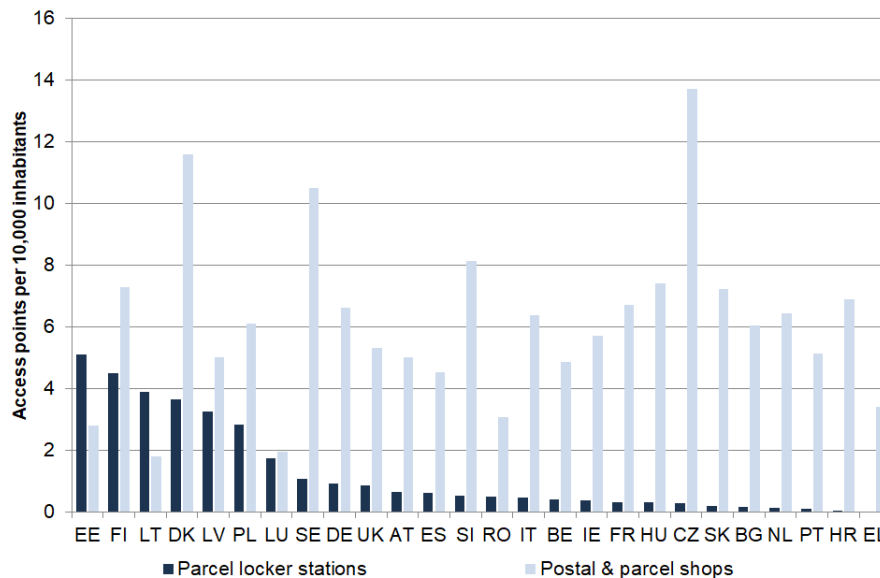
⁹ Austrian Post (2021).

¹⁰ PostNord (2021a), p. 7-8.

- The European parcel carriers DPD and GLS reported significant increases in their parcel volumes: 26% at GLS¹¹ and 24% at DPD; both reported an increase in the share of B2C parcels, GLS to 57% (+12 percentage points compared to the previous period) and DPD to 55% (+10 percentage points).¹²

The effects of the pandemic accelerated expected growth in parcel volumes and the shift to B2C parcel deliveries by several years and revealed significant capacity constraints in the last mile. Expansion in home deliveries became limited due to driver shortages and is extremely costly due to a significant rate of unsuccessful first-time delivery attempts. Consequently, for years, parcel and postal operators have been extending delivery (and return) options for parcels by increasing the number of alternative pick-up and drop-off points. Postal outlets and parcel shops are increasingly complemented by parcel locker stations (or automatic parcel machines (APMs)). These trends are also confirmed by statistics on ‘postal establishments’ and parcel lockers collected by the ERGP (European Regulator Group for Postal Services) for a selection of European countries. Between 2015 and 2019, their number increased by 16% to nearly 180,000 outlets driven by the increasing number of parcel shops.¹³ The number of parcel locker stations even increased by 57% within one year from 19,344 (2018) to 30,338 (2019).¹⁴ However, the developments resulted in densities that vary considerably among European countries (Figure 1).

Figure 1 Density of access points per 10,000 inhabitants by country (2020)



Source: Own research from publications of operators and market studies of national regulatory authorities, complemented by Last Mile Experts (2021).

Figure 1 shows that in 2020 the density of parcel locker stations varied considerably among 26 European countries from more than five stations per 10,000 inhabitants in Estonia to less than one station in more than two-thirds of the countries (starting with Germany). The density of postal outlets / parcel shops is

¹¹ Royal Mail Group (2021).

¹² Le Groupe La Poste (2020 and 2021).

¹³ ERGP (2020b), p. 60.

¹⁴ Ibid, p. 72.

considerably higher (see Figure 1). We estimate that in 2020 the ratio ‘parcel locker station per postal outlet / parcel shop’ was around 1:7 on average.

During 2020, the networks of postal outlets and parcel shops were partly hit by the closure of stationary retail shops during the lockdowns in respective countries.¹⁵ Alongside social-distancing requirements, the lockdowns apparently led to the increasing attractiveness of parcel locker stations as an alternative to home or parcel shop deliveries in 2020. This was followed by announcements of parcel carriers and national postal operators who indicated that the number of parcel locker stations will be expanded in the coming years:

- DPDHL plans to double the number of parcel locker stations (‘DHL Packstationen’) to 12,500 by 2023.¹⁶
- Polish InPost increased the number of parcel locker stations by more than 2,500 in 2020 and plans to expand the total number to 14,500-15,500 locker stations by the end of 2021.¹⁷
- The Norwegian postal operator, Posten, plans to roll out 3,000 parcel locker stations at 1,000 locations during 2021.¹⁸
- PostNord Sweden tested SwipBox parcel locker stations in Stockholm and decided to roll out 2,500 of these parcel locker stations in 2021.¹⁹
- Finnish Posti has massively raised the number of parcel locker stations in 2020 and announced the expansion of its parcel locker network from 2,150 to 4,000 over the next two years.²⁰
- DPDgroup announced that they plan to increase the number of parcel locker stations to 30,000 in Europe.²¹ For 2020, they reportedly provided access to a total of around 1,600 parcel locker stations in France, Denmark, Finland, the Baltic countries, Portugal and Spain.²²

This paper explores the potential reasons for this variety and discusses the role of parcel locker stations in e-commerce delivery. The emphasis falls on deliveries to parcel locker stations (or APMs) that are accessible to the public, either indoor (in shops or malls) or outdoor.²³ The paper aims to identify challenges and key drivers for the development of APM networks based on case studies for a selection of countries. It illustrates the economics of APM networks and analyses typical business models with special emphasis on the importance of open (or carrier-agnostic) networks.

To better understand the drivers for the development of parcel locker networks we selected five countries based on their the national characteristics; four countries with high-density networks (Estonia, Finland,

¹⁵ See ERGP (2020a), p. 12-13.

¹⁶ Deutsche Post DHL (2020).

¹⁷ InPost (2021a), p. 139.

¹⁸ Posten (2020).

¹⁹ PostNord (2021b).

²⁰ Posti (2021a).

²¹ Geopost DPDgroup (2021a), including Russia.

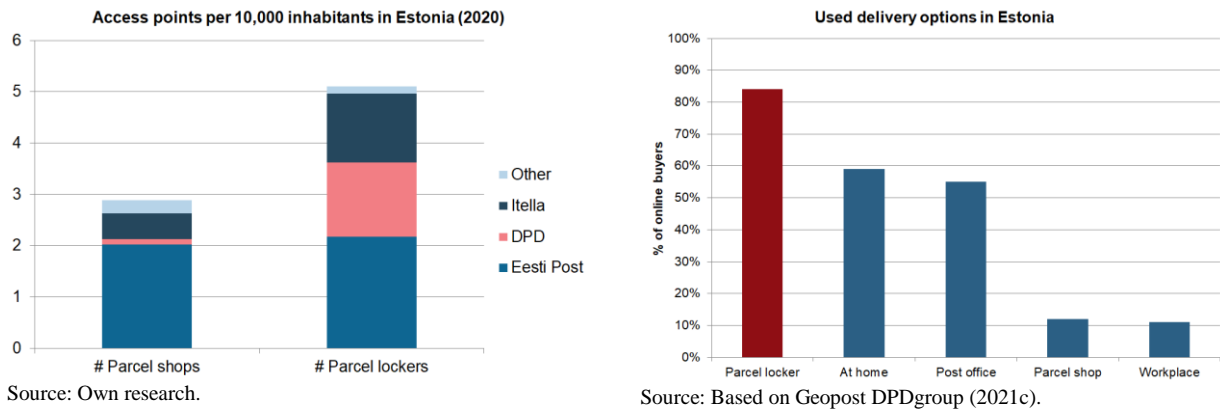
²² Geopost DPDgroup (2021b), excluding Russia (with in total 3,394 parcel locker stations).

²³ We are aware that APMs can and will often be used for sending pre-paid parcels (especially returns). In this paper we put the emphasis on the delivery function of APMs.

Denmark and Poland) and Germany, that shows a relatively low density of such stations despite DPDHL being the first operator to launch parcel locker stations 20 years ago.

Estonia – Competition between three closed APM networks

Figure 2 Estonia: Density of parcel shops and parcel locker stations and online buyers’ usage of delivery options



Estonia has the densest network of parcel locker stations by population in Europe, consisting of three competitive parcel carriers operating their own network of parcel locker stations, including Eesti Post (the national postal operator of Estonia), Itella (subsidiary of Posti from Finland), and DPD Estonia. DHL Express also has an independent network in Estonia, but on a much smaller scale compared to the aforementioned players. Eesti Post²⁴ and Itella started operating parcel locker stations around ten years (2011 and 2010 respectively) ago while DPD started five years ago in 2016. The individual parcel locker networks are operated exclusively by the respective carriers, with each carrier additionally operating their own networks of parcel shops. Estonia is the only country where the density of parcel shops is smaller than the density of parcel locker stations (see the left hand side of Figure 2). So far, parcel locker stations are mainly placed at high-traffic locations and in bigger cities. Press releases of the major operators suggest that the networks are continually being expanded and moving closer to the people. This year, Eesti Post started a network expansion project to establish parcel locker stations in smaller cities and villages in collaboration with local governments and communities.²⁵

Parcel lockers are reportedly the most used delivery method by Estonian online shoppers, even more used than home delivery or delivery to parcel shops (see the right-hand side of Figure 2). This may be largely due to parcel locker delivery being the most affordable delivery option, and many online merchants offer free delivery to parcel lockers for orders above a certain value threshold. For example, the listed prices for Eesti Post deliveries to parcel lockers are between 30-40% cheaper compared to home deliveries, depending on the parcel size.²⁶ The delivery to parcel locker stations is even cheaper than delivery to post offices or parcel shops reflecting the intense competition in this segment. Furthermore, online merchants offer their customers a choice of their preferred carriers, thereby allowing them to choose the parcel locker station that is most convenient to them.

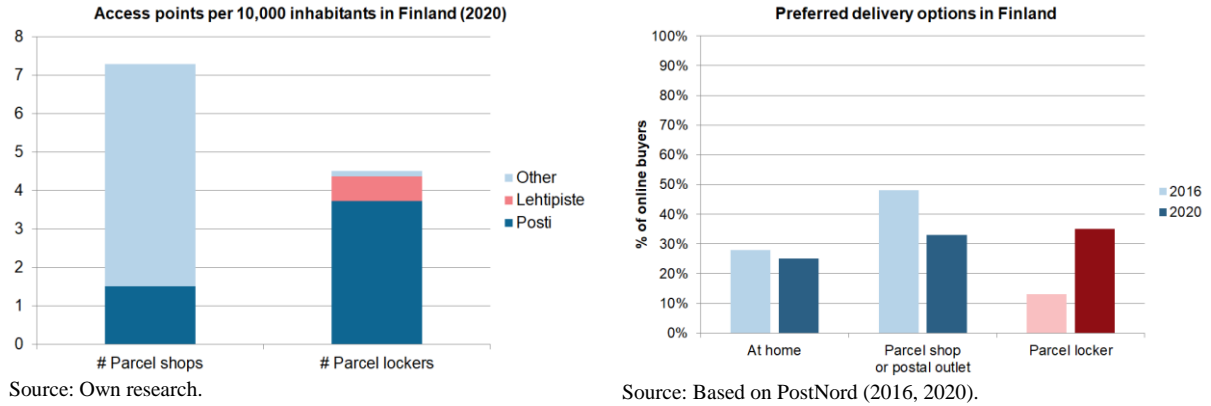
²⁴ The international brand of Eesti Post is Omniva.

²⁵ Omniva (2021).

²⁶ WIK calculation based on price lists of Eesti Post.

Finland – Posti have boosted the number and the usage of parcel locker stations within five years

Figure 3 Finland: Density of parcel shops and parcel locker stations and online buyers’ preference for delivery options



Finland has the second-densest network of parcel locker stations, in Europe in relation to its population size.²⁷ The majority of parcel lockers are operated by Posti (the national postal operator) as part of an exclusive network alongside its parcel shops and post offices. In 2010, Posti started with the implementation of screen-controlled parcel locker stations and promoted the expansion of the network as an element of their transformation strategy in 2017²⁸ (thereby switching to battery-driven smart locks with IoT technology). Since 2018, smaller players started to launch parcel locker stations, e.g. Pakettipiste and Smartmile both implementing a carrier-agnostic approach. This has enabled Posti’s competitors, including Matkahuolto, DB Schenker, and PostNord, to offer parcel locker services and not only rely on parcel shops and home deliveries. PostNord recently announced that they will establish their own stations in Finland in metropolitan areas.²⁹ Therefore, Finland presents an interesting case where parcel lockers are increasingly becoming the preferred delivery method with opportunities arising for other parcel carriers to compete with the incumbent national postal operator in this specific segment.

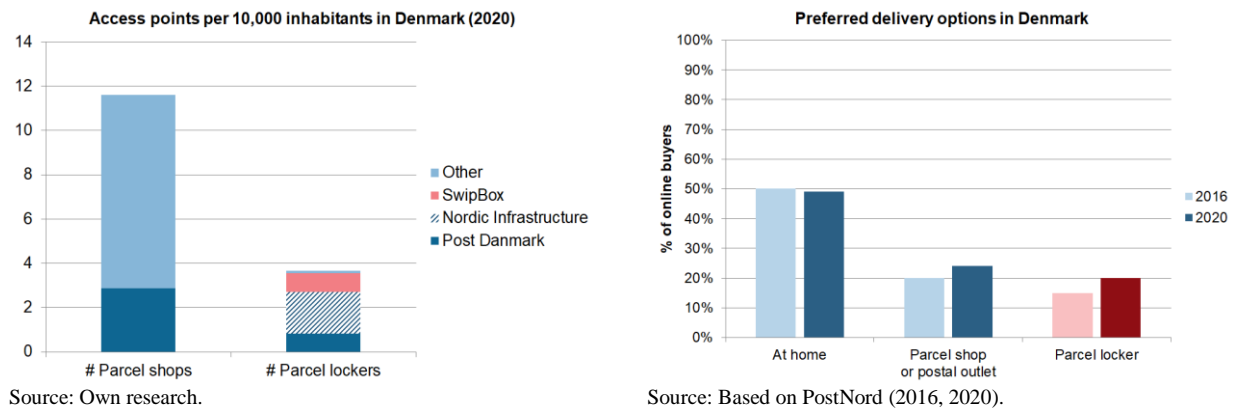
Finland has developed a strong culture of using parcel shops / parcel lockers over time, with it becoming the preferred method of delivery compared to home delivery (see the right hand side of Figure 3). This may partly be due to the convenience of having parcel shops and parcel lockers available at large retail chains (i.e. mainly indoors), e.g. K-group, R-Kioski, and S-group stores – parcel shops and parcel lockers are often in the same location allowing recipients freedom to choose their preferred delivery method. Moreover, retail stores in Finland typically have long business hours and some are even open 24/7, allowing recipients plenty of flexibility to collect their parcels. Posti recently announced that it successfully tested the use of outdoor parcel locker stations, given the extreme weather conditions in Finland, and plan to roll out more of them in areas where they do not receive space for indoor parcel lockers.³⁰

²⁷ Last Mile Experts (2021).
²⁸ Posti (2017).
²⁹ PostNord (2021b).
³⁰ Posti (2021b).

Another contributing factor to the preference for parcel shop / parcel locker delivery stems from the price incentives with discounts between 22-35% offered (by Posti) compared to home delivery, depending on the size and weight of a parcel. Similarly, price lists published by Matkahuolto indicated that delivery to parcel shops / parcel lockers are offered at discounted prices ranging between 34-49% cheaper than home delivery depending on the parcel size and type of collection point. From this evidence, it is clear that there are strong price incentives in Finland to promote the use of parcel shops and/or parcel lockers as delivery options while the decision between the two pick-up options is more driven by the online shoppers' preferences.

Denmark – the largest carrier-agnostic network of parcel locker stations in Europe

Figure 4 Denmark: Density of parcel shops and parcel locker stations and online buyers' preference for delivery options



The national postal operator (Post Danmark respectively PostNord Denmark) started offering parcel locker stations as delivery option more than ten years ago, in 2008. SwipBox, a producer and operator of parcel locker stations, implemented a carrier-agnostic open network of parcel locker stations in 2015 that was used by Bring, DHL Express, and TNT Express at that time. In 2019, PostNord teamed up with SwipBox forming a joint venture (Nordic Infrastructure) to provide a carrier-agnostic APM network (Nærboks). This presented a unique case for such collaboration in the Nordic countries since national postal operators usually operate an exclusive and independent network. The aim was to reach a larger share of the population by bringing parcel lockers closer to consumers and making parcel delivery and collection more convenient and environmentally sustainable. In this model, the financial risks in expanding the parcel locker network were shared between PostNord and SwipBox. It presented an asset-light approach to PostNord, whereas SwipBox gained access to the customer base of an important parcel delivery partner and thus increased parcel volume. As of June 2021, PostNord bought out SwipBox's share of Nordic Infrastructure, making the postal operator the sole owner of the Nærboks parcel locker network.³¹

Following the buyout of SwipBox's share of Nordic Infrastructure by Post Nord, it is unclear whether Nærboks parcel lockers will continue to be operated as a carrier-agnostic network. So far, smaller competitors (by volume) like DHL Express and Bring (owned by Posten Norge) have already joined the network. It is worth noting that the main competitors in B2C parcel deliveries, GLS Denmark and DAO,

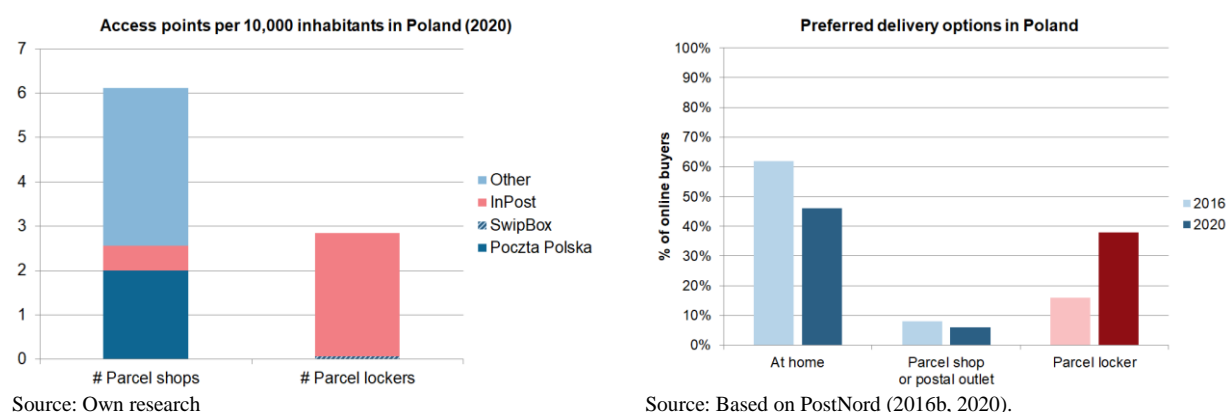
³¹ PostNord (2021b).

neither participate in the Nærboks open parcel locker network nor operate their own parcel locker networks.

In Denmark, deliveries to parcel shops and parcel lockers are relatively popular alternatives to home delivery (see right-hand side of Figure 4). These delivery options are incentivised by prices being cheaper compared to home delivery, approximately 20-30% cheaper for parcels depending on weight and size (based on price lists of GLS Denmark and PostNord). A recent consumer survey revealed that Danish online shoppers select delivery to parcel locker stations, to the home or to the workplace because of convenience considerations while delivery to parcel shops is more driven by the low price.³²

Poland – InPost operates the largest number of parcel locker stations in Europe

Figure 5 Poland: Density of parcel shops and parcel locker stations and online buyers' preference for delivery options



The B2C parcel delivery market in Poland is unique in the sense that the market is one of the most competitive in Europe. InPost is a first mover as the first parcel operator implementing APMs in 2008. Today, InPost boasts with a network consisting of the largest number of parcel locker stations in Europe and plans to further expand its network not only in Poland but also internationally, following its IPO in January 2021.³³ InPost parcel locker stations make up the vast majority in Poland and the closed network is used to serve online merchants that have an agreement with InPost – the largest online marketplace in Poland, Allegro, has a seven-year framework agreement as of November 2020 – for the delivery of parcels to parcel locker stations.³⁴ In contrast, other B2C parcel carriers, such as DPD Poland, GLS Poland, DHL, UPS, and FedEx, use parcel shop networks and home delivery as their main focus. Other than InPost, Poczta Polska operates a small-scale carrier-agnostic network of parcel lockers (in cooperation with SwipBox) that is also used by DHL Parcel and DPD Poland.

While home delivery remains to be the most preferred delivery method among Polish online shoppers, there appears to be a substantial shift of preference towards parcel lockers. It is estimated that at the end of 2020 approximately 35% of B2C parcels were delivered to parcel locker stations in Poland.³⁵ The shift away from home delivery may also be due to the price of deliveries to parcel shops being the most

³² FDIH (2020).

³³ InPost (2021b).

³⁴ InPost (2021a).

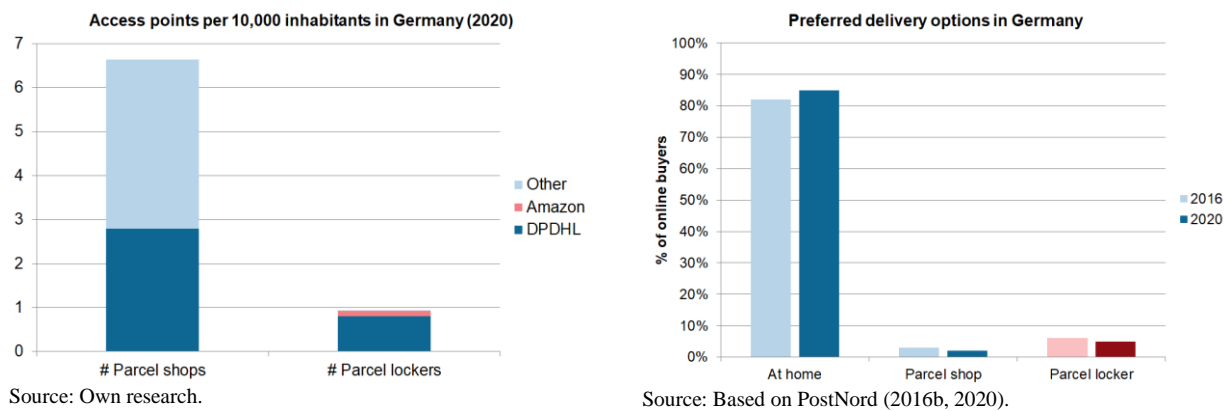
³⁵ Inpost (2021a).

affordable, followed by parcel lockers, at approximately 20-30% cheaper compared to home delivery. Furthermore, online merchants and marketplaces offer lower delivery fees to buyers if they choose items to be delivered to parcel lockers or parcel shops, e.g. the subscription model of the largest online marketplace Allegro Smart!

In 2021, there have been reports of the development of new market entrants in the parcel locker/shop market. The gas station chain, Orlen, has announced that it plans to launch a service called Orlen Paczka in September 2021 that will consist of parcel lockers and already existing collection points.³⁶ This appears to follow the termination of the agreement Orlen had with Poczta Polska in the same month, suggesting that the latter could lose some of its parcel delivery points. Furthermore, Allegro also announced that it will be looking to launch its own parcel locker network (1,500 stations by end of 2021 in cooperation with Modern Expo) in addition to the parcel lockers it uses for its Smart! parcels in agreement with InPost.³⁷ These developments imply that competition in this specific segment may increase in the next years. In light of increasing competition, InPost is expanding its APM network to smaller cities and aims for reaching between 15,500 and 16,000 stations by the end of 2021.³⁸ Similar to Finland, it shows that investments in additional APMs appear attractive in a country where a significant share of people is already familiar with the usage of parcel locker stations.

Germany – Still low but growing usage of parcel locker stations by German online shoppers

Figure 6 Germany: Density of parcel shops and parcel locker stations and online buyers’ preference for delivery options



One of the first parcel locker networks in Europe was introduced by DPDHL in Europe in 2003 and has grown into one of the largest such networks, by number of parcel locker stations, but by far not the densest network. DPDHL’s nationwide parcel locker network does not allow access to other parcel carriers – seen as a competitive advantage – aiming to increase its own delivery capacity in the last mile (in addition to home delivery and parcel shops), to reduce delivery costs and to better meet the needs of online shoppers by providing more flexible delivery options.³⁹ Established in 2003, the number of DPDHL’s stations had slowly grown to 3,700 until beginning 2019. As part of the ‘Strategy 2025’

³⁶ WH (2021).
³⁷ Allegro (2021).
³⁸ InPost (2021c).
³⁹ DPDHL (2019), p. 66.

launched in 2019, DPDHL announced to nearly double the number of machines (7,000) by the end of 2021. In light of the e-commerce boom in 2020, DPDHL decided to further expand the APM network to 8,500 stations by 2021 and more than 12,000 stations by 2023. DPDHL is also testing the use of a screenless, app-controlled parcel locker station that shall form around one-third of the 2023 APM network.⁴⁰

Competition in B2C parcel deliveries is quite fierce regarding home deliveries provided by other prominent players such as Hermes, DPD, GLS, etc. At this stage, the only viable parcel locker alternatives to DHL Packstation appear to be localised solutions, e.g. Amazon Logistics introduced their own exclusive network of parcel lockers in 2016, but is mainly only found in large cities. Another local carrier-agnostic parcel locker solution was introduced by ParcelLock, in cooperation with Hochbahn and Deutsche Bahn, at train and underground stations in Hamburg.

In Germany, home delivery is still by far the most used and preferred parcel delivery method mainly due to its convenience (see Figure 6). Furthermore, DPDHL does not offer any price incentives to customers for delivery to either parcel shops or parcel lockers, but remains competitive in their delivery prices. In contrast, other parcel carriers offer small discounts on delivery to parcel shops compared to home delivery, ranging between 4-15% depending on the size of the parcel.⁴¹ Moreover, driven by large online marketplaces like Amazon and Zalando, German online shoppers generally expect free delivery of online orders. The evidence suggests that convenience and affinity to digital solutions (indicated by the age group of online shoppers using parcel locker stations) are the main reasons for the selection of the delivery option.

Parcel locker networks are operated by various types of organisations

Among the most notable parcel locker network operators are national postal operators (usually universal service providers), e.g. DPDHL, Posti (Finland),⁴² and Omniva/Eesti Post (Estonia),⁴³ that have an advantage of an existing nationwide network for collecting and delivering letters and parcels. Parcel operators have also been successful in deploying parcel locker networks, for example, DPD in the Baltics and Lehtipiste/Pakettipiste in Finland, but they are generally less present than national postal operators in this field. Parcel locker networks operated by postal and parcel operators are mostly regarded as supplementary to home and parcel shop deliveries, which give them a competitive advantage by being able to offer more delivery choices to their customers. A major challenge (among others) faced by postal operators and parcel carriers are legacy problems with their existing IT platforms. These were originally developed to support their internal operations and less to improve customer service (senders and recipients). However, there have been developments in IT platforms with emerging e-commerce having encouraged operators like Posti and DPDHL to set up dedicated digital strategies that put customers, senders (notably e-retailers) and recipients (online buyers), to the forefront of their efforts.

Parcel locker manufacturers such as SwipBox or InPost also operate their own parcel locker networks as stand-alone businesses in cooperation with local carriers. Therefore, they are responsible for managing

⁴⁰ DPDHL (2020).

⁴¹ WIK calculation based on 2021 price lists for retail customers of DPD Germany, Hermes and GLS Germany.

⁴² Posti also operates a parcel locker network under its Itella brand in the Baltic countries.

⁴³ While Omniva (Eesti Post) is the universal service provider in Estonia, it also operates its parcel locker network in Lithuania and Latvia.

the daily operations through their software solutions that are tailored for a specific parcel locker network. In other words, their incentives differ from traditional postal and parcel operators by finding innovative solutions that suit customers' (senders and buyers) needs, and not only providing a supplementary delivery service. These companies are more technology-based and have developed their own software solutions for operating a parcel locker network, thereby placing themselves in a much better position than postal / parcel operators. However, it is more common for parcel locker suppliers to sell or lease their parcel lockers to national postal operators or parcel carriers, and continue to offer hardware and software support relating to managing and operating the network. InPost presents a unique case because they started as a main competitor of Polish Post in the letter market and only later entered the parcel market. The company was a 'first mover' in the segment of parcel locker deliveries and was quite successful in attracting online shops and, most importantly, the online marketplace Allegro as contract partners. In contrast to SwipBox, InPost built up their own logistics network to collect and deliver parcels either to parcel locker stations or at home.

Online marketplaces like Amazon have also deployed and operate their own parcel locker networks in certain countries (mainly in large cities in Austria, Germany, France, Italy, Spain, and the UK) as part of its last mile operations (Amazon Logistics). Similarly, Allegro in Poland are planning to roll out their own parcel locker network, thereby providing additional delivery options for parcels that do not fall under the agreement with InPost for the delivery of Allegro Smart! parcels to parcel lockers.⁴⁴

Finally, technology start-ups have emerged and entered the segment of parcel locker deliveries, like Smartmile in Finland. Another example outside the presented countries is Swedish Instabox.⁴⁵ In contrast to national postal operators and parcel carriers, these companies do not have to tackle any legacies faced by traditional postal and parcel operators. Instead, their focus is on reaching agreements with retailers and online merchants, or partnerships with parcel carriers, ensuring that they have sufficient parcel volumes that are being moved through the parcel locker network. This is a crucial requirement for start-up APM operators in order to cover their significant investment costs. Additionally, they are able to provide the necessary IT solutions for smooth integration with online merchants' and parcel carriers' existing systems and to encourage the use of their APMs as a delivery option.

Table 1 summarises the typical business models we identified in our research. We distinguish the operation of open and closed APM networks of operators with and without logistics operations. Logistics operations include collection and transport services, operation of logistics hubs (sorting facilities) as well as delivery of parcels to parcel locker stations.

⁴⁴ See Allegro (2021).

⁴⁵ Instabox operates one of the quickest growing APM networks in Europe. PTS (2021) estimates that the market share in the B2C parcel delivery segment was between 3% and 5% in 2020. The company operates a closed APM network and was quite successful in winning many Swedish online shops as customers, see Digital (2021). Their business model has some similarity to InPost in Poland.

Table 1 Business models with APM network: Examples

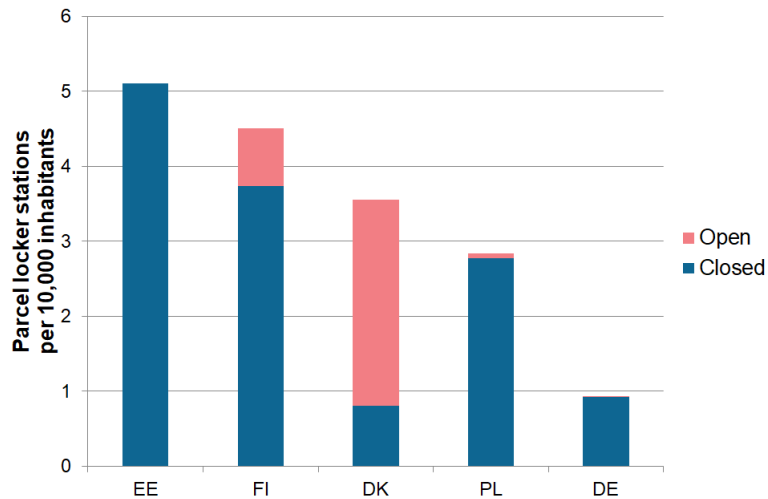
APM Network	Without logistics operation	With logistics operation
Open	Smartmile (Finland) SwipBox (Poland) Hamburg Box (Germany) Nordic Infrastructure (Denmark)	Lehtipiste (Finland) InPost (UK and Italy)
Closed		InPost (Poland) National postal operators (DPDHL, Posti, Eesti Post) DPD, Itella (Baltic countries) Amazon Logistics (e.g. Germany) Instabox (Sweden)

Source: Own analysis

Most parcel locker networks are exclusively used by the operator

In the majority of European countries where APMs are being used as a delivery option, these networks tend to be exclusively used by a single operator (‘closed’ network). Open parcel locker networks are still in the minority and rather the exception to the rule as illustrated by the evidence from the countries selected for our case studies (Figure 7).

Figure 7 Open versus closed parcel locker stations in selected countries (2020)



Source: Own research.

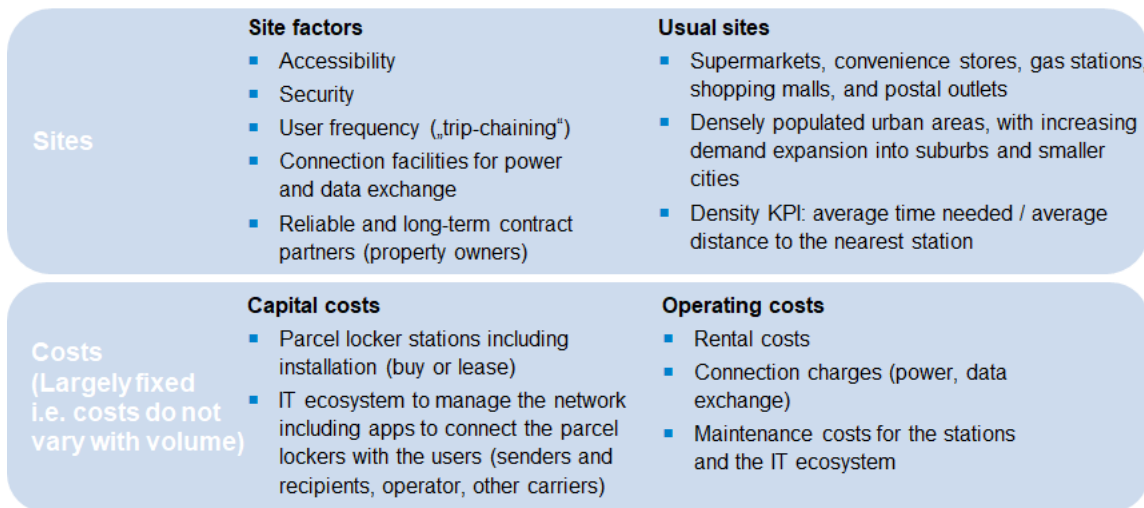
APM networks of significant size are mostly operated by a carrier, either by national postal operators, e.g. Omniva, Posti or DPDHL, or by parcel operators, e.g. InPost in Poland, DPD in the Baltics or Lehtipiste in Finland. Denmark is a unique case where the APM network, Nærboкс, was found by a joint venture between SwipBox and PostNord Denmark in 2019. However, the acquisition of SwipBox’ shares by PostNord shows a change in PostNord’s strategy with regard to the role of parcel locker stations in their delivery mix. So far, it appears that the network remains open for other carriers. However, as noted

above, the biggest competitors in the Danish B2C parcel segment, GLS and DAO, have not joined this network.

There are very few examples of other countries where open parcel locker networks are present. Open parcel locker networks are typically developed and operated by start-ups or suppliers that basically rely on a stand-alone business model, e.g. SwipBox (Poland), InPost (Italy and UK), and Smartmile (Finland). This decision involves a rather high-risk investment and may even include speculation that a large carrier or a large online merchant would eventually acquire the network. Whether a national postal operator or parcel / express operator participates in an open parcel locker network seemingly occurs where they do not have a sufficiently large customer base and thus not enough volume (e.g. Poczta Polska in Poland, Lehtipiste in Finland) and / or do not take the financial risk to invest in establishing their own parcel locker network.

That there are only few examples of (open) APM networks, especially from independent providers, can also be explained by the cost structure of an APM network.

Figure 8 Site factors and cost elements for APMs



Launching a network of parcel locker stations requires significant investments and time (see Figure 8). Capital, operating and other costs of such a network are largely fixed, i.e. independent from parcel volume. The identification of appropriate sites with high user frequency, the development of a smoothly running IT ecosystem, the purchase and installation of parcel locker stations, and promotional campaigns to increase awareness are necessary steps to establish a reasonably dense network. The country examples highlighted that the densest parcel locker networks were launched more than 10 years ago. Postal and parcel operators with well-established networks of parcel shops and postal outlets have a competitive advantage in identifying appropriate sites. Firstly, they can install a parcel locker station in or near parcel shops / postal outlets, and secondly, they already have experience in finding appropriate sites and negotiating with potential site owners.

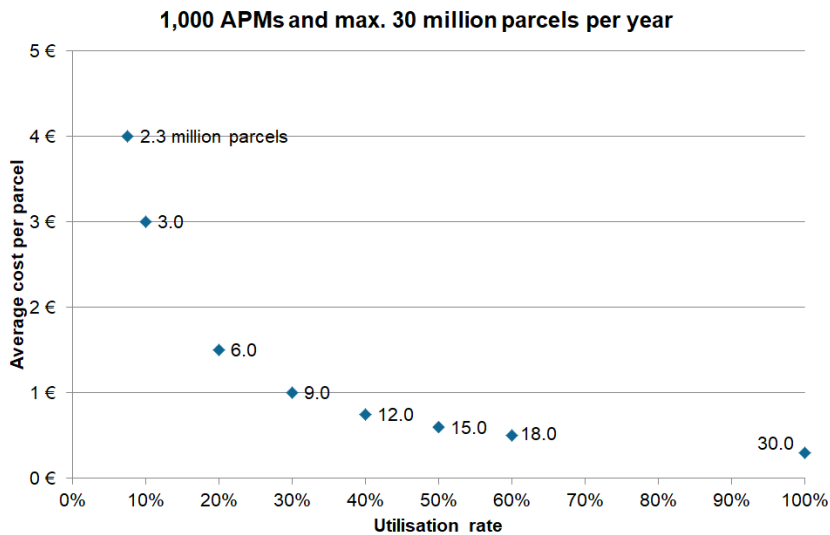
The additional average cost per parcel⁴⁶ born by an APM network largely depends⁴⁶ on the capacity of the network in relation to the number of parcels delivered through the network (utilisation rate).⁴⁷ The total

⁴⁶ The additional cost does not include the cost for delivering parcels to APMs. We assume that the time needed for the drop-off process should be largely comparable to the time needed for handing over a parcel to a person (home delivery) or to a parcel shop owner. It should be noted, that the potential bundling effect depends on the number of

capacity of an APM network (per year) is the product of the average number of lockers per station, the total number of stations, the number of delivery days per year and the number of deliveries per day (i.e. how often a carrier drops off parcels at the APM per day), and the implicit assumption that recipients pick up their parcels within one day. The utilisation rate of an APM network is the ratio of total parcels delivered to lockers and network capacity. The higher the utilisation rate, the lower the average cost per parcel delivered. Figure 9 illustrates this relation and highlights the impact of parcel volume and utilisation rate on the average cost per parcel resulting from the operation of an APM network. The assumptions are summarised in the upper part of Figure 9 and the development of average costs per parcel is presented in the diagram.

Figure 9 Illustrative example: Relationship between utilisation rate and average cost per parcel

Parcel locker network & volume		Capex and Opex per station	
# Parcel locker stations	1.000	∅ Capex	30.000 €
∅ Lockers per station	100	Depreciation period	10 years
Parcels delivered / year	1-30m	∅ Opex / year	6.000 €
Delivery days / year	300	Cost per station / year	9.000 €
Deliveries per day	1		



Notes: The Capex include investment costs in parcel locker stations (tangible and intangible assets, i.e. hard- and software). The depreciation period implies that the cost of capital corresponds to 10% which appears reasonable given the financial risk.

This illustration highlights the importance of parcel volume in relation to the size of the APM network (the utilisation rate) and provides an idea about the additional average cost per parcel delivered to a parcel locker. Therefore, it is not surprising that APMs are primarily placed in urban, densely-populated areas and at places with high user frequency. The average cost per parcel is a benchmark to assess the competitiveness of parcel locker delivery with alternative delivery options (home delivery with low drop-off rates and delivery to parcel shops). In this example the average cost per parcel of 1 € would be reached at an average utilisation rate of 30% (in this example 9 million parcels per year delivered to 100

lockers per station (i.e. the maximum number of parcels that can be delivered to one locker). The more lockers per station there are, the higher the potential bundling effect (and thus the lower the average delivery cost per parcel).

⁴⁷ The utilisation rate is a key performance indicator (KPI) for APM networks, see InPost (2021a).

thousand lockers on six days per week). The average cost should be at least the same level as the transaction fee for dropping off a parcel at a partner shop or equal the cost saved by foregoing home delivery. This example highlights only one aspect, although an important one, for the financial viability of an APM network. However, the investment decision also depends on other aspects including, for example, using APMs for collection services as well as capacity buffer, or the role of APMs as a potential unique selling point to attract users (senders and recipients).

Open APM networks follow different pricing strategies which are dependent on its business model, especially whether the operator provides its own logistics. For APM networks which rely either on one or multiple third-party parcel carriers for the delivery of parcels, the carriers, or local and online retailers, typically pay either a fee per locker or a subscription fee to the operator / supplier of the APM network, e.g. SwipBox (Poland), Quadiant, and Smartmile or a combination of subscription rate and fee per locker. The fee per locker is usually based on the actual number of lockers used for making deliveries, comparable to pay-as-you-go, and the price is likely to be higher compared to a subscription fee (usually combined with a longer contract period). Subscription fees are typically monthly or annual fees that determine a fixed number of lockers that can be used by a specific carrier or retailer over the contract period. In some cases it may be possible to extend the number of lockers available to a carrier or retailer, when required, usually on a fee per parcel basis.⁴⁸ Similar payment models are most likely employed by open APM network operators, with their own logistics operations, that share their network with other parcel carriers, e.g. InPost (UK and Italy) and Lehtipiste (Finland). Moreover, some costs may be transferred to recipients by means of delivery fees to APMs and/or penalty fees for not collecting parcels within a predetermined timeframe.⁴⁹

Alternatively, national postal operators or large parcel carriers buy APMs outright from suppliers for a one-off purchasing fee and independently operate the APM network in addition to their other delivery services. Even in these cases there may be a subscription fee paid to the APM supplier for software and hardware support, and maintenance services, e.g. KEBA, SwipBox, and Quadiant all provide this type of payment model. The cost of the APM network then has to be covered by the operator through cost-savings by avoiding home delivery, and hence depends heavily on large volumes being delivered via APMs. Generally, the identified pricing strategies of operators that offer a mix of delivery options reflect some of the cost-savings between home delivery and (bundled) delivery to pick-up points (with the exception of DPDHL). A lower price incentivises online shops to actively offer cheaper delivery options in the check-out process which could further promote the usage of parcel locker stations by online shoppers especially in combination with a convenient way to select an appropriate APM in the check-out process (e.g. by clicking on a map).

⁴⁸ Quadiant (2021), p. 101, provides an example of the different payment models they implement. They offer both a purchase model and a rental model of their APMs, and distinguish the share of revenue that the subscription services generate under each model.

⁴⁹ In China, HiveBox operates an open APM network with around 264.000 stations (including the locker stations they acquired from China Post) in more than 100 cities. Since April 2020, recipients have to pay a charge to use a locker if they fail to pick up parcels from their lockers within 12 hours (see Lee (2020)). After protests they adapted the payment schedule and offer a membership program with a monthly fee and free-of-charge usage of their locker stations. Non-members have to pick-up their parcels within 18 hours before being charged (see Duddle Blog (2021)). One major difference between the usage of Chinese and European APM networks is that in China carriers use APMs as a fall-back delivery option for failed home delivery while in Europe the online shopper / recipient usually decides whether an order shall be delivered to an APM.

From this perspective, it appears quite challenging to operate an APM network on a stand-alone basis without logistics operations. Therefore, it is not surprising that many APM networks are operated by large carriers and online merchants who already have a broad customer base and who are able to apply a mixed calculation in combination with other delivery and logistics services. Moreover, operators with a significant stake in the B2C delivery segment basically have no incentive to voluntarily share their APM network with competing carriers as long as they have enough volume delivered through APMs to achieve financially acceptable utilisation rates. They consider their ability to offer online retailers and online buyers a mix of different delivery options and the flexibility to redirect parcels to alternative delivery locations as a competitive advantage. From an operational point of view, parcel locker stations help reduce delivery costs and provide easy-accessible spare capacity to handle peak demand when facing transport and labour shortages for home delivery and limited storage capacities in partner outlets. Finally, from an environmental point of view, parcel locker stations are an opportunity to reduce the operator's carbon footprint in the last mile.⁵⁰ In this regards, open APM networks are more likely to succeed in situations where the operator is not able to attract enough parcel volume in a short period of time to cover its costs.

From the existing research,⁵¹ it appears quite clear that APM networks cannot reasonably be considered as an essential facility that may justify regulatory action in order to enforce access to an existing APM network. The main arguments are (1) that the delivery to parcel lockers can be substituted by delivery to parcel shops or home delivery (thus it is not essential for delivery) and (2) that mandatory access may hinder innovations and technological progress in this field. The five country studies illustrate that different market players have emerged and these players are not necessarily identical with national postal operators or parcel carriers with significant market shares.

- The Estonian example shows that competition among exclusively used parcel locker networks is feasible. Online shops provide the choice to their customers by having contracts with each of the operators. There are additional indications that e-retailers and consumers generally benefit from this competition in terms of lower prices (cost savings are reflected in the price structure) and improved quality of service.
- In Finland and Poland, there are operators that already have a big stake in the delivery to parcel locker stations. Both, Posti and InPost operate dense networks of parcel locker stations (that they are going to further expand) and have achieved extremely high levels of user acceptance and utilisation rates. Even though Posti has a significant market share in the Finnish parcel market, especially for B2C deliveries, there is emerging competition with open networks of parcel locker stations established by a smaller competitor Lehtipiste and by a start-up Smartmile. In Poland, it appears that competition emerges from the online marketplace Allegro (major customer of InPost and the most important online marketplace in Poland) and Orlen, a major provider of parcel shops (in gas stations and Ruch kiosks). Both announced plans to establish APMs in Poland.

Overall, parcel locker stations are a useful and increasingly well-accepted complement to existing delivery options especially in densely populated areas. Experiences have shown that the successful implementation of an APM network requires several years of significant investments and a dedicated digital and marketing strategy of the respective operators. Moreover, the affordability and convenience of

⁵⁰ The environmental impact of parcel locker deliveries (e.g. in combination with a broader city logistics concept) is another important topic that is not discussed in this paper.

⁵¹ See AGCOM (2020) and Rozman (2020).

parcel lockers to carriers, retailers and recipients are key factors to the success of an APM network. The acceptance of parcel locker stations can be promoted by price incentives for e-retailers and by a high level of convenience for consumers (easy access and simple handling). We expect that with volume growth and increasing capacity bottlenecks in the last mile, APM networks will become more common especially in countries where people are already used to pick-up parcels from parcel shops and postal outlets. The switch from parcel shop delivery to APM delivery is much easier than the switch from home delivery to APM delivery (given that the delivery speed is the same). In the first case the recipient's effort is basically the same while in the second case it implies additional effort from the recipient to get the parcel. If this extra effort is not remunerated with lower delivery costs and/or better quality of service, the switch merely depends on the recipients' delivery preferences and digital affinity. Finally, we expect that open APM networks remain an exception even though open networks benefit participating carriers and retailers in that they are able to offer APMs as an alternative delivery method without requiring significant investment in an APM network of their own.

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