Baggage Management and Infrastructure

Frankfurt/Main Airport

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Responsible for the contents
Dr. Ulrich Kipper

Editorial and text
Alfons Bachmann, Martin Bien,
Ralf Becker, Peter Dudenhöfer,
Michael Haag, Jörg Huber,
Markus Müller, Uwe Müller,
Axel Rumler, Axel Willert

Realization
Axel Rumler, Christina Loucas,
Helen Sanzenbacher, Anette Schmid

Photos
Fraport Photo Team

Concept and design
MarketingConsult Wiesbaden

Lithography
Team 3 Mainz

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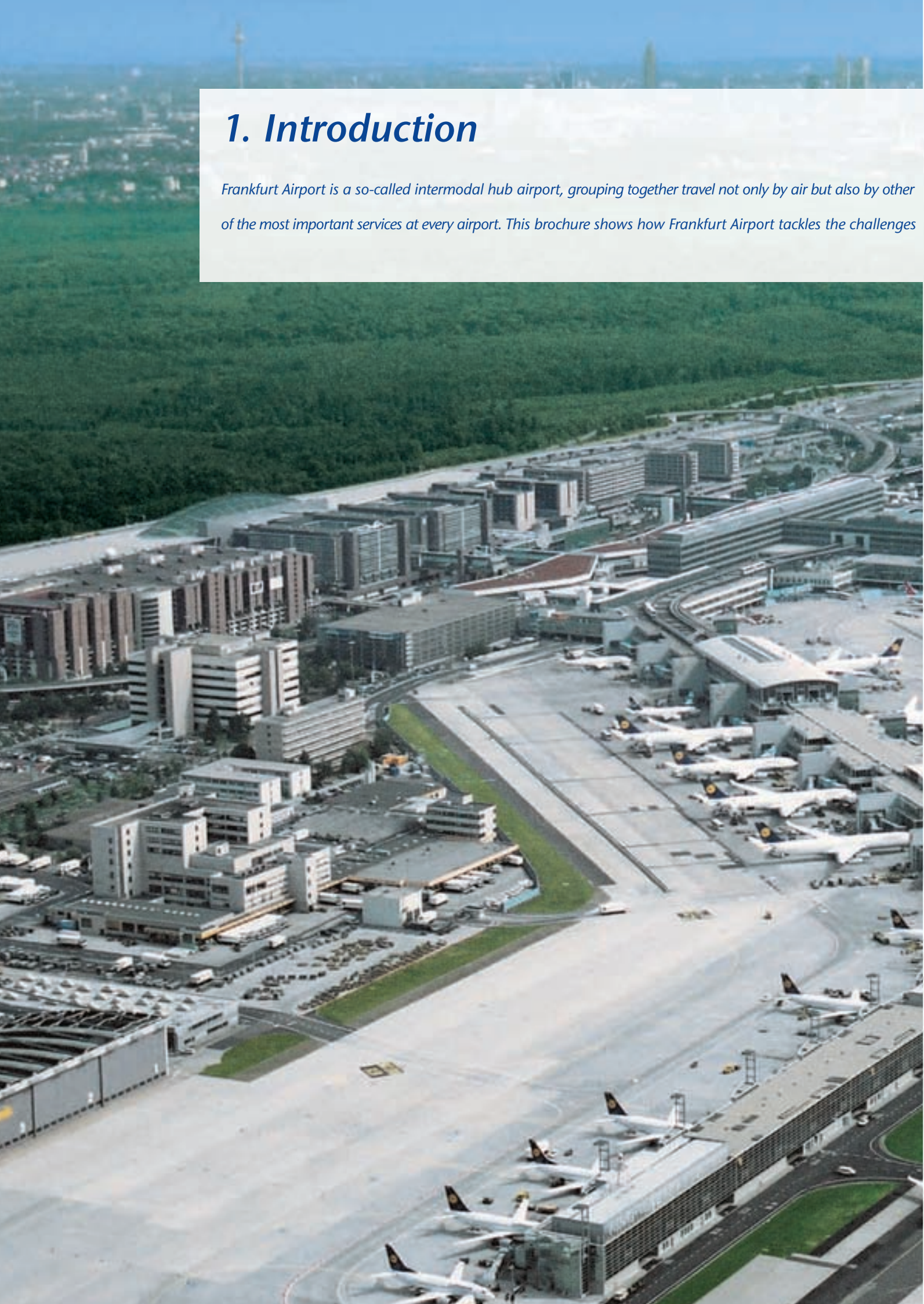
1. Introduction

Frankfurt Airport is a so-called intermodal hub airport, grouping together travel not only by air but also by other

of the most important services at every airport. This brochure shows how Frankfurt Airport tackles the challenges



means of transport. Baggage handling creates a bottleneck in the time required for flight clearance in a hub. It is, therefore, one arising from this and, as a result, has earned a reputation as a worldwide reference model for excellence in baggage handling.

1.1 The hub function of Frankfurt Airport (FRA)

The importance of FRA rests basically on its capabilities as a hub airport, i.e. its function as a central point for grouping traffic.

The grouping of passengers at a hub airport results in higher utilization of capacity on flights. This is the only factor that makes many connections economically viable. The number of flights available from FRA (307 destinations per week, worldwide) is only possible because of its hub function and it can only be sustained in the future by maintaining this function.

A high degree of functionality for its users is one of the defining features of an efficient hub airport. The airport operator's staff must be aware at every stage of the services they provide and of the worldwide consequences for the airline of punctual or unpunctual handling. Above and beyond what the actual individual does (part process) it is important for everyone involved to recognize the result of the whole process in its high priority.

Frankfurt is very important in international comparison as a transfer airport (originating passengers 46% – transit passengers 54%). Modern facilities ensure comfortable and rapid transit. The bringing into service of Terminal 2 and the AIRail Terminal (long-distance train station) provided Frankfurt with new traffic connections.

Even though this means that there are now three terminals in existence, the guaranteed minimum transfer time of 45 minutes has been maintained. This has been made possible in the main by the baggage conveyor facility (known as the GFA), a "roller coaster" now approx. 73 kilometers long that ensures that departing and transit passengers' suitcases get to their destination without a hitch.

"Sky-Line" automated shuttle trains enable passengers to transfer rapidly and easily between Terminals 1 and 2. Transfer routes from one terminal to another are kept separate so that international passengers do not need to leave the passport and customs control area at any time.

On peak days more than 180,000 passengers use Frankfurt Airport

With a passenger volume of more than 52.8 million a new peak was again reached in FRA in 2006. The effects of the events of September 11, 2001 in New York had been overcome by 2004 when the 50 million mark was passed. The peak month in 2006 was July with almost 5.1 million passengers, the peak day being September 29, 2006 with 181,794 passengers.

Volume development	2002	2003	2004	2005	2006
Passengers*	48,459.594	48,359.320	51,106.647	52,230.323	52,821.778
Originating passengers	47.1%	46.3%	46.8%	46.1%	47.0%
Transit passengers	52.9%	53.7%	53.2%	53.9%	54.0%
Business passengers	no evaluation	no evaluation	49.8%	51.0%	53.7%
Domestic*	7,891,218	7,579,233	7,292,845	7,024,393	6,759,379
Europe + intercontinental*	40,282,941	40,536,092	43,483,274	44,836,670	45,720,721
Peak month	September	August	August	August	July
Passengers	4,737,931	4,838,272	4,924,415	5,051,825	5,085,258
Peak day	174,269 (26.09.)	170,322 (30.08.)	177,666 (19.09.)	181,032 (30.07)	181,794 (29.09)

*Table 1: Volume development 2002 to 2006 *(arrival + departure + transit)*

With more than 52 million passengers Frankfurt is one of the busiest airports in the world

1.2 Fraport - The Airport Managers

As a flexible market- and customer-oriented services company Fraport has a presence wherever airport business is involved around the globe. The company is notable for its service-orientation, its professionalism and its flexibility. With its broad palette of serv-ices Fraport has established itself as an international ground services provider and is today rated as a quality leader in this market.

It is our intention to maintain and further develop our strengths as hub experts. To this end we are expanding our range of high quality services still further. Acknowledged weaknesses are eliminated aggressively, flexibly and with our customers' interests in mind. We accept this continuing challenge. We face up to this increasingly aggressive yet at the same time fascinating market with confidence in our own abilities.

We operate the Frankfurt "travel port", the attractive hub for all modes of transport, as a reference model for our customers. We cooperate with road and rail so that the particular strengths of these different modes of transport are tied in with air traffic in a pioneering way. What we do is relevant beyond the borders of our own area.

In this extended framework we see ourselves as having a responsibility for society and the upkeep of our environment. We use natural resources with care. We are developing our company in dialog with the surrounding countryside and feel involved in the development of society as a whole.

Optimum service and customer satisfaction are our watchwords. We are committed to handling independent corporate duties within the air traffic industry. We do more than just provide an infrastructure. For example we have made the best possible preparations for the A380. The baggage conveyor facility has been equipped to deal with this new challenge too, to enable it to convey and sort the increased volume of baggage without any problem.

To a large extent our staff determine the success of our business with their knowledge, their capabilities and their commitment. As an attractive company to work for Fraport offers interesting, challenging and worthwhile jobs.

We are proud of over 70 years of successful operation as an international airport. And at the same time that is an incentive for the necessary further development of our company in a dynamic environment.

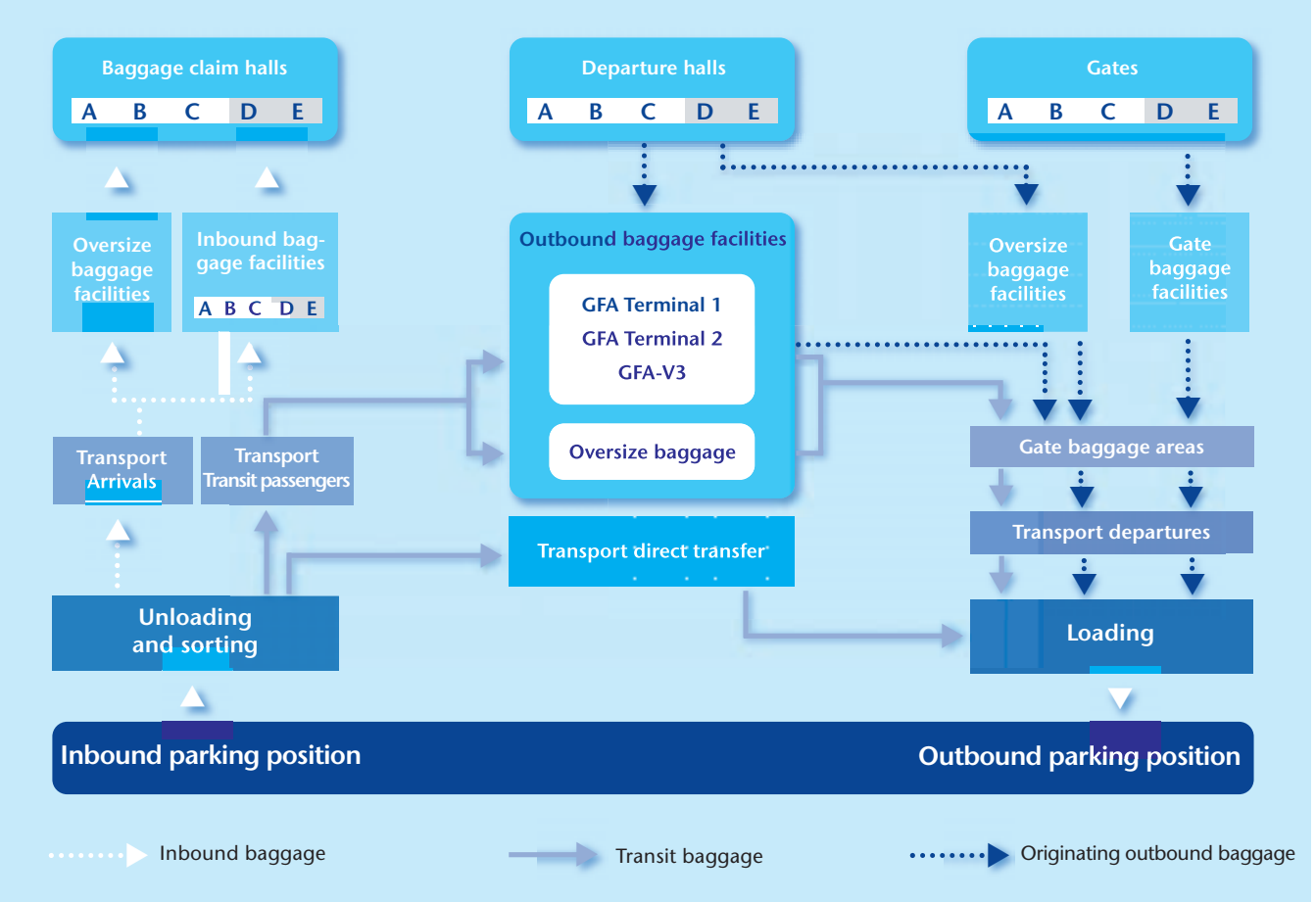
Fraport is making a continuous effort to improve its position in the market and is now handling the clearance of aircraft in a number of countries with great success.

1.3 Baggage turnaround at the Mega-Hub

One topic that is often the focus of attention for customers (passengers and air transport companies) is baggage handling. Particular attention is paid at Frankfurt Airport to departing and transfer baggage. Transfer baggage accounted for 57% in 2006 and the trend is upward.

An optimum transit baggage process is one of the key functions for a successful hub. The 45 minute transfer time currently guaranteed for all passengers at Frankfurt presents a permanent challenge to

Frankfurt is one of the first airports in the world which the A380 will be using in regular service



Graphic 1: Schematic view of baggage handling at Frankfurt Airport with the different baggage streams

baggage handling in view of the continually changing background conditions, for it must be the target to ensure that all passengers arrive at their destination airport together with their baggage. Baggage management calls for a high level of logistics and a well thought-out and workable system. It is exactly on these points that Fraport has proved its worth as a specialist for ground handling services in the world market.

Frankfurt/Main Airport	2002	2003	2004	2005	2006
Total baggage turnaround	37,273,847	36,795,870	38,681,987	39,378,818	39,359,290
Inbound baggage	9,960,166	9,592,767	10,077,611	10,479,897	10,681,523
Total outbound baggage	27,313,681	27,203,103	28,604,376	28,898,921	28,677,767
Transit baggage (GFA)	15,389,846	15,810,206	16,493,786	16,614,367	16,353,815
Originating passenger baggage (GFA)	9,308,450	9,061,915	9,587,058	9,821,570	10,252,437
Oversize baggage	1,183,074	1,008,492	1,013,776	974,303	1,160,768
Direct transfer	383,367	531,184	452,234	434,033	471,375
Hand transport	222,625	241,643	265,425	260,531	270,922
Last Minute (LMC) baggage	73,188	72,739	66,230	60,566	63,489
Gate baggage	43,569	48,376	53,981	56,021	92,285

Table 2: Baggage handled in FRA 2002 to 2006

2. The Baggage Management Challenge

In Frankfurt great importance is attached to rapid baggage return, a guaranteed connecting time of only

wishes. A functioning quality management system monitors all the baggage processes constantly to ensure that

45 minutes including baggage, an absolutely minimum baggage misdirection rate and complying with a wide range of customer they run smoothly. As a result baggage handling creates a bottleneck only on the rarest of occasions at Frankfurt.

2.1 Baggage handling as a service function

On peak days more than 220,000 pieces of baggage have to be handled in Frankfurt

Baggage handling can be a bottleneck in the time taken to clear a flight. It is, therefore, one of the most important services at any airport. Secure operation and a well functioning organization are the mainstays of a baggage handling system oriented to the needs of customers.

From the quality point of view a major priority is handling baggage with due care and with the absolute minimum of misdirected items, which have amounted to less than two per thousand since the system came into operation.

Rapid baggage return, Frankfurt's guaranteed transfer time of only 45 minutes and check-in up to shortly before departure are taken for granted. Compared with other commercial airports Frankfurt has a particularly high rate of transfer passengers at about 54% and transfer baggage at 57.03% respectively. The proportion of transfer baggage for Lufthansa is considerably higher still at approx. 80%.

On peak days up to 110,000 inbound and more than 110,000 outbound pieces of baggage (originating outbound baggage and transfer baggage) have to be dealt with to the right destination, rapidly, at the right time and with due care and attention.

Baggage varies very widely in shape and condition. Suitcases and bags, surfboards, baby carriages, bicycles, skis etc., up to and including animals in their transport boxes.

The baggage handlers have to sort this baggage belonging to inbound passengers, transfer passengers and outbound passengers and deliver it to the various terminals as well as the inbound and outbound aircraft.

Baggage handling is divided into three different types with varying flow patterns each of which has to be dealt with differently:

- **Inbound baggage** refers to baggage brought in from an inbound aircraft and delivered direct to passengers at their destination airport without any further handling. Depending on where it has come from inbound baggage can be differentiated as Schengen or non-Schengen baggage (see Infobox right).
- **Transfer baggage** is transferred without the assistance of the passenger from the inbound aircraft to the predetermined outbound machine and is loaded there taking into account the security regulations.
- **Originating outbound baggage** is checked in by the departing passenger at the check-in desk and – also observing the security regulations (such as the multi-stage baggage screening facility (MRKA) – conveyed to the appropriate departing aircraft.

The Schengen Agreement

Schengen became the synonym for an area without border controls, when five EU member states signed the "Schengen Convention" on June 14, 1985 on board a ship on the River Moselle near to the town of Schengen.

The Schengen Agreement provides for the dismantling of controls at shared borders and the introduction of free movement for persons and goods. It came into effect on March 26, 1995 and controls compensatory measures aimed at ensuring a uniform security and legal area following the abolition of internal border controls.

This involves the standardization of the regulations covering the entry and short-term stay of foreigners in the "Schengen Area" (the Uniform Schengen Visa), asylum questions (determination of the member states for an application for asylum), measures against cross-border drugs trafficking, cooperation between police forces and judiciary cooperation by Schengen states.

2.2 Quality management in the baggage services

More and more airlines are going over to concluding quality assurance agreements with their handling agents in which the handling of outbound, transfer and inbound baggage is a significant element.

Fraport AG's baggage services have in fact been certified to the EN ISO 9001 ff. quality standard since late 1997. The certifying agency confirmed by this that a functioning quality management system was being implemented for baggage handling, which forms the basis for complying with the standards agreed with customers.

The quality management handbook contains descriptions of the baggage processes in procedure, working and inspection instructions and these are permanently updated whenever changes are made in procedures and requirements as the case may be.

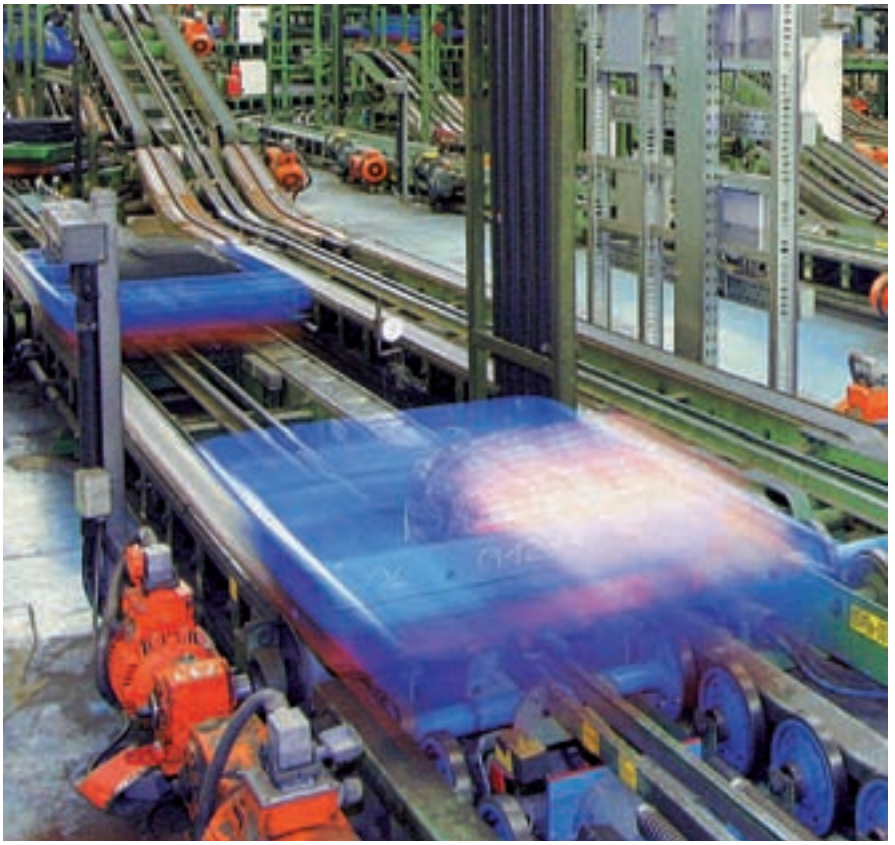
All members of staff are thus always up to date. There are separate handbooks in the individual departments containing descriptions of the individual working procedures. These form the basis for the training of staff.

In November 2000 recertification was carried out and this was based on the requirements of the new ISO 9001 : 2000 quality standard.

A certified quality management system ensures that baggage processes run smoothly

Scanner gates at every check-in desk play a significant part in the seamless checking of baggage

At Frankfurt even oversize baggage is handled within the normal time scale, rapidly, with care and delivered to the correct destination



The 73 km long baggage conveyor facility is the heart of the baggage handling system at Frankfurt Airport

At the same time additional quality assurance agreements were made with the airlines in which customer-specific standards were jointly laid down for the most important handling processes with levels of fulfillment incorporating previous performance.

One of the major objectives is to identify problems in procedures by permanent monitoring and to work out solutions jointly with a view to ensuring trouble-free handling on a long-term basis.

Committed staff ensure that standards agreed with customers are adhered to 100% (picture right center)

Carousels in the baggage claim halls enable passengers to pick up their baggage in comfort and without delay (picture right below)

3. Outbound Baggage

Frankfurt's chosen concept of integrated baggage handling with three early check-in baggage storage units all the baggage for an outbound flight in one place guarantee that even with a connecting time of only

and the baggage conveyor facility as the automatic connection between all origination and destination points plus assembling 45 minutes passengers' baggage is also transferred – even where a change of airline is involved.

3.1 Integrated handling

Outbound baggage handling is considerably more complex in contrast to inbound baggage. Originating outbound baggage and transfer baggage for an outbound flight has to be assembled at one point from a whole range of different sources.

The sources for originating outbound baggage are the baggage check-in desks in departure halls A, B, C, D, E and the AiRail Terminal plus all departure gates. Those for transfer baggage are the parking positions of the inbound flight. The baggage all has to be delivered to the position where the outbound aircraft is parked.

Outbound baggage can be checked in at practically any time of the day. Transfer baggage too accumulates at a variety of times during a day. It is, therefore, necessary to provide temporary storage for baggage of this type checked in early.

Automatic connection between all the various sources and destinations is taken care of by the outbound baggage conveyor facility (known as the GFA). The GFA consists of three independent systems in Terminal 1, Terminal 2 and at the apron station V3 with three early check-in baggage storage facilities at the current time.

For outbound baggage the integrated baggage handling concept was chosen, i.e. all the baggage for an outbound flight is taken to one place and loaded into containers there. This reduces the amount of work that has to be done, avoids interfaces, requires less space at parking positions, reduces the amount of transport required and reduces the number of personnel used.

In view of the high degree of interdependence in air traffic a high level of flexibility is an essential prerequisite as an overriding principle for the use of outbound baggage facilities. Utilization ideas for specific airport areas or specific airlines should not be restricted by conceptual baggage handling guidelines; room for maneuver must be left for subsequent developments.

3.2 Types of outbound baggage

Transit baggage

Most inbound aircraft are loaded with transfer baggage for a number of outbound flights. It is not rare for an inbound flight to be carrying baggage for up to 30 outbound aircraft. The average proportion of transfer baggage to total baggage on inbound flights is 57.03%.

For Frankfurt the handling of this transfer baggage represents a critical size. Fraport guarantees that with a minimum connecting time of 45 minutes between arrival and departure passengers' baggage will also be turned round in that time, i.e. it will be loaded on the outbound flight – even when a change of airline is involved.

The significance of this timespan is demonstrated by the fact that unloading and loading, including transfer to the GFA, each take 15 minutes. This leaves approx. 15 minutes to sort and transport the transfer baggage within the GFA's 73 km of conveyor lines. Bearing in mind the size and expanse of the airport that is an extraordinarily tight schedule.

Advance information about the amount of transfer baggage and where it is going to is available for more than 70% of inbound flights. This makes it possible to identify critically timed connections.

However, there is a limit to how much controlling action can be taken to speed up baggage handling in such cases. The information about transfer passengers does not, however, always indicate in which of the aircraft's baggage compartments or in which container the pieces of baggage affected by critical timing are in. This means that the piece of baggage unloaded last may well be subject to the most critical timing.

For the future ever bigger quantities of baggage will have to be sorted for more and more destinations and transported over still greater distances. With no change in the 15 minutes time allowed this will force a reduction of the working stages involved to the absolute minimum and a high degree of automation. What is more, the GFA is already in operation for more than 23 hours every day.

Originating outbound baggage

Baggage that the passengers boarding in Frankfurt hand over to their airline at a check-in desk in the departures hall is described as originating outbound baggage. The baggage is taken away by the GFA.

Outbound baggage is assembled per flight in one place and loaded there into containers

3.3 Operating functions

Originating outbound baggage

Passengers can check in their baggage at 263 check-in desks in Terminal 1 and 136 in Terminal 2. In Terminal 1 there are a further ten desks in the AIRail Terminal where baggage can be checked in for outbound flights.

As part of the check-in procedure at the baggage desks boarding cards are issued, baggage is accepted and various security measures are carried out. The pieces of baggage are weighed and baggage tags are attached. The tags include information such as flight number, connecting flight number in the case of transfer baggage and the individual number of the piece of baggage.

Baggage is loaded onto the conveyor belt at the check-in desks by hand. After being weighed and labeled each individual piece goes through a scanner gate where it is scanned and then automatically sent on its way. At any one time there is only one piece of baggage in the section between the scanner gate and the loading station, i.e. the next piece of baggage is not moved to the scanner gate until the previous one has been loaded. When the container is loaded a unique container number is allocated to the baggage's flight number (tag number) and reported to the central computer.

There are 464 check-in desks in total so that passengers can check in their baggage quickly

After check-in the baggage is transported in its tray via the GFA and every piece is coded when the flight number is entered. Bulky items of baggage such as surfboards, bicycles, baby carriages, skis, etc. are transported on separate conventional conveyor belts or elevators.

Airlines have individual check-in times. Their desks are open up to five hours before Scheduled Time of Departure (STD). Fraport provides the airlines' passengers with a service which enables them to check in their baggage at any time on the day of departure or the evening before. Desk closing times, i.e. the latest possible time for baggage to be checked in, is 30 minutes before STD.

The ultramodern AIRail Terminal, which came into service in 1999, is also linked to the baggage conveyor facility. 10 check-in desks in the long-distance train station terminal hall provide passengers with the facility to check in baggage for their flights as soon as they get off the train.

Baggage screening

With the start-up of the multi-stage baggage screening facility (MRKA), see page 27, the identification and allocation of pieces of baggage takes place immediately behind the check-in desks via scanner gates. So, even before the pieces of baggage start their individual journeys in the baggage conveyor facility, they go through baggage screening in the MRKA facilities within the GFA.

Handling transfer baggage

To achieve short transfer times it is not enough just to have a technically well thought out sorting system. The whole baggage handling process from the inbound aircraft to the outbound flight must be fully coordinated. Delays, which occur during unloading and the transport process for example, cannot be made up in the subsequent phases.

At Frankfurt passengers can check in their baggage at any time on the day of departure or during the previous evening

The high demands made on transfer baggage turnaround result in the main from what are known as critically-timed pieces of baggage with short connecting times of 35 to 45 minutes.

As far as the handling of critically timed pieces of baggage on the inbound side is concerned, three different operating procedures can be involved:

- Presorting of the critically timed baggage at the previous airport and turnaround via direct transfer
- Sorting out the critically timed baggage during unloading or at transfer baggage check-in and turnaround via direct transfer
- Dealing with all the pieces of transfer baggage for an outbound flight without differentiation

Transfer baggage is forwarded to the GFA and encoded there. Automatic scanning systems are used for this. A further challenge, particularly as regards the 45 minutes transfer time allowed, is presented by integrated multistage baggage screening.

In the long-distance train station, in addition to the check-in desks, there is also an automatic check-in and collection point for transit passengers which can be used by travelers to check in their baggage for flights from Frankfurt at the train station in Cologne and Stuttgart.

Conversely, for those arriving via Frankfurt, baggage can be checked through to Cologne or Stuttgart. This interface between the air and rail transport systems provides greater mobility and makes traveling a more comfortable experience.

Baggage belonging to passengers, who travel by train from Cologne or Stuttgart to catch their flight or who travel on to those cities by train after landing, is automatically transferred in Frankfurt

Sorting and forwarding

Within the GFA there are pieces of baggage for all outbound flights which have to be forwarded to their particular offloading point. For automatic sorting and routing purposes the individual tag number and the flight number applicable to it is used.

The ten check-in desks in the long-distance train station are linked to the central baggage conveyor facility

Automatic coding of transfer baggage

To adapt the efficiency and the quality of transfer baggage turnaround at Frankfurt Airport to the continually increasing demands made on it, an automatic baggage coding system has been introduced. It is, however, quite possible that automatic identification of originating passengers' baggage at check-in will come into use too in the future. The basis of automatic coding is the fully automated scanning of baggage identification numbers on baggage tags plus the processing of the associated Baggage Source Messages (BSM) and Baggage Transfer Messages (BTM) issued by the airlines' check-in systems. In the case of baggage that has to go through baggage screening, the baggage control facilities are integrated in the coding stations. The technical capacity of an automatic coding station is up to 1,380 pieces of baggage per hour which is three times higher than a manual loading station.

Storage of early check-in baggage

At Frankfurt outbound baggage is defined as early check-in baggage if the position of the baggage assembly point for the outbound flight is not yet known when the baggage is checked in. The baggage forwarding and sorting process does not start until it has been entered. Before this time all the baggage for this flight is automatically transported to an early check-in baggage storage area and kept there until it is called off. If the sorting destination is known, baggage is described as "Current Outbound Baggage".

At Frankfurt Airport early check-in baggage accounts for about 35 per cent of outbound baggage; at the same time in peak periods up to about 10,000 pieces of baggage have to be held in temporary storage and up to about 4,000 suitcases per hour have to be accepted in or taken out of this area.

In Frankfurt almost 100% of baggage is handled automatically: The picture shows a transfer entry point with feeder belt, scanner gate, X-ray machine, conveyor belts and automatic loading (from right)

Assembly of outbound baggage, setting up containers, transport and loading

Automatic, measured forwarding to a baggage assembly point makes it possible to determine the exact point in time when baggage activities should start for an outbound flight. Depending on the aircraft type this can be between one and three hours before departure time.

From this time the baggage for an outbound flight is forwarded to the baggage assembly point and it is loaded there into containers or, in the case of conventional aircraft, on vehicles.

GFA baggage offloading points in Terminal 1 are located at each parking position so that there is no need for vehicle transportation to the aircraft. In Terminal 2 and at apron station V3 the offloading points are located in a central sorting hall. From there containers or baggage trucks are transported to the parking positions using ground handling vehicles.

Following the airlines' instructions outbound baggage is sorted according to six criteria:

- Passenger class (First/ Business/ Economy)
- Intermediate destinations in the case of multiple destination flights
- Transfer destinations at the destination
- Critically timed transfer baggage at the destination
- Non-critically-timed transfer baggage at the destination
- Baggage to which any security criteria apply

The purpose of separating baggage by passenger class is to facilitate differentiation in the time required at the baggage claim; i.e. First Class baggage for example is loaded onto the aircraft last and can, therefore, be offloaded at the destination first.

Separation of baggage belonging to terminating passengers from that of transit passengers is necessary, in particular in the case of wide body aircraft, to avoid mixed containers. Transfer baggage can be further sorted by connecting flights.

It is, therefore, a good idea in the case of an outbound flight to New York to identify the baggage belonging to passengers flying on to Chicago and pack it into a separate container before the flight leaves Frankfurt. Another criterion can be separation of baggage on the basis of critically timed connecting flights at the destination airport.

Handling oversize baggage

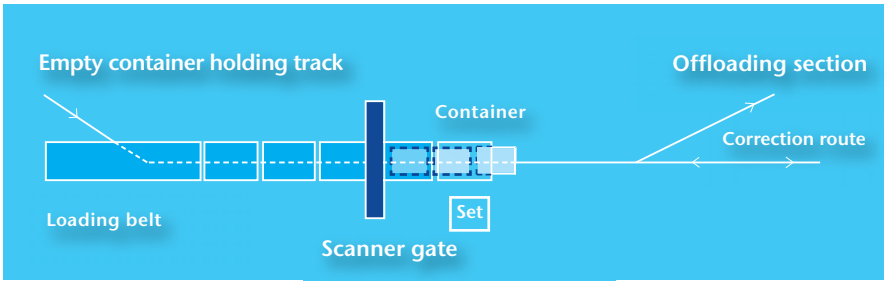
Oversize baggage that is not transported using the automatic baggage facilities (GFA) has to be sorted by hand and transported by vehicle direct to the baggage assembly point or the aircraft's parking position. Processing oversize baggage is very labor-intensive.

Handling gate baggage

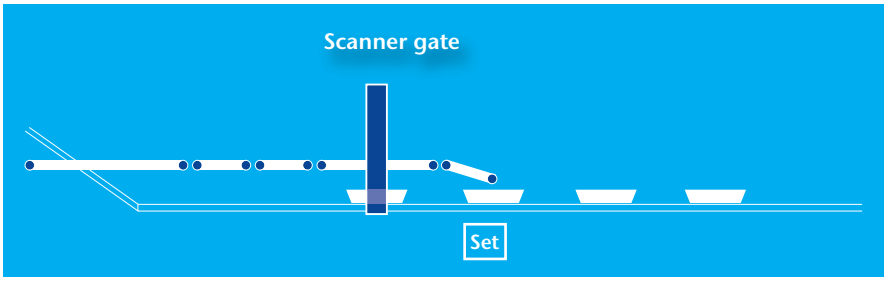
Normally baggage is handled at the check-in desks, since at Frankfurt passengers are only allowed access to the gate carrying their boarding card and permitted hand baggage (BGO = Boarding Gate Only). However, Frankfurt, unlike other commercial airports, provides a facility in exceptional circumstances for the acceptance at the gate of cases or hand baggage belonging to transit passengers that is too heavy or too big. A large number of departure gates are equipped with these handling facilities.

Direct handling at the gate, i.e. in the case of pier stands directly at the aircraft, means that baggage can be accepted up to the last minute. This is without any doubt a special service that is not normally available at major airports.

Top view



Side view



Graphic 2: Sketch showing principle of automatic container loading

Special baggage handling

In the case of baggage going astray or failing to connect or changes being made in bookings, which occurs primarily as a result of irregularities in air traffic, baggage handling is supported by an intelligent EDP-controlled routing system.

The objective, even when things go wrong, is to get the baggage loaded on the same flight on which the passenger leaves Frankfurt. If this fails to happen, the baggage is sent on after the passenger by the fastest possible route to its destination taking into account the relevant security requirements. To satisfy safety requirements, the appropriate technical facilities are available in the special baggage areas in Terminal 1, at Apron Station V3 and in Terminal 2.

Baggage tracing

The Ground Services' Baggage Tracing Team handles compliance with individual customer requirements and responsibility for special baggage questions. Linking the widest possible variety of baggage systems on a worldwide scale makes it possible to achieve an almost seamless comprehensibility in the whole process chain and targeted access to single pieces of baggage.

Rerouting baggage

If unfavorable attendant circumstances, e.g. heavy fog, prevent transit passengers from making their connection, there is a computer-controlled system which arranges for their baggage to be rerouted onto the flight on which they are rebooked. Under ideal circumstances this happens completely automatically but it can be triggered manually by an operator.

Special baggage of this type is processed at work stations set up specifically for this purpose and integrated in the baggage conveyor system.

Special or changed booking lines ensure that in the case of tightly timed booking changes the baggage is transferred automatically or manually to the flight concerned

The baggage conveyor facility's overnight function

The baggage conveyor facility's system interconnection is designed to permit baggage to be sorted ahead of the day of departure and stored until the departure date.

Baggage outside the baggage conveyor facility

There is a further EDP system available to take care of pieces of baggage that cannot be handled by the baggage conveyor system. This system, which was developed by Fraport itself, also incorporates various functions to handle irregularities and rebookings outside the baggage conveyor system.

Container storage and administration

With the increased usage of wide body aircraft the circulation of containers between the airports and temporary storage of them at the airport has become a new and significant task. From inbound flights the empty units have to be removed from the baggage facilities and either moved to the outbound flights' change-over points or put into temporary storage until called off. As the number of inbound and outbound containers at any point in time is never the same, there is a need to provide facilities for the circulation of empty containers and administration facilities for all the empty containers on the airport. At the present time about 25,000 sqm. is required for the storage of empty containers at Frankfurt. From the point of view in particular of the shortage of space on the airport at Frankfurt thought is just starting to be given to an automated high bay warehouse.

Back-up operations

High demands on performance standards and obligations towards passengers call for adequate provisions for dealing with any breakdown in services. This applies above all to the GFA. It is a system that can tolerate faults, but breakdowns cannot be completely excluded. For extensive breakdowns a specific back-up operation is to be installed and guaranteed in the short term. Special facilities for a back-up operation of this type are being reserved. For originating passenger baggage these are the carousels in the A area and the direct conveyors out of the counter hall in the arrivals area and the outbound gate baggage conveyors.

4. Outbound Baggage Facilities

Without its 73 km long baggage conveyor facility Frankfurt Airport would not be able to compete in its role stretch roughly from Frankfurt to Heidelberg and back. The current reliability rate of this gigantic unit is

as an intercontinental hub. On peak days more than 220,000 suitcases are handled now. Laid end to end these would

99.65 per cent.

4.1 Three facilities linked in system

At the heart of the outbound baggage turnaround are the three electronically controlled automatic baggage conveyor facilities GFA-Terminal 1 inc. long-distance train station, GFA-Terminal 2 and GFA-V3. These three facilities are automatically linked by six km long sections of tunnel and form a baggage conveyance unit that transports, sorts, feeds and stores.

The facilities comprise more than 73 km of conveyor lines and link together 405 baggage check-in desks in the check-in halls, 48 transfer check-in points and 10 special desks with 84 baggage assembly points. It incorporates three dynamic early check-in baggage storage units.

The three baggage conveyor facilities are linked by six km long sections of tunnel: The picture shows the section of tunnel in the extension to airgate A0

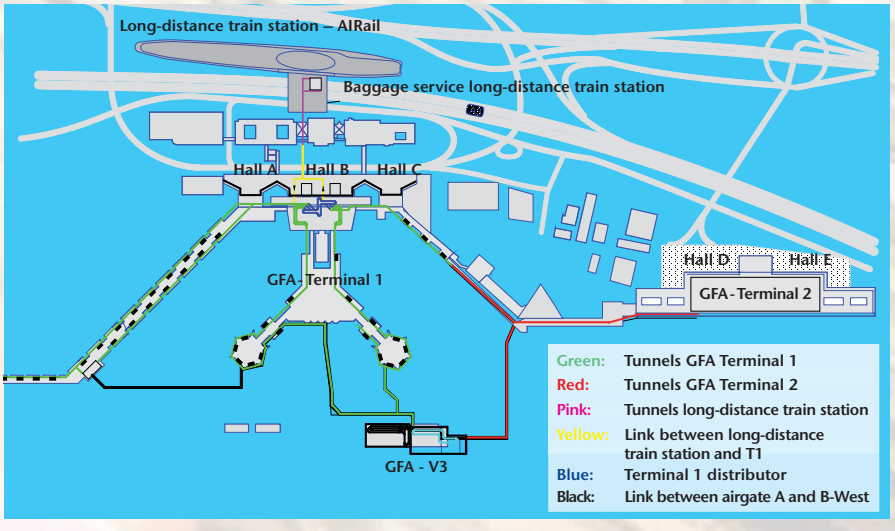
Operating principle

Bins are forwarded on conveyor lines by frictional contact between metal runners and plastic straps and wheels respectively. The containers consist of a metal framework with guide rollers and pins forcibly guiding them in the facility plus a plastic dish placed on them which take pieces of baggage up to 85 x 65 x 45 centimeters in size and 70 kg max. weight.

Each container has its own number in the form of a coding strip on the steel frame. Optical scanning points record this coded number and pass the information on to baggage computers.

From the combination of the container number and the flight number of the piece of baggage which is entered in the system automatically via the tag number or manually with the help of an input set it is possible to identify and control it at any point with absolute certainty.

With the integration of the multi-stage baggage screening facilities (MRKA) the entire container set-up was re-equipped for technical reasons (see page 27).



Graphic 3: Networked GFA system between Terminals T1, V3, long-distance train station and T2

After check-in baggage is transferred in a container by lift to the conveyor lines which are largely underground: The picture shows a lift exit in the Terminal 2 false ceiling

Baggage computers direct the suitcases from the check-in points and storage areas to the baggage assembly lines: The picture shows the final assembly line in the airgate A extension tunnel

After loading behind the check-in desk, baggage is transferred in a container from a lift to the conveyor system, which for the most part is underground, and transported off towards the MRKA. It then continues to its destination. The container numbers are recorded at scanning points and the route is decided on the basis of the flight and destination information. Points control the route.

If there is no departure position for the flight at the time, the baggage is directed to an early baggage check-in storage point. When baggage handling for the particular flight starts, the offloading point is entered and the baggage computers direct the bags on the basis of this destination information from the check-in and storage points to the offloading stowage lines.

A dumper transfers the baggage from the container to a conveyor belt: The picture shows the dumper in the extension to airgate A

Stowage lines are sections of track on which the containers can be stowed continuously through a switchable barrier. They are arranged before loading and offloading points and where two sections join.

When a container arrives at its offloading stowage line, it is offloaded and after being optically checked to see if it is empty or full it is forwarded in what is known as a "stacker".

To save space empty containers are stacked. Four containers at a time are automatically assembled in the "stackers".

The containers with the pieces of baggage are unloaded after reaching their assembly point: The picture shows the unloading belt in the extension to airgate A

They are held ready for call-off either in the gate baggage area itself on feed lines before the desks or alternatively in the early baggage check-in storage area.

Monitoring of all the empty container stowage lines provides the computers with an accurate picture of the containers available. On the basis of this information empty containers are automatically supplied to the check-in points as required. "Destackers" separate the containers. This closes the circuit.

4.2 System layout and overall configuration

The layout of each and every system is built up hierarchically and it is very complex. In Terminal 1 conveyors run from the check-in halls and the airgates to a central distributor. Here streams of containers are distributed on a traffic circle from eleven incoming to seven outgoing sections to the airgates of Terminal 2 and V3 facilities.

For reasons of forwarding capacity and as a precaution against breakdown this principle is triplicated with a circulating conveyor belt. The three levels have the identical layout and are arranged one above the other but they operate independently of each other.

The baggage in Terminal 1 is moved via tunnels direct to baggage assembly points located immediately adjacent to the aircraft parking positions. The baggage is transported at 2.5 m/sec in these tunnels. The connecting sections between Terminal 1 and Terminal 2 and also GFA-V3 plus those from Transfer Center A going to B-West forward the baggage at 5 m/sec.

GFA-V3 and GFA-Terminal 2 layout structures are comparable with those of GFA-Terminal 1. In Terminal 2 the redundancies have been increased in many areas to be able to ensure a very high level of availability, in particular in the event of breakdowns. The increased redundancy is caused by the layout: the outbound and unloading loops are located between two distributors, each with two conveyor levels so that they can be approached from two sides. A so-called hand-over head with 2,000 meters of guideways is specially designed to ensure that there is a constant flow of containers from other areas. In contrast to other systems the empty system only comprises "rings" and loops; this ensures that in the event of peak loads there are always empty containers available at the loading points. Early check-in baggage storage units like the distributors are in the form of revolving lines. The baggage revolves here until called off. The early check-in baggage storage unit in Terminal 1 comprises 15 storage loops with a capacity of approx. 5,200 container places. In GFA-V3 there are three storage loops with a capacity of approx. 2,700 places. With two storage loops Terminal 2 has a capacity of 2,100 places.

For handling capacity and breakdown security reasons the baggage conveyor facility has been triplicated. The three levels have the same floor plan; they are laid out one above the other and operate independently of each other

4.3 Control concept

The control concept for the baggage conveyor facilities is divided into four parts. The design provides efficient and modular control for the system as a whole. The local control covers all the motors, terminals, meters and actuators.

Programmable logic controllers are used here which intelligently handle all the tasks for a clearly defined area. There are today about 440 controllers of this type in use in total.

The flow of containers is controlled by intelligent industrial PCs. They analyze the readings from the containers and on the basis of the flight data and the load situation in the facilities they decide the route to be taken and pass this on to the points.

Each facility has its own control computer that takes care of the whole flight and baggage data administration and the exchange of data between the baggage systems. In addition all the processes are shown here in visual form which facilitates optimum operational management.

The individual control levels are linked by ultramodern networks. Active network elements (star coupler, router and switches) use light wave guides to ensure that a secure data flow takes place in one of the largest industrial networks.

An overriding main computer provides the link with the airport-wide information system, coordinates the exchange of data between all the baggage facilities and makes information about the pieces of baggage in the system available to different users. To keep completely up-to-date a migration to a new generation of computers took place in 2004.

The technical monitoring of the baggage conveyor facility requires, in addition to decentralized control, a central management system and this is handled in the Baggage Control Center (BCC): This is a view inside the nerve center of the baggage conveyor facility

Technical management

The technical supervision of facilities such as these requires not only decentralized controls but also central management which is handled in the Baggage Control Center (BCC). This is the nerve center of the baggage conveyor system.

It is the job of the engineers and technical staff to handle the technical process, starting with switching on the parts of the sections of the facilities and covering the involvement of maintenance staff in the event of breakdowns, identification and analysis of faults right through to the archiving of all baggage information.

A visual flowchart depicting the whole installation, equipped with illuminated indicators showing whether an element is functioning or not, computer-aided visualization of the conveyor elements and dialogue information from the baggage computer support the permanent supervision of the baggage facilities and enable a high degree of availability for the whole system.

Long-distance train station baggage facilities

With the start-up of the AiRail Terminal a further ten check-in desks were added to the GFA plus an acceptance point and a collection point. The integration of this part of the facility means that rail travelers' baggage can be transported.

Oversize baggage facilities

Items of baggage that are too large for the GFA containers are transported from the check-in halls to the apron areas on conveyor belts with a maximum width of 1.2 m. In the case of very bulky goods there are also goods lifts available.

If there should ever be a total breakdown of the GFA the oversize baggage belts in both terminals can be used as a back-up facility.

Back-up facilities

In addition to the oversize baggage belts, in Terminal 1 four "direct belts" (Teleflex belts) are used in the event of a breakdown to handle baggage from the check-in halls to the apron control centers.

Gate baggage facilities

Special check-in facilities are available at the gate for baggage that passengers have not checked in at the check-in desk and which they are not allowed to take on board the aircraft as cabin baggage and for baby carriages etc.

After being weighed suitcases are transported at the touch of a button onto a check-in conveyor belt and then via the main conveyor belt system and spiral chutes direct to the gate baggage area located below.

If there are no conveyor facilities at the gate desk, the baggage is carried by hand by a member of staff using elevators or stairs to the appropriate gate baggage area.

As these facilities are used for "critically-timed" baggage, magic eyes monitor the baggage stowage situation and automatically indicate to the operating personnel if a piece of baggage that has already been checked in has not yet arrived at the offloading point.

If the aircraft is parked at the building, the suitcase is loaded by hand. In the case of a parking position on the apron this "last minute" baggage is transported by vehicle.

The passenger baggage destined for these outbound flights is checked in using the bus gate facilities.

They are comparable with the gate baggage facilities.

4.4 Future challenges and expansion measures

Extension of the baggage conveyor facility

Ever since it came into existence (1974) the extent of GFA has been continually expanded and its performance and reliability has undergone constant improvement. Up to now a noteworthy feature of the system has been the fact that again and again it has been able to keep pace with the continually increasing demands resulting from successive extensions and improvements over many decades. This will continue to happen; its capacity for extension is a foregone conclusion as ever.

Projects in the completion phase:

- Extension to Hall C with 40 check-in desks, oversize baggage belt and four baggage claim carousels
- Further expansion of transit check-in points with X-ray machines
- Alterations to and addition of baggage assembly points at airgate B in Terminal 1
- Early check-in baggage storage unit in Terminal 2 with 2,100 places

Projects in the planning stage:

- New A-West airgate with baggage assembly points, automatic transit check-in points, early check-in baggage storage units plus baggage claim carousels and oversize baggage belt
- Rearrangement with optimization of the GFA function units at apron station V3 subject to a tunnel link to the future Terminal 3 in the south part of the airport

Increasing volume of baggage

Over the next ten years an additional increase in traffic volume of about 2 million passengers per year can be expected. Increasingly

larger types of aircraft (A380 and B747-800 respectively) are being used, airlines are optimizing their seat loading factor and the number of aircraft movements is rising. Baggage handling capacities have, therefore, to be expanded at appropriate points – to match airport and terminal developments.

Higher quality requirements

The number of pieces of baggage which are left behind and which have to be sent on afterwards has to be further reduced. This happens by optimization of the process procedures and process times with appropriate technical support from the conveyor system. The optimization of baggage transport times is of grave importance. In spite of increasing quantities, longer and longer distances to be covered because of the spaced-out distribution of aircraft parking positions, tighter security requirements, a drastic rise in the number of tight (critically timed) connections and delayed arrivals, rapid and reliable processes must further improve the quality of turnaround, to adhere to the 45 minute transfer time. Conveyor engineering support is being compared here with operational alternatives.

New products

New developments in intermodal travel are being responded to with a conveyor belt link to the transfer building at the long-distance train station. Since early 2001 baggage checked in at a train station can be transported via the conveyor belt system (GFA) from the train to the aircraft and vice-versa without the involvement of the passenger. In addition baggage checked in at the transfer building at the long-distance train station can be transported via the conveyor belt system to the departure position.

New services, new tasks

Extending the services provided to include check-in on the day before departure, changing the booking for baggage in the facility and increasing numbers are resulting in an increased storage requirement for baggage in the facility. The extra early check-in baggage storage unit for Terminal 2 is a current example of this.

Higher security

The increased security requirements have to be incorporated in the baggage handling concept. Putting into effect and updating of exhaustive security checks on outbound baggage in the existing baggage handling process in line with official conditions are further milestones in the GFA development process.

Further technical developments

Developments in control and computer technology call for continuous replacement of old systems. Product life cycles are getting shorter and shorter and call for flexible and backward compatible solutions with new hardware. New control and computer systems and architectures, however, also make improved control and monitoring opportunities possible and this has a positive influence on reliability and performance.

Airport expansion

As part of the expansion planning process for the airport as a whole, passenger growth of approx. 30 million passengers over the next ten years (approx. 80 million passengers in 2015) has to be catered for. In addition to the planned northwest landing-only runway, terminal facilities in particular will have to be installed for this in the south of the airport (on the former military airbase site) and these will have to be equipped with the appropriate baggage handling infrastructure. Both the baggage handling facilities there and a suitable north-south link for the baggage turnaround will have to be designed to ensure that the 45 minute minimum transfer time is also adhered to for the future Terminal 3. System studies for this have been submitted.

Workplace ergonomy

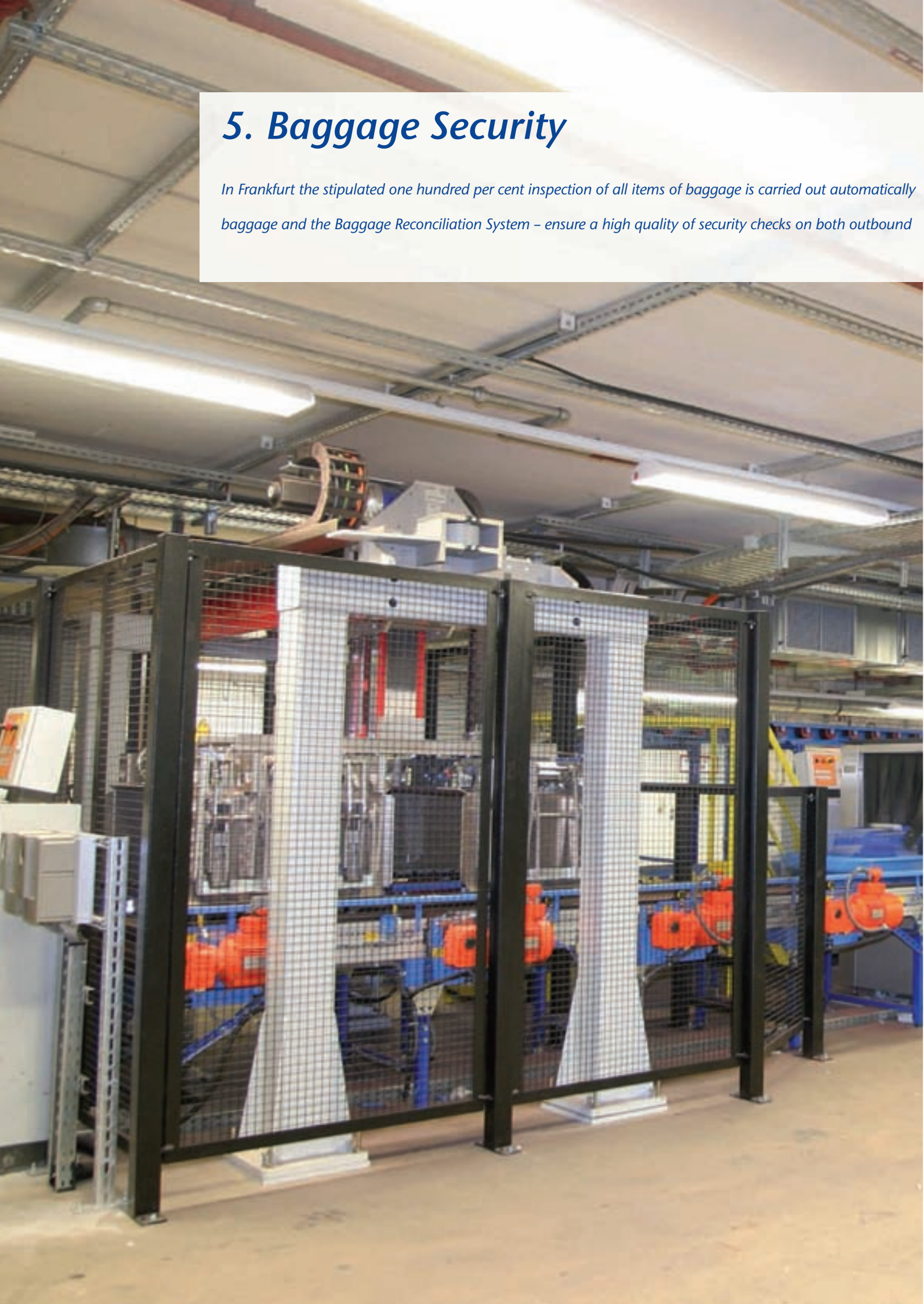
All the expansion measures are being coordinated in close cooperation with the industrial health and safety authorities based at the airport to achieve the highest possible level of safety and a high degree of ergonomic design for the man-machine interfaces. Space constraints, container shapes, time restrictions and the extremely wide variation in the size and condition of baggage, however, complicate development efforts to a significant degree in particular as regards part or fully automated loading and unloading of containers, but also simple weight relief aids. As part of the expansion planning, concept and prototype developments in research and industry are followed up and supported with appropriate operating know-how. Developments that are ready for testing can be installed at any time on site and exposed to operating conditions.

Graphic 4: Plan of airport extension with the new northwest runway and new Terminal 3

5. Baggage Security

In Frankfurt the stipulated one hundred per cent inspection of all items of baggage is carried out automatically

baggage and the Baggage Reconciliation System – ensure a high quality of security checks on both outbound



within the baggage conveyor facility. The multi-stage inspection process – X-raying of and also transfer baggage.

5.1 Target

Security in air travel is one of the most important problems facing airports and airlines. On the basis of EU security regulations and the Aviation Security Act appropriate measures have to be taken to implement the necessary safety standards in practice.

In the baggage turnaround precautions are taken to ensure that each item of baggage is checked for dangerous content and only those cases are sent on whose accompanying passenger is on board.

The most important security procedures involved here are X-raying passenger baggage (100% baggage checking) and baggage reconciliation.

Fraport AG has the most up-to-date infrastructure for these procedures and performs these services independently on behalf of the airlines.

5.2 Multi-stage baggage screening facility (MRKA)

Because of the EU security regulations on the formulation of common security requirements in civil aviation, airport authorities have been required since 01.01.2003 to carry out 100% checks on originating outbound baggage (check-in baggage).

Since January 1, 2006 all non-EU transfer baggage has also had to be subjected to these checks in accordance with the EU standard. Following Federal Ministry of the Interior guidelines Frankfurt Airport has put into effect the concept of a multi-stage baggage screening facility (MRKA). In order to integrate this stage by stage an MRKA of this type for transfer baggage checks has been in existence since the beginning of 2006.

Since January 2007 the MRKA system for originating outbound baggage has also been in operation. X-ray control equipment has been installed for this purpose with different technical properties (sensibility) for the particular control levels plus a central baggage data management system (RDMS) for assessment and management purposes.

Implementation

After extensive investigations Fraport AG decided on a centrally located control level arrangement at apron level.

Although this version calls for a very high GFA investment, there are significant reasons for it in the comparatively low increase in GFA baggage handling times from check-in to departure gate plus the advantage that the MRKA process takes place at apron level and thus has no effect on baggage handling in the check-in halls (= passenger area).

To implement the centralization of all control levels 174 scanner gates in total have been installed behind the check-in desks in both terminals

To achieve a uniform process Fraport AG decided to introduce a so-called "two-part" container: this comprises an upper section (plastic baggage tray) and lower section (steel frame) which are no longer bolted together; this type of connection has been replaced by a mechanical locking system.

This makes it possible for a portal robot to separate the "container/tray" transport unit into its two parts automatically and to move the piece of baggage sitting in the plastic tray through the X-ray machine on a conveyor belt without affecting the test level.

After the loaded baggage tray has gone through the check a portal robot reassembles it with the container frame.

Scanner gates have been installed behind the check-in desks to centralize all checkpoints: This is the scanner gate on a check-in desk in Terminal 2

Before the X-ray process the "container/tray" transport unit is automatically separated by a portal robot (large picture page 26), so that the piece of baggage in the plastic tray can be X-rayed without affecting the test level. Then the upper part of the container (plastic tray) and the lower part (steel frame) are reassembled using a connecting device (picture above)

As part of the MRKA project modifications were made to the frames of the 18,500 conveyor containers in operation and all the baggage trays were changed in succession and in so doing 2 barcode labels were fitted to each of them.This concept for the identification of the baggage trays ensures that the results of the X-ray check can be assigned to the tray number and to the piece of baggage in the tray during the checking process without any possibility of error.

Any piece of baggage, which does not receive security clearance after going through the automatic inspection stage procedures, is then checked by hand: The picture shows a manual inspection point

5.3 Passenger baggage reconciliation system (FRA-BRS)

FRA-BRS ensures the highest service and safety standard in baggage security.

FRA-BRS is a baggage security system that ensures that only bags belonging to passengers, who are actually on board, are carried on the aircraft or if the airline has provided a loading authorization for the baggage in question.

Fraport has developed a forward-looking, customer-friendly, reasonably costed and uniform process that takes into account all the airlines' requirements and which can record and collate the passenger and baggage data by IT. The basis of this is standardization in the exchange of data. The system is conceived in such a way that it can be used without any problem at other airports and by handling agents or airlines.

Hardware and software concept

FRA-BRS comprises a central system and an airport-wide network of different terminal equipment:

- The central FRA-BRS system is a biprocessor system and a disaster backup computer comprising Type p520 IBM servers.
- In addition to the AIX (IBM-Unix) operating system, Oracle is installed as database software plus WebSphere MQ as middleware for communication with external systems.
- There are 250 static terminals and approx. 150 terminals for recording baggage data.
- Around 25 host processes monitor the application.

Process

- **Check-in with allocation of baggage tag number**

  The baggage of locally originating passengers and transit passengers is issued with a machine readable baggage tag (10 Digit Bar Code "Licence Plate"). The data are collected in the airline's check-in system and transmitted to FRA-BRS.

- **Boarding control**

  The check-in system is used on boarding to determine whether all the passengers are actually boarding the aircraft.

- **Recording of baggage tag numbers**

  Every baggage tag is scanned or the number is entered manually if the tag is not readable. Additionally the number of the transport unit and a loading sequence number are recorded. Using these baggage can be quickly located should it need to be offloaded.

- **Matching**

  The check-in system's boarding data is compared with the FRA-BRS data. Matching the two ensures that baggage that cannot be assigned to a passenger is not loaded or is offloaded if already on board.

Since 2004 customers have been provided with access to the FRA-BRS system via the SITA infrastructure at the airport.

With the help of this web technology based technology customers can call up the loading status at any time and access the process to make rapid corrections.

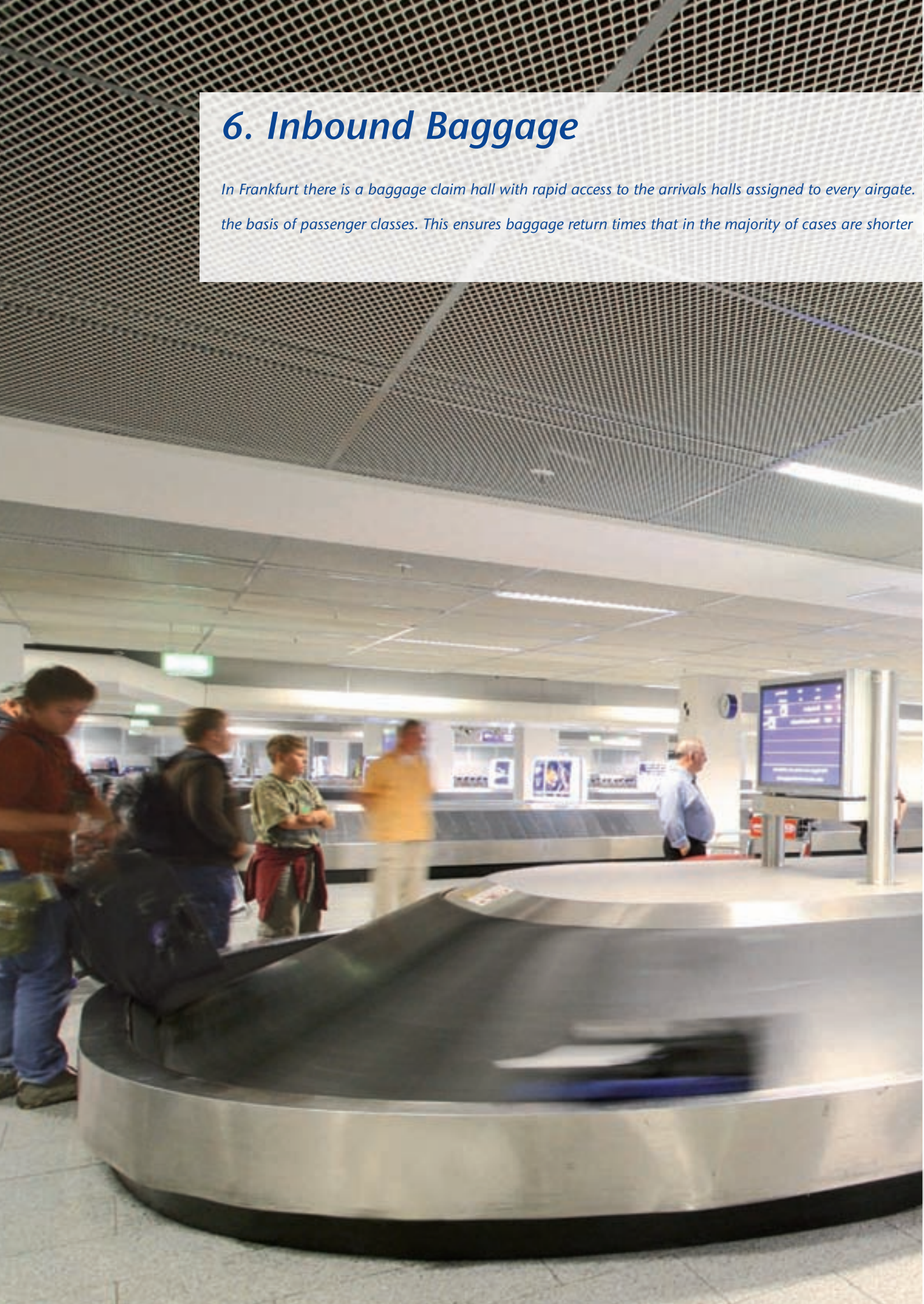
The FRA-BRS system

- provides the highest possible security standard with high handling quality
- takes into account the technical peculiarities of the customers' wishes
- enables efficient recording and transmission of all baggage data
- is user-friendly and easy to operate
- produces security at low costs
- is designed for use by handling agents and airlines
- is hardware and software platform independent
- based on Java

The Baggage Reconciliation System guarantees that only suitcases whose owners are on board are loaded: The picture shows a new BRS machine in B44

6. Inbound Baggage

In Frankfurt there is a baggage claim hall with rapid access to the arrivals halls assigned to every airgate. the basis of passenger classes. This ensures baggage return times that in the majority of cases are shorter



In this way inbound baggage can be reclaimed in the minimum of time following a schedule laid down by the airlines on

than the standards agreed with the airlines.

6.1 The Baggage claim concept

After the arrival of a flight the baggage must be returned to the passengers in the shortest possible time after being handled with care and in a service-friendly manner.

That is why at Frankfurt there is a baggage claim hall assigned to every air-gate and directly linked to the landside facilities (arrivals halls, car parking, rail links, etc.).

Inside every baggage claim hall there are carousels accessible all round, to which baggage is fed by conveyor belts from the basement from the apron unloading halls.

Following the airlines' guidelines the baggage is delivered in time sequence according to passenger class. It is pre-sorted for this before leaving the departure airport.

There are agreed standards for baggage return times (see table 3) and in the majority of cases Frankfurt achieves shorter times than these.

6.2 Baggage flow to the baggage claim belt

Aircraft unloading and transport

After the arrival of the aircraft at its parking position (On Blocks) unloading of the baggage starts immediately.

In narrow body aircraft the baggage is stowed loose and unloaded by hand. If the inbound and transfer baggage is not stowed separately, it is sorted during the unloading process. For delivery to the baggage delivery halls pieces of baggage are loaded loose on "baggage carts" which each hold about 35 suitcases.

In wide body aircraft the baggage is generally stowed in containers. Loose stowage or the use of pallets and igloos for baggage are the exception. The most widely used type is the "LD-3 container"; smaller containers are also being used now in new types of aircraft such as the Airbus A321. LD-3 containers can hold about 35 to 45 pieces of baggage and the smaller containers about 35. Future new types of aircraft will use still larger container units.

Wide body aircraft have conveyor systems in their holds to move the containers between the point where they have been stowed and the hatch. The difference in height between the hatch and apron is, for example, 2.95 meters for the B747 and 3.25 meters for the A380. Straddle carriers are used to take the loading units from the unloading hatch, lower them to apron

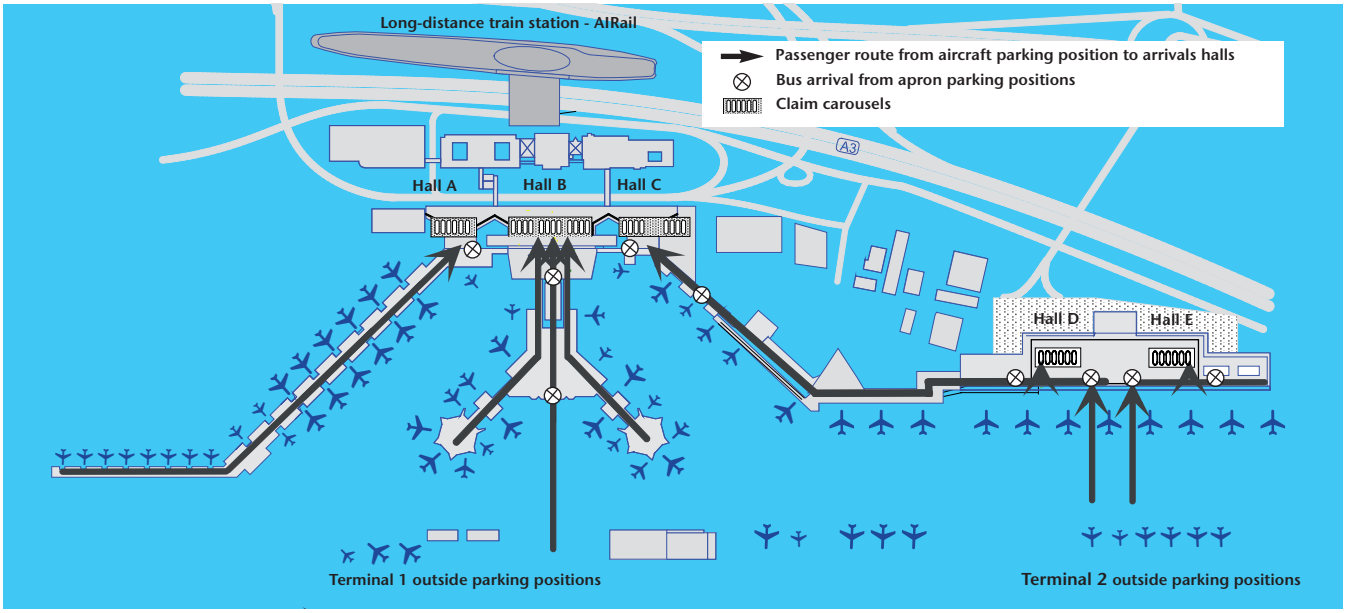
Baggage is offloaded immediately after an aircraft arrives at its parking position and transported to the baggage return halls

The baggage is transferred from the airside return halls rapidly and carefully to the baggage return carousels

A disposition system developed in-house ensures optimum allocation of flights to reclaim carousels

Baggage return times	Building parking position	Outside parking position
Delivery of 1st piece of baggage		
Conventional aircraft	15 Min. after On Blocks	20 Min. after On Blocks
Wide body aircraft	20 Min. after On Blocks	25 Min. after On Blocks
Delivery rate	Average of 8 -10 pieces of baggage per minute	

Table 3: Standards for baggage return times



Graphic 5: Allocation of airgates to baggage claim points and carousels

level and transfer them automatically to the "baggage container trailer" (CGA). Heavy-duty tractors are used to transport the baggage to the baggage delivery halls.

Baggage delivery and claim

The baggage is fed from the delivery halls to the baggage claim carousels and is collected there by the passengers. The design of the baggage delivery halls must be oriented to the dimensions of the transport units (baggage trucks, containers), the transport vehicles (tractors, cars, etc) and the belt feeds.

Basically at least two transport units are handled at each loading point, so that there can be a continuous feed of pieces of baggage to the carousels.

Belt assignment, information for passengers and people meeting them

Every effort has to be made to ensure optimum utilization of the conveyors in everyday operation in accordance with the utilization concept for every baggage claim hall. At the current time assignment of a flight to a baggage claim carousel is made before landing and this is oriented to the number of passengers, the length of the carousel and the wishes of the airlines.

Information displays in the terminal guide passengers to their baggage return carousel and there are displays in the arrivals hall showing the exit travelers can be expected to come out through.

A specially developed system will make it possible in future to leave the assignment of the arrivals belts until the aircraft is "On Blocks" and this will make better use of the belts and achieve a still better utilization of the capacity available.

At peak times it is normal for baggage claim belts to be handling more than one flight.

6.3 The baggage claim carousel technique

The carousels

In Frankfurt freestanding carousels that can be accessed all round have been chosen for the return of baggage to provide the maximum possible space and convenience for passengers.

Technically these carousels comprise overlapping panel belts angled at 25° and 30°and a panel length of 1,200 mm which can also provide double layer baggage return; the carousels operate at a speed of v = 0.4 m/s; in both terminals baggage is moved from the basement on flat and curved belt conveyors over several different levels of the building.

Each baggage return carousel has a dedicated belt feed section; the width of the belts is 1,000 mm as a rule; for structural reasons the 12 belt feed sections in Hall B of Terminal 1 are only 800 mm wide.

Oversize baggage is brought separately to the baggage claim halls on wide belt units, elevators or by hand. As passengers frequently only decide to fly on to another destination after they have reclaimed their baggage, all the baggage claim halls have facilities for baggage to be checked back in for departure.

24-hour storage and customs baggage collection store

Baggage that is not collected by a passenger and that cannot be assigned to a passenger is taken to what are known as "24-hour storage areas". If it is not collected on the same day, it is taken to the customs baggage collection store and is recorded in the unclaimed baggage database after being checked by customs.

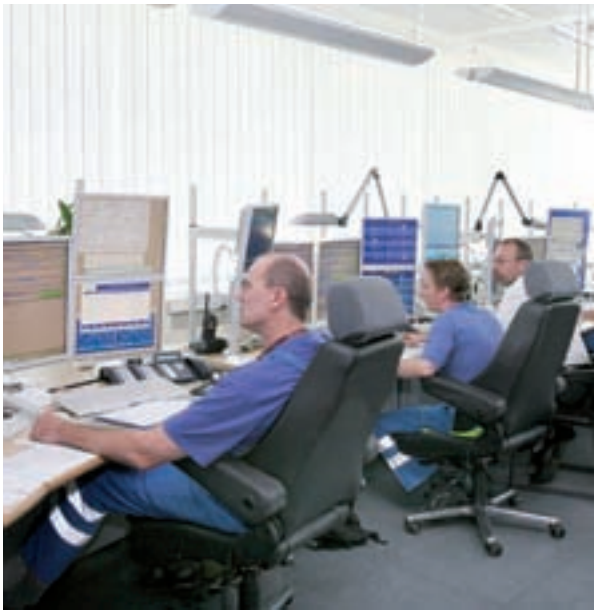
Mixed container handling

With the increase in wide body aircraft the handling of mixed containers (holding both inbound and transit baggage) has become a problem.

If the container is taken to the baggage delivery hall, the transfer baggage has to be extracted and then forwarded to the outbound baggage facilities.

The same applies in reverse. To speed up the procedure, automatic conveyor systems are used between inbound and outbound baggage facilities.

A central baggage operations co-ordination team controls and monitors the whole baggage flow



Free-standing carousels that can be accessed all-round provide passengers with spacious and comfortable waiting areas

7. Baggage Transport

To ensure baggage turnaround within the 45 minute plane-to-plane connecting time guaranteed in Frankfurt

system ensures that in spite of the high level of requirements resulting from a wide variety of sorting criteria

baggage has to be transferred to and from the aircraft as quickly as possible. In Frankfurt a well thought-out disposition all the transport services operate smoothly and speedily.

7.1 Transport requirements

The movement of baggage between the GFA and the aircraft is one of the most important parts of the baggage services operated by Fraport AG's Ground Services section. To ensure a 45 minute baggage turnaround, the baggage must be transported from and to the aircraft as quickly as possible. This calls for a high level of logistics and a well thought-out and workable system. It is exactly in these areas that baggage movement has undergone constant further development in recent years.

One of the main tasks is the handling of inbound and outbound baggage. In this connection there are still more differences in the sorting criteria: First Class baggage, crew baggage, VIP baggage and LMC baggage. In addition on-board couriers have to be handled, arrangements made for animals and oversize baggage and in the case of certain flights customs regulations have to be adhered to. This means that there are many pieces of baggage that have to be cleared by customs before they can be reclaimed or forwarded as transfer baggage.

In the case of what are known as "HOT" containers, transfer baggage is loaded with a transfer time of less than 75 minutes. It is often not possible to deliver this critically timed baggage to the connecting flight on time using the "normal" baggage route (via GFA) because of the long distances it has to travel across the airport. For this reason the baggage is sorted out by hand and taken direct to the connecting flight (direct transfer).

In addition to transport for the baggage, a special transfer service (Short-Connex) is provided for passengers with a scheduled transfer time of 35 to 40 minutes. This involves collecting the passengers from the aircraft and, subject to the regulations governing entry into the country, taking them direct to the connecting flight. This process is also used by arrangement with the airlines in the case of delayed flights.

7.2 Electronic distribution system

In order to be able to perform all these services quickly and without any problems, the baggage transport service works with one of the most advanced dispatching systems, which it played a very great part in the development of. This TESS system (Transport-Einsatz- Steuerungs-System = Transport Use Control System) is operated by a number of dispatchers, who pass on orders to staff on the apron by radio data transmission.

There is a small monitor in the staff vehicle containing all the data required to carry out the order and the staff have to acknowledge it from there. In the course of a month more than 90,000 transport orders are dealt with.

The vehicle fleet has more than 150 tractor units and more than 2,200 trailer units available at the current time. These tractor units are equipped with modern and very complex hybrid systems. Outside the building they are diesel powered and this charges two batteries which enable them to be electrically powered inside the building. The whole fleet is subject to a continuous maintenance program and is always kept up to the latest standards covering, amongst other aspects, pollution control.

7.3 Baggage transport development

To improve the recording of handling statistics for baggage transport the radio transmission is being converted from "analog radio data transmission" to wireless LAN transmission. After the new displays required for this have been installed in all the vehicles it will be possible to send better quality and considerably more of the information baggage drivers require to them on a user-friendly surface on which they can also record it.

In this way it is possible to inform drivers direct when moving off from the aircraft what the current transfer destination is. This eliminates the need for involving the loadmaster on the spot, who at the current time receives details of the transfer destinations at TMO (ten minutes before landing) and then passes the information to the driver. This makes a significant contribution to considerably improved transfer baggage turnaround, since it results in both saving time and also a more efficient distribution of transfer passengers.

The possibility of recording all the time stamps required for tracking in the EDP will also eliminate all the entries that have to be made at present by hand.

At the same time the TESS dispatching system is undergoing permanent further development. Another feature that will result in a significant easing of the load for the dispatchers is a Windows-supported surface which will provide a graphic display in real time of the current and upcoming utilization of the whole team. In consequence it will be possible to identify any bottlenecks in good time and to take appropriate action to avoid them.

In Frankfurt a high level of logistics and a well thought-out and functioning transport system ensures that baggage is conveyed smoothly and without error

8. The Staff Quality Factor

The only way to achieve smooth-running baggage handling is with committed, well-qualified and

turnaround and aircraft handling is the basis of Frankfurt's ability to handle a large amount of

continually trained specialist personnel. Well-established know-how in baggage

baggage reliably and without error.

8.1 Organization of the baggage services

In addition to the functioning infrastructure the organization of the baggage services and its upkeep are important prerequisites for a good service.

At the present time there are about 1,600 people with varying qualifications working in the baggage services. They ensure that the extensive range of services operates and guarantee that service standards are maintained.

A low rate of baggage going astray, careful handling of baggage and a rapid turnaround present the staff with ever-new challenges in their daily operations.

8.2 Qualification of staff

Well-established know-how in baggage turnaround and aircraft handling, reliable and flawless work, quality awareness, flexibility and customer-oriented behavior are demands that are placed on the team in the course of every day. Good and extensive basic and ongoing training is, therefore, a prerequisite and a permanent task.

The various members of staff have different duties. A foreman baggage handler is in charge of a team of six to eight men with varying levels of qualification.

Three foremen with their teams form a group of about 25 workers headed by a group foreman. The groups all have specific tasks and areas assigned to them.

The staff work around the clock in a three-shift pattern. In the summer months check-in starts as early as 1.00 a.m. and the last inbound aircraft are handled up to midnight.

Baggage service job profiles	Maintenance job profiles
Stage 1,2 and 3 baggage handlers	Power and plant electronic technicians
Baggage foremen and baggage movement foremen	Mechanics and Mechatronics
Group foremen	Foremen mechanics, foremen electricians and foremen electronics

Table 4: Baggage handling job profiles

8.3 Maintenance of the baggage facilities

Maintaining all the baggage facilities for three-shift operation is a major challenge, especially as the highest demands are made on availability. All parts of the various facilities are monitored electrically and electronically. Technical breakdowns are flagged up in the Baggage Control Center (BCC) and also on the industrial PCs in the maintenance staff's operational areas.

The maintenance staff are located in various operational areas in the baggage facility area. This enables them to deal with anything that goes wrong as quickly as possible. The average time taken to deal with a breakdown is just five to ten minutes from the time it occurs which underlines the high state of readiness that exists and is proof of skilled and qualified work.

Continuous training here too keeps the staff involved up to the latest technical standard.

1,600 experienced employees ensure a low rate of misdirected baggage, careful baggage handling and rapid baggage turnaround

9. Linking the Information Systems

These days baggage handling without a worldwide uniform data management system is inconceivable.

Operational Database in real time so that all staff on the spot and at the control desks can make optimum

In Frankfurt all baggage data from a wide variety of subsystems and external systems are entered in a Baggage

use of the available capacity to a high degree of quality.

9.1 Networked exchange of data

Setting up uniform data management in the hubs and the main intermediate stations is absolutely essential. In the information technology age baggage handling without the use of computer and information systems is inconceivable.

Various systems have been developed and installed, scattered all over the world independently of each other. The networking and integration respectively of these systems in a single integrated system is crucial for optimum process development in baggage logistics. Fraport accepted this challenge and began to implement it as long ago as 1997.

Using the exchange of data in accordance with the IATA standard, Fraport is committed at all times to the sustained expansion and optimization of networking with the wide variety of computer systems used by airlines and other airports.

Process control thanks to optimum provision of data

To enable everything to operate smoothly both now and in the future it is absolutely essential to provide the staff on the spot, at the control desks and on the service lines with the best possible data and information.

In addition the staff in the various sub-systems such as BRS (Baggage Reconciliation System) and TESS (baggage transport) are provided with displays of the data.

A "Baggage Operational Database" (BODB) has been developed in the baggage services. This database, which is being constantly further developed, is updated in real time with all the baggage data from the sub-systems and external systems. Using this as a basis, various applications (BOAP = Baggage Operational Application) provide support for the distribution of transfer baggage, the control of offloading points in the baggage conveyor facility plus the reservation of conveyor belts for inbound baggage. The constant updating of the data provides interactive monitoring which gives advance warning of any problems or deviations which may occur.

The objective of this application is, for one thing, to make better use of the existing capacity and improve its quality. For another thing the dispatchers need to have a better overview of the overall situation in the baggage services.

9.2 Tracking and tracing

The large volume of baggage and the many special cases that occur (changes to bookings, irregularities, security, etc.) call for comprehensive tracking and tracing of every item of baggage.

As every event in the process chain in the BODB mentioned above is stored, it is possible to keep track of every single piece of baggage at all times.

In Frankfurt it is possible to track every single piece of baggage seamlessly

10. Frankfurt Airport – Facts and Figures

More than 52 million passengers a year, 54% of those transfer passengers, a guaranteed transfer time of

with a 99.65% reliability rate, 100% multi-stage baggage check, more than 1,600 qualified and experienced

45 minutes, an annual baggage turnaround of nearly 40 million pieces of baggage, a 73 km long baggage conveyor facility employees in the baggage service. It is not only these figures that are impressive. So are all the others in the following tables.

FRA traffic volume

Volume development	2002	2003	2004	2005	2006
Passengers*	48,459.594	48,359.320	51,106.647	52,230.323	52,821.778
Originating passengers	47.1%	46.3%	46.8%	46.1%	47.0%
Transit passengers	52.9%	53.7%	53.2%	53.9%	54.0%
Business passengers	no evaluation	no evaluation	49.8%	51.0%	53.7%
Domestic*	7,891,218	7,579,233	7,292,845	7,024,393	6,759,379
Europe + intercontinental*	40,282,941	40,536,092	43,483,274	44,836,670	45,720,721
Peak month	September	August	August	August	July
Passengers	4,737,931	4,838,272	4,924,415	5,051,825	5,085,258
Peak day	174,269 (26.09.)	170,322 (30.08.)	177,666 (19.09.)	181,032 (30.07)	181,794 (29.09)

FRA baggage volume

Frankfurt/Main Airport	2002	2003	2004	2005	2006
Total baggage turnaround	37,273,847	36,795,870	38,681,987	39,378,818	39,359,290
Inbound baggage	9,960,166	9,592,767	10,077,611	10,479,897	10,681,523
Total outbound baggage	27,313,681	27,203,103	28,604,376	28,898,921	28,677,767
Transit baggage (GFA)	15,389,846	15,810,206	16,493,786	16,614,367	16,353,815
Originating passenger baggage (GFA)	9,308,450	9,061,915	9,587,058	9,821,570	10,252,437
Oversize baggage	1,183,074	1,008,492	1,013,776	974,303	1,160,768
Direct transfer	383,367	531,184	452,234	434,033	471,375
Hand transport	222,625	241,643	265,425	260,531	270,922
Last Minute (LMC) baggage	73,188	72,739	66,230	60,566	63,489
Gate baggage	43,569	48,376	53,981	56,021	92,285

GFA data

Frankfurt/Main Airport		GFA-T1	GFA-V3	GFA-T2 / Tunnel	Total
Delivery length	m	45,004	10,920	17,925	73,849
Sorting output	bag/h	10,000	6,000	7,800	
Linked sorting output	bag/h				18,000
Max. speed	m/s	5.0	2.5	5.0	
Early check-in bagg. storage unit/buffer	bag	5,200	2,700	2,100	10,000
MRKA - tub conveyor	m	350		282	632
MRKA – robot (separator/reassembler)	Pieces	18		14	32
Check-in desks					464
- Direct (check-in halls)	Pieces	259		136	395
- Indirect (Hall A and hall C)	Pieces	16 + 40			56
- Special baggage desks	Pieces	8		2	10
- Recheck-in desks	Pieces	3		2	5
- Train station check-in desks	Pieces	10			10
- Train station special desks	Pieces	1			1
- Train station auto. coding points	Pieces	1			1
- Check-in points for orig. passengers	Pieces	2 + 5			7
Check-in points for transit passengers	Pieces	26	1		27
Check-in pts. f. transit passengers autom.	Pieces	3	8	8	19
Post processing stations	Pieces	1	1	2	4
Rewrite tracks	Pieces		1	2	3
Offloading points	Pieces	41	15	21	77
Drives total	Pieces				22,488
- Drives conveyor elements	Pieces	10,220	2,030	4,931	17,181
- Drives check-in belts	Pieces	2,952		1,768	4,720
- Drives interline belts	Pieces	238	171	178	587
Cell controllers	Pieces	116	35	69	220
Programmable logic controllers	Pieces	227	28	168	423
Scanner points	Pieces	400	95	240	735
Installed electrical power	kw	15,288	3,712	6,678	25,678
Master computers		1 cluster comprising 2x HP Alpha ES 45 and 1x HP Alpha DS 10			
Main computers		3 off: per unit 1 Cluster comprising 2x HP Alpha DS 25 and 1x HP Alpha DS 10			
Number of containers (expandable to 32,767 containers)		approx . 18,500			
Max. dimensions of baggage		850 x 650 x 450mm			
Opening hours/max. daily performance to date		23 hours 110,000			

Inbound baggage facilities

Frankfurt/Main Airport	Terminal 1			Terminal 2		
Hall	A	B	C	D	E	Total
Number of carousels	6	12	8	6	6	38
Carousel length	52 m²	58 m²	44 - 83 m²	58 m²	58 m²	2,176 m²
Delivery time for baggage	2 Min.	2.5 Min.	2 Min.	1 Min.	1 Min.	
Belt type	Tilted plate	Tilted plate	Tilted plate	Tilted plate	Tilted plate	
Belt width	1.0 m	0.8 m	1.0 m	1.0 m	1.0 m	
Delivery speed	0.6 m/s	1.0 m/s	0.6-0.8 m/s	0.6 m/s	0.6 m/s	

Oversize baggage facilities (Inbound and outbound)

Number of belts	2	4	2	2	2	12
Delivery lenght	35 m	156 m	45 m	75 m	75 m	386 m
Delivery width	1.0 m	1.0 m	1.0 m	1.2 m	1.2 m	

Gate baggage facilities

Number of check-in desks	3	17	2	7	7	37
Delivery length	64 m	396 m	124 m	438 m	438 m	1,510 m
Delivery width	0.8 m	0.8-1.0 m	0,8-1.0 m	1.0 m	1.0 m	

Back-up facilities

Number	1	2	1	-	-	4
Delivery length	155 m	300 m	140 m	-	-	535 m
Delivery width	0.8 m	0.8 m	0.8 m	-	-	

Elevators

Facilities	1	2	1	2	2	8

List of tables and graphics

Fraport AG
Ground Services

P.O.Box
60547 Frankfurt/Main, Germany
Telephon +49 69 690-66847
Telefax +49 69 690-66898
Mail: handling@fraport.de
www.fraport.com