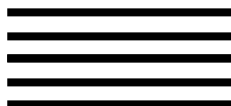


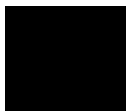
PROGRAMME FOR
HARMONISED AIR TRAFFIC
MANAGEMENT RESEARCH
IN EUROCONTROL



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PD/2 OPERATIONAL SCENARIOS

PHARE/DLR/PD2-7.1/OSD;1



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PD/2 OPERATIONAL SCENARIOS

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1. SCOPE

This document details the operational procedures to support PD/2.

It describes the working procedures of controllers for each of the three organisations of the PHARE Demonstration PD/2, ORG 0, ORG 1 and ORG 2.

It lists the main sequences of events for the air-ground, ground-ground dialogues.

Details of the operation of the Human Machine Interfaces to support these procedures will be developed during the facility test.

This document forms the output of task PD2-7.1.

Related Documents are outlined in annex B.

Where reference is made to related documents the version and issue of such documents will be the most recent as specified in the PHARE Document Database (see related documents).

To the reader:

Paragraphs written in *italics* indicate that the content is under discussion and not yet fixed.

The chapters which describe the working procedures for ORGANISATION 0, ORGANISATION 1 and ORGANISATION 2 can be read independently as self consistent units. Therefore many phrases are identical within the different units.

To support the comparison between the different ORGANISATIONS paragraphs written in bold within the Controller Working Procedures chapters ORGANISATION 1 and ORGANISATION 2 indicate that there are differences in comparison to the description of the preceding ORGANISATION (0 or 1).

2. INTRODUCTION

Whilst the non uniform development of economic conditions over recent decades has resulted in fluctuations in the growth rate of air traffic, there has been an underlying trend to an increase in demand.

Whilst economic forecasts do not lead to the expectation of an early repeat of conditions experienced at the end to the 1980s when annual growth rates of the order of 10% per annum were experienced over a number of years, estimates continue to predict demand doubling from the 1993 level by the early years of the 21st century.

Considerable gains in ATS capacity have been achieved during the late 1980s and early 1990s as a result of a coordinated programme of improvements with, for example, improved inter-centre communications, improved radar coverage etc. However, there have been few ATC centres where significant changes have been made to the level of external assistance being provided to controllers in the prediction and resolution of conflicts. Thus this growth has for the most part resulted in greater demands being placed upon controllers which has been alleviated where necessary by modifications to the structure of the airspace. Whilst further gains appear possible in the medium term by, inter alia, changes in sectorisation, improvements to the controller communications and display facilities etc., the potential for further significant capacity increases by these means is becoming small and unlikely to be sufficient to meet the forecast demands.

A means has to be found by which the controller can be enabled to handle a larger number of aircraft in a given airspace without significant increase in workload. This will have to be achieved whilst maintaining or improving system safety. One proposed method is by providing automated assistance to both the planning and tactical controllers and by application of data links to communicate between the airborne systems providing the aircraft trajectory predictions and those of the ground system which could support the controller in the resolution of conflicts and planning the efficient use of airspace.

In providing such support and removing from the controller and pilot certain executive tasks by means of direct computer to computer communication, it is necessary to ensure that the tasks removed for the pilot and controller are those which are best executed by computer and those which are best executed using the flexibility and adaptability of human skills are those which remain their responsibility.

The areas where computer support is expected to yield improvements are those which make use of their ability to provide accurate predictions of future aircraft profiles, analyse potential options for the resolution of conflicts and sequence aircraft for optimum use of airspace and runways. These together with the monitoring of flight execution, could provide a support environment which would allow a safe reduction in aircraft separation. To achieve this, detailed aircraft performance data, meteo condition information and criteria concerning aircraft operational requirements would need to be made available using data link communications.

These proposals raise a number of questions concerning the resulting division of responsibility and tasks between the aircraft and the ground. This will need to take into account, inter alia, the relative small bandwidth of available data links and the differing strengths and weaknesses of the human and the computer. It is to answer some of these questions that the developments within the PHARE Programme have been undertaken.

Within PHARE, the necessary ground and airborne tools are being produced and will be evaluated initially as individual components. The culmination of this work will be the execution of a series of real time simulations entitled „PHARE Demonstrations“. These will allow the developments to be evaluated not just on the basis of their individual capabilities but rather to establish how the elements work when combined into a proposed operational system. Different options will be assessed and recommendations made on the contribution such automated support could make to the future European ATM system.

The PHARE Demonstrations will be initiated by separate simulations of the enroute and TMA environments. The subject of PD/2 is the initial demonstration of the TMA environment which will take place subsequent to the evaluation of the enroute environment. The results from both will be used to guide further development and adaptation of facilities which will in turn be evaluated in subsequent demonstrations covering the full flight regime.

3. OBJECTIVES

The PHARE Demo PD/2 will be a measured exercise which aims to prove concepts and tools developed within PHARE. The most important objectives are to demonstrate the enhancements of:

Computer Assistance to the ATCO to handle increased arrival traffic,

Introduction of computer generated 4D-profile-Planning and Sequencing,

to support the ATCO to plan and establish a conflict free trajectory covering all flight phases from Entry Fix to the airport,

Experiences with usage of full duplex Data Link in addition to R/T for Exchange of Constraints and Trajectory Data,

and to evaluate the enhancements with respect to:

Performance (quantitative traffic handling)

Controller workload

Acceptance (controller approval)

So the effects of foreseen ATC enhancements will be measured in a scenario which provides a set of analysis and planning functions to assist the work of the planning controller and further automation of data coordination air/ground and ground/ground to optimise workload of both planning and executive ATC controllers.

The area to be considered will be an extended TMA. That means a combination of approach and enroute sectors within and around a selected TMA. This covers the time horizon of about 20 - 30 minutes or more of both arrival and departure flights, in which for arrivals the top of decent (TOD) out of cruise level is included.

Since PD/2 concerns a system to be used in post 2000 timeframe it is assumed that the controller working procedures, the working environment and the airspace structure will have no major changes. The following planning and control procedures are still based on current ATC practices.

4. ORGANISATIONS

For the TMA simulation of PD/2 different options have been developed corresponding to different methods by which the arrival and departure traffic is controlled. The following proposal of the PD/2 operational scenario and its realisation in simulation can be characterised as:

- Planning and control of arrival (Arrival Manager) within the extended TMA.
- A Meteo Data Base is an integral part of the enhanced ATC system.
- Departure traffic will be simulated as if there would be a Departure Manager.
- Overflights will be simulated.

The following paragraphs describe the operational aspects of the system. These take into account that the realisation of any future operational system needs to be a progress of evolution and the transition should be made in steps. So the ATC functionality of the reference system is similar to the existing one. Control procedures are still based in the main characteristics of the present day environment.

This is also an important aspect for the users of the system, the airlines and aircraft operators. One has to take into account, that in the beginning of a new ATC system not all aircraft will be equipped to take advantage of the capabilities and services available in the new system.

The human functions 'planning and tactical control' within each control unit (two controllers at one working position) will still exist, that means the sector concept remains, but computer assistance for planning and communication will be extended over each sector that belongs to the extended TMA (multisector planning).

The ground system should represent an ATC environment, which is responsible for the control of flights in an extended TMA, consisting of the original TMA with its adjacent enroute sectors. Building such a higher integrated environment is necessary because the ground-based arrival planning functions can only work satisfactorily if they cover a range like this.

To achieve credibility of the results of the evaluation an existing but slightly modified airport (Frankfurt 2000) should be modelled to enable the participation of controllers in the experiments, who are familiar with the situation in the simulated ATC-Centre. These controllers should also support the set-up of the simulation.

Traffic flows from or to adjacent control sectors/centres are to be predefined by the chosen boundary conditions within the simulation scenario.

A computer system on the ground will hold up-to-date data bases of information about aircraft performance, flight procedures, airspace organisation and meteorology.

The simulated ground system must provide different modes of operation characterised by three organisations:

ORG 0:

A reference mode, in which the controller has to handle the traffic samples with the standard means of 1995 (radar data, flight plans data, flight strips, weather information, radio communication) and assistance by e.g. the arrival planning system COMPAS. Flight strips will be used for documentation purposes ("ATCO's scratch pad").

ORG 1:

An advanced mode with 4D profile planning detection and resolution of planning conflicts and *negotiation of constraints or trajectory data*. An arrival planning system (Arrival Manager Version 1) avoids planning conflicts by separating aircraft in space and time.

The Arrival Manager has to be assisted by the following PATs: Trajectory Predictor, Conflict Probe, Flight Path Monitor and *Negotiation Manager*.

The controller has to perform the tactical conflict probing task manually. A data link (up and down) is available. No short term coordination between preceding sectors and extended TMA is considered. Flightstrips (paper) will be no longer used.

ORG 2:

A more advanced mode, additionally to ORG 1, with detection and resolution of tactical conflicts.

An arrival planning system Arrival Manager (Version 2) will support the tactical probing and resolution task instead of leaving this to the controller's manual work.

For this the Arrival Manager has additional functionality to assist problem solving.

The basic experimental method will be a measurement and evaluation of differences between simulation runs using reference and advanced modes of operation.

5. CONTROLLER WORKING PROCEDURES

In PD/2 the Extended TMA is sectorised in one TMA sector (about 30 NM radius around the airport) surrounded by three adjacent sectors where the transition from and to level flight takes place.

The procedures described in PD/2 are designed for IFR conditions. VFR procedures and a mixture between IFR procedures and VFR procedures are not taken into account here.

It is assumed that the runways in use are 25R and 25L. They are used for arrivals and departures. A runway 18 is used for departures only.

Runway direction change procedures and operations of runway 07L and 07R are not described because they will not be used in PD/2.

Figure 5.1 gives a schematic overview of the ETMA (north direction at top) with its sectorisation and arrival route structure. The characters X and R indicate the lateral flexibility limits of the routes for expedition (X) and for reduction (R) in time, building the Fan (north and south approaches) or the Trombone (west approaches) areas. RUD, GED and PSA are the Metering Fixes, where the control is transferred from ACC to the Pickup within the TMA sector. The handover of traffic from Pickup Controller to the Feeder takes place near the points, where the routes split in X and R branches. The frequency change to the Tower Controller takes place around the so called 'Gate' (Shown as a little bar perpendicular to the parallel lines of the extended centrelines 10 NM from threshold). The parallel runway system together with the runway 18, only used for departures is depicted in the centre of the figure.

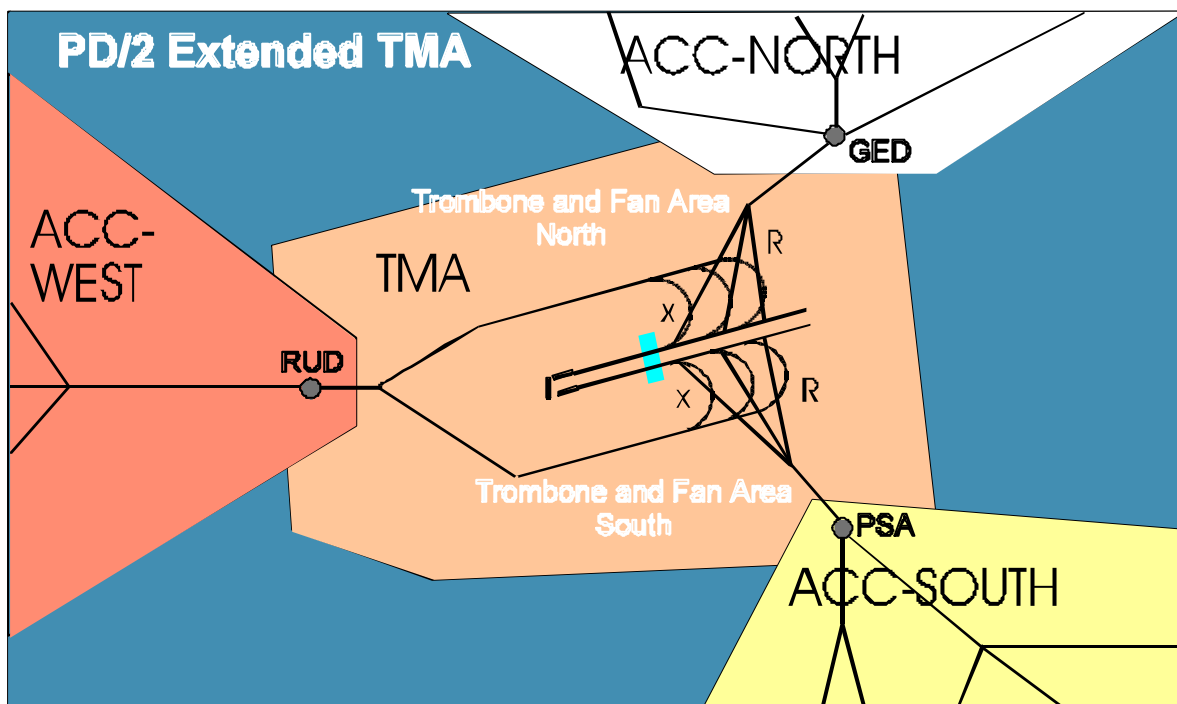


Figure 5.1: ETMA Structure

The **adjacent sectors** are controlled by **ACC controllers**, which have their licence for Enroute control. In PD/2 only one adjacent sector is staffed. This is the West Sector. The departure and arrival traffic are treated within the same airspace by different ACC controllers on using different R/T frequencies and routes. The traffic that comes from the two

other adjacent sectors is simulated as if they were staffed. The procedures and sector staffing are assumed as to be equal to the West ACC.

As in the today's system for the arrival traffic special coordination procedures between the different adjacent ACC sectors are not required for the ETMA structure used.

The performance of the departure traffic control is simulated as if there were ACC departure controllers that work along the published Standard Instrument Departures Routes (SIDs), These are separated from the Standard Arrival Routes (STARs), which results in a decoupling of the arrival traffic and the departure traffic.

The working position for the control of the arrival traffic and overflights (traffic from and to other airports) within the West Sector is staffed with one **Tactical Controller TC-W** (for **Tactical Controller ACC Arrival West**) and a **Planning Controller PC-W** (for **Planning Controller ACC Arrival West**).

In PD/2 possibly only the TC-W will be needed because co-ordination with other adjacent sectors (main task of the PC-W) is not modelled.

Both controllers sit side by side and can observe each other's displays. This allows to establish the necessary close teamwork and to perform the coordination between them in a very flexible and natural way.

A pilot addresses the TC-W by R/T by using the phrase „FRANKFURT RADAR“ on the reserved frequency channel.

The **TMA sector** is controlled by **APP controllers**, which have a licence in Approach control but also in Tower control (The ability to apply the Tower procedures in use at the airport is necessary due to safety reasons. A Tower controller for example has sometimes to turn an aircraft immediately, may be due to a problem on the runway, which affects the traffic controlled by the APP controller. Those events can be handled safely only if both the Tower and Approach do not need to spend time in explaining their specific procedures. For those events some kind of blind understanding is necessary, which can only be established if the procedures are actively present).

Two working positions for tactical controllers, a **TC-P** (for **Tactical Controller APP Pickup**) and a **TC-F** (for **Tactical Controller APP Feeder**) are needed, which work within the same airspace but on different R/T frequencies.

The team of the two tactical controllers is completed by a Planning Controller **PC-A** (for **Planning Controller Approach**)

The three APP controllers sit side by side and share their displays. This allows to establish the necessary close teamwork and to perform the coordination between them in a very flexible and natural way.

The pilot phraseology used for the Pickup TC-P is „FRANKFURT ARRIVAL“ and „FRANKFURT DIRECTOR“ for the feeder TC-F.

The procedures used for the Organisations of PD/2 are described in terms of tasks that have to be performed by the five (*four*) controllers.

5.1 ORGANISATION 0

The procedures used for ORG 0 will be based on those used for Frankfurt today. The controllers will be supported by the COMPAS system which provides sequencing and scheduling proposals for an ETMA based on rough flight time estimates.

In general the order of priorities for the work of all controllers is:

- first safety;
- second efficiency (optimal use of airspace capacity available in terms of delay reduction, minimal fuel consumption and noise abatement)of the overall traffic;
- third efficiency for flights on the basis of individual aircraft performance and airborne requests.

5.1.1 Planning Controller West Sector PC-W

The role of the PC-W is one of co-ordination. Both intersector and intrasector co-ordination. *If mainly co-ordination only with the Approach is necessary (in case of low traffic rate of overflight and independent departures), the tasks of PC-W could be performed by the TC-W. In those cases an extra PC-W position is not necessary.)*

5.1.1.1 Intersector Co-ordination:

The PC-W receives the flight plan information in form of paperstrips 10 minutes before the aircraft enters the sector.

After consideration of the level, routing and displayed radar data the PC-W may accept the traffic. The PC-W determines whether or not potential conflicts exist by comparing the Entry Flight Level or Cleared Flight Level with traffic already on FRANKFURT RADAR frequency.

If a potential problem is detected the PC-W telephones with the ATCO of the sector where the aircraft is controlled and achieves a revised coordination(In PD/2 this is only possible with the TMA sector).

Any new coordinated information like new Entry Flight Level etc. the PC-W will note on the paper strip.

The PC-W monitors the COMPAS Display for changes introduced by the PC-A of the TMA sector. In case of potential problems PC-W telephones the PC-A and informs the PC-A.

If the planning proposals of the COMPAS system cannot be fulfilled due to problems within the sector the PC-W informs the PC-A about this situation. PC-A will then either change the COMPAS planning or the affected aircraft will be guided further without use of the COMPAS proposals.

PC-W co-ordinates changes that could have impact on the overall planning within the ETMA resulting from the tactical situation in the ACC with the PC-A.

5.1.1.2 Intrasector Co-ordination:

The PC-W monitors the present traffic situation and informs the TC-W about any planned traffic which would require special attention by the TC-W.

The PC-W sorts the flight strips of aircraft entering the sector in the timely order, as their entrance into the sector is expected, and fills the flight strip holder of the TC-W with sorted flight strips.

The PC-W updates the COMPAS Display if sequence changes or larger delays as original planned are necessary due to the tactical situation.

If the aircraft that enters the sector has no flight plan information yet, PC-W fills out an empty flightstrip (not in PD/2).

If this aircraft is also not known by the COMPAS system the PC-W adds a slot for that aircraft in the COMPAS system (not in PD/2).

5.1.1.3 Summary of PC-W Task

Use flight information, in association with flight-strip information, COMPAS data and Radar data to identify and assess potential conflicts between aircraft offered into the sector.

Notify TC-W about any special conditions about the traffic before entering the sector.

Update the Flight Strips if any difference between Flight Plan and actual situation has occurred and provide the TC-W with Flight Strips in the expected order of incoming traffic.

Co-ordinate with TC of adjacent sectors if entry and exit conditions have to be changed.

Update the COMPAS Display for changes in the sequence of traffic under control that are planned or already have been applied by the TC-W.

Co-ordinate with PC-A if the arrival planning generated by PC-A would induce major problems within the ACC-W sector.

5.1.2 Tactical Controller West Sector TC-W

The TC-W will be responsible for ensuring conflict-free passage of aircraft through his airspace. The TC performs all direct communications via R/T with the aircraft and will be responsible for all transfers to and from the neighbouring sectors. Transfer of control is coincident with transfer of communication.

The transfer of traffic is done near the sector boundaries based on standing agreement procedures.

5.1.2.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Entry Fixes **EF** and also leave the sector over defined fixes (for arrival traffic these are the Metering Fixes **MF**). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors.

Modifications of agreements can be co-ordinated with the TC of the neighbouring sector using telephone lines on a ad hoc basis.

These are agreements like

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-W can delegate some or all of those co-ordination tasks to the PC-W.

If the main standing agreement (to fly over fixes during transfer) cannot be met for tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbouring sector TC.

5.1.2.2 Summary of TC-W Task

The tasks of TC-W can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-P for arrivals and other ACC TC for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather information,
- application of guidance and control commands in order to avoid separation conflicts (3 NM *min lateral* ,1000 ft vertical),
- Apply guidance commands and clearances from cruise to transfer point (MF for arrivals, Exit Fix for Overflights) in order to fulfil COMPAS schedule using the COMPAS display (delay and accelerate aircraft in the descent phase),
- Inform PC-W if the COMPAS schedule cannot be met in terms of sequence,
- negotiate with PC-W and TCs of adjacent sectors if standing agreements have to be changed,
- hold aircraft within the sector either on request of TC-P or in case of any doubt about the status of standing agreements.

5.1.3 Planning Controller Approach PC-A

The role of the PC is one of co-ordination.

Both intersector co-ordination between the terminal area TMA and the adjacent sectors and intrasector co-ordination in close co-operation with TC-P and TC-F.

PC-A performs and co-ordinates the planning for all arrivals within the Extended Terminal Area ETMA using the COMPAS system for ground-ground communication of plan changes.

5.1.3.1 Intersector Co-ordination:

The PC receives the flight plan information in form of paperstrips about 30 Minutes in advance (at the same time as it is available for the ACC sectors of the ETMA).

The PC monitors the COMPAS Display and checks if the sequence and schedule is workable by the Approach TCs taking into account the present and/or expected traffic situation within the TMA.

In case of potential problems PC-A either inputs planning changes into the COMPAS system and/or informs the PC-W about this.

If the planning proposals of the COMPAS system cannot be fulfilled, because the planned traffic rate delivered from the ACC sectors is too high for the tactical controllers, PC-A applies inputs into the COMPAS system.

If traffic reduction for a longer period (more than 5 minutes) is needed, PC-A increases the minimum spacing the COMPAS planning is based on (increasing a so called FLOW value). This method will not be applied within the PD/2 experiments since traffic demand is one of the independent variables.

If a traffic reduction for a shorter period of time is sufficient (about 1 to 5 minutes), PC-A adds slots into the COMPAS system.

Those changes are also displayed on the COMPAS displays of the adjacent ACC sectors. It is a standing agreement that all changes in scheduled time and sequences induced by PC-A are accepted by default.

If PC-A is informed by a PC of an adjacent ACC sector about problems to perform in accordance with the new plan, PC-A negotiates work-around procedures with this PC in close reconciliation with TC-P and/or TC-F.

PC-A performs inputs into the COMPAS system very carefully in order to avoid frequent changes of the COMPAS schedules in the ACC sectors.

Therefore updates of the COMPAS system by the PC-A just to reflect the tactical situation within the TMA is not mandatory, since this would induce unnecessary changes for the ACC planning.

On request of TC-P the PC-A co-ordinates changes of the standing agreements with the adjacent ACC sectors.

5.1.3.2 Intrasector Co-ordination

The PC-A monitors the present traffic situation and informs the TC-P about any planned traffic which would require special attention by the TC-P.

The PC sorts the flight strips of aircraft entering the sector in the timely order, as their entrance into the sector is expected, and fills the flight strip holder of the TC-P with sorted flight strips.

The PC-A updates the COMPAS Display if sequence changes or larger delays as originally planned are necessary due to the tactical situation.

If the aircraft that enters the sector has no flight plan information yet, PC-A fills out an empty flightstrip.

If this aircraft is also not known by the COMPAS system the PC-A adds a slot for that aircraft in the COMPAS system.

5.1.3.3 Summary of PC-A Task

- Use flight information, in association with flight-strip information, COMPAS data and Radar data to identify and assess potential conflicts between aircraft offered into the sector.
- Notify TC-P and TC-F about any special conditions about the traffic before entering the sector.
- Update the Flight Strips if any difference between Flight Plan information and actual situation has occurred and provide the TC-P with Flight Strips in the expected order of incoming traffic.
- Co-ordinate with TC and /or PC of adjacent sectors if entry and exit conditions have to be changed.
- Update the COMPAS system in order to generate an adequate traffic flow in the TMA.
- If necessary, update the COMPAS system with respect to the actual traffic situation within the TMA.

5.1.4 Pickup Approach TC-P

The main tasks of TC-P are to establish the COMPAS landing sequence and to prepare a safe and effective runway allocation.

In close co-operation with TC-F the TC-P will be responsible for ensuring conflict-free passage of aircraft (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) through the TMA airspace.

The TC-P performs all direct communications via R/T with the aircraft and will be responsible for transfers of arrivals from the Metering Fix until transfer of control to TC-F is performed. This transfer is done as soon as the landing sequence is decided and the aircraft is free of conflict in relation to TC-Ps further traffic.

The transfer from ACC is done near the sector boundaries under standing agreement procedures. The arrival traffic is accepted close to the Metering Fixes after initial call of the aircraft.

If the weather information received by the aircraft is out of time (information version received by ATIS will be reported during initial call by pilot), TC-P informs pilot about new weather update available.

The landing sequence has to be close co-ordinated with TC-F if the COMPAS sequence is not chosen.

The aircraft are guided with radar vectors, descent and speed commands via R/T towards the Extended Centreline.

If the transition from Flight Level to Altitudes is advised or if QNH has changed, the pilot has to be informed about the actual QNH value.

5.1.4.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Metering Fixes **MF** and also leave the sector over defined fixes (for overflights only). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors. The handover process for arrival traffic between Pickup TC-P and Feeder TC-F within the TMA is performed in a very close co-operation but also on the basis of ad hoc agreements.

Agreements can be co-ordinated with the TC of the neighbour sector using telephone lines on an ad hoc basis.

These are agreements e.g.:

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels,
- to transfer aircraft in distinct speeds.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-P can delegate some or all of those co-ordination tasks to the PC-A.

If the main standing agreement (to fly over fixes during transfer) cannot be met by tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbour sector TC.

5.1.4.2 Intrasector Co-ordination:

The TC-P monitors the present traffic situation and informs the PC-A and/or TC-F about any traffic which would require special attention by the PC-A and/or TC-F.

If an aircraft is advised to contact TC-F, TC-P transfers the flight strip of that aircraft to the TC-F.

If TC-F decides to change the sequence and/or runway allocation due to tactical problems, TC-P re-plans the aircraft on pickup frequency to adjust and optimise the traffic for the new condition.

5.1.4.3 Summary of TC-P Task

The tasks of TC- P can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-F for arrivals and to other ACC TCs for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather display,
- application of guidance and control commands in order to avoid separation conflicts,

- apply guidance commands to transfer point (vicinity of extended centreline for arrivals, Exit Fix for Overflights) in order to fulfil COMPAS schedule and sequence using the COMPAS display,
- inform PC-A if the COMPAS schedule cannot be met in terms of sequence,
- negotiate with TC-F and TCs (*and/or* PCs) of adjacent sectors if standing agreements have to be changed,
- if necessary hold aircraft within the sector either on request of TC-F or in case of any doubt about the status of standing agreements.

5.1.5 Feeder Approach TC-F

The main task of the Feeder Controller TC-F is to guide the aircraft conflict-free (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) to the extended centreline, to give ILS clearance and to establish separation over the threshold by speed commands up to the Outer Marker (4 NM from threshold).

Normally near the gate (10 NM from threshold) the transfer of communication to the Tower Controller takes place. In this case the transfer of communication is not coincident with transfer of control. TC-F is responsible for the guidance of aircraft up to the threshold.

Every control command from tower controller has to be approved by TC-F before, because otherwise the minimum separations at ILS could not be guaranteed (in PD/2 no Tower/TC-F interaction is modelled other than transfer of communication).

If an aircraft is established on ILS the minimum separation between two aircraft flying in trail on the same glidepath can be reduced to 2.5 NM for non Wake Vortex relevant pairs. For aircraft established on different ILS (25R and 25L) no minimum separation has to be applied (independent runways).

5.1.5.1 Standing Agreement

The main standing agreement is that each aircraft will leave the sector near the Gate already established on ILS for 25R or 25L.

Other agreements can be co-ordinated with the Tower Controller on a ad hoc basis.

These are agreements e.g.:

- to use only one runway,
- to open a gap for departing aircraft

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-F can delegate some co-ordination tasks to the PC-A.

5.1.5.2 Summary of TC-F Task

The tasks of TC-F can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation, ILS clearance and frequency change command to initiate handover to Tower Controller for arrivals),

- surveillance of aircraft using the radar display and weather display,
- apply guidance and control commands in order to avoid separation conflicts,
- guide the aircraft to the localizer,
- give clearance for allocated ILS,
- establish separation on ILS,
- inform PC-A and TC-P if the schedule cannot be met in terms of sequence,
- negotiate with TC-P and Tower Controller if standing agreements have to be changed,
- note changes in aircraft status and applied commands on the flight strip.

5.2 ORGANISATION 1

The procedures used for ORG 1 will be based on those of ORG 0 but with additional support by automated systems.

This system consists of:

An advanced mode with 4D profile planning, detection and resolution of planning conflicts and *negotiation of constraints or trajectory data*. An arrival planning system (Arrival Manager Version 1) avoids planning conflicts by separating aircraft in space and time.

The Arrival Manager has to be assisted by the following PATs: Trajectory Predictor, Conflict Probe, Flight Path Monitor and *Negotiation Manager*.

The controller has to perform the tactical conflict probing task manually.

A data link (up and down) is available. No short term coordination between preceding sectors and extended TMA is considered.

Flightstrips (paper) will be no longer used.

In general the order of priorities for the work of all controllers is:

- first safety;
- second efficiency (optimal use of airspace capacity available in terms of delay reduction, minimal fuel consumption and noise abatement) of the overall traffic;
- third efficiency for flights on the basis of individual aircraft performance and airborne requests.

5.2.1 Planning Controller West Sector PC-W

As in ORG 0 the role of the PC is one of co-ordination, both intersector and intrasector co-ordination.

In addition to ORG 0 the PC-W is also responsible for the co-ordination and performance of air-ground communications via datalink for Class A aircraft.

Since co-ordination only with the Approach is available in the PD/2 experiment (as it would be the case in a real system in case of low traffic rate of overflight and independent departures), the tasks of PC-W could be performed by the TC-W. Therefore an extra PC position is not necessary.

5.2.1.1 Intersector Co-ordination:

The PC-W receives the flight plan information in form of paperstrips 10 minutes before the aircraft enters the sector.

After consideration of the level, routing and displayed radar data **and aircraft category (Class A equipment)** the PC-W may accept the traffic. The PC-W determines if potential conflicts exist by comparing the Entry Flight Level or Cleared Flight Level with traffic already on FRANKFURT RADAR frequency.

If a potential problem is detected the PC-W telephones with the ATCO of the sector where the aircraft is controlled and achieves a revised coordination. In PD/2 this is only possible with the TMA sector.

For adjacent sectors equipped with electronic co-ordination support (e.g. PD/1 system) this negotiation can be performed by an electronic co-ordination procedure based on e.g. label interaction or message windows (see reference 1).

With the PC-A the PC-W co-ordinates changes that could have impact on the overall planning within the ETMA resulting from the tactical situation in the ACC.

Any new coordinated information like new Entry Flight Level etc. the PC-W will input on the electronic flight plan representation.

The PC-W monitors the AM Display for changes introduced by the PC-A of the TMA sector. In case of potential problems PC-W telephones the PC-A and informs the PC-A.

If the planning proposals of the Arrival Manager cannot be fulfilled due to problems within the sector the PC-W informs the PC-A about this situation. ***PC-W works out all aircraft that take part on the problem. After co-ordination with TC-W the information about new planned route, exit flight level, speed and sequence of affected aircraft based on manually control procedures will be input to the electronic flight plan system for co-ordination with PC-A.***

Class A aircraft specific:

Class A aircraft affected by manual control will be declared to Class B aircraft by R/T communication performed by TC-W.

5.2.1.2 Intrasector Co-ordination:

The PC-W monitors the present traffic situation and informs the TC-W about any planned traffic which would require special attention by the TC-W.

The PC is responsible for the update of the electronic flight plan information, whenever the tactical situation requires deviation from the actual plan.

The PC-W updates the AM Display if sequence changes or larger delays as original planned are necessary due to the tactical situation.

If the aircraft that enters the sector has no complete flight plan information yet, PC-W generates a new electronic plan for this aircraft (This function is not used within PD/2).

Either on request of TC-W or by detection of a R/T command which makes a further flight in the Class A category no longer possible PC-W updates the electronic system.

Class A aircraft specific:

The PC-W monitors the automatic performance of trajectory negotiation with Class A aircraft.

There is only one negotiation foreseen in ORG 1. This is when the plan for a new aircraft entering the ETMA has been frozen by the Arrival Manager.

In the West sector this negotiation consists of three steps:

1. Uplink of Tube (route allocation and constraints at MF and Gate at least).

This requires that the AM Manager has frozen the 4D-planning of this aircraft (about EF, but timely before the first TOD, where the aircraft leaves its cruise level).

2. Downlink of Trajectory

If the aircraft has accepted the uplinked constraints it downlinks a trajectory which fulfils the constraints.

If the aircraft cannot fulfil the constraints it sends down a message, which declares itself as a Class B aircraft.

Every downlink of trajectory causes a new check of this trajectory in terms of conflicts and constraints against all other active system plans.

3. Class A Clearance

After reception of the airborne trajectory a „contract given“ message is transmitted by an automatic uplink.

This message exchange would imply a standard clearance to progress up to the *Threshold (the GATE)*.

After establishment of contract the PC-W monitors as TC-W does the flight progress along the contracted trajectory with the support of the FPM AND CP tools.

Every aircraft violating its 4D-tube will be treated as Class B aircraft by the system automatically.

Every deviation or conflict indicated by a Flight Path Monitor or a Conflict Probe message has to be assessed in terms of relevance for the status of Class A aircraft in close co-operation with TC-W.

If it becomes necessary (e.g.: deviations to large, conflicts cannot be solved by touching other Class B aircraft) to guide Class A aircraft manually the status of aircraft would be changed from Class A to Class B automatically as soon as PC-W updates the system about the tactical intervention.

Affected Class A aircraft will become aware of their status change by R/T control performed by TC-W.

A Class A equipped aircraft, which has been guided as a Class B aircraft due to tactical reasons can not be brought back to a Class A aircraft category.

Class B aircraft specific:

PC-W supports TC-W in monitoring of Class B aircraft. For this purpose PC-W monitors the FPM and CP messages for Class B aircraft as well as for Class A aircraft.

In case that the standard routes and means on which the AM plans are based are not sufficient due to tactical reasons, maybe only for a limited period in time, PC-W supports the TC-W in marking the affected Class B aircraft as manually guided in order to inform the electronic system to suppress senseless 4D Guidance advisories based on the old 4D-plan.

If those aircraft are brought back to the planned trajectory or if the system can produce a new trajectory for that aircraft with the help of controller inputs, the 4D-Guidance support possibility will be announced by the system.

5.2.1.3 Summary of PC-W Task

- **Use flight-plan information, AM data, FPM and CP messages and Radar data to identify and assess potential conflicts between aircraft offered into the sector.**
- Notify TC-W about any special conditions about the traffic before entering the sector.
- Update the electronic system if any difference between system plan and actual situation has occurred.
- **Monitor the air/ground negotiation process for Class A aircraft.**
- **Co-ordinate with TC-W if a Class A to Class B aircraft change has to be applied.**
- Co-ordinate with PC/TC of adjacent sectors if entry (not performed in PD2) and exit conditions have to be changed.
- **Update the AM Display for changes in the sequence of west inbound traffic that are planned or already have been assumed by the TC-W.**
- Co-ordinate with PC-A if the arrival planning generated by PC-A would induce major problems within the ACC-W sector.

5.2.2 Tactical Controller West Sector TC-W

The TC-W will be responsible for ensuring conflict-free passage of aircraft through his airspace.

The TC performs all direct communications via R/T with the aircraft and will be responsible for all transfers to and from the neighbouring sectors.

Transfer of control is coincident with transfer of communication.

The transfer of traffic is done near the sector boundaries based on standing agreement procedures.

The predictability and accuracy in time by which the arrival traffic can be transferred to the TMA will be supported by an automated system which integrates air and ground computers.

The control methods used by the automated system either airborne within the 4D-FMS if a contract with the ground has been established via Datalink (4D-Guidance of Class A aircraft) or 4D-Guidance commands generated by the Arrival Manager on ground (4D-Guidance of Class B aircraft) are based on a standardised set of control methods.

These methods are compatible with the standing agreements for manual control in ORG 0.

The application domains and limits of the different 4D-Guidance methods are supposed to be well known by pilots and controllers. By this way the application of 4D-guidance is treated as permanent automated procedures like flight on an ILS or flying within a holding.

For a 4D equipped aircraft it is necessary that the pilot is in the loop during the negotiation process via datalink. This guarantees that the pilot knows if the aircraft is guided along the Class A aircraft procedures.

5.2.2.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Entry Fixes **EF** and also leave the sector over defined fixes (for arrival traffic these are the Metering Fixes **MF**). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors.

If an aircraft is advised to contact the next TC, TC-W marks that aircraft as a "released" one.

Modifications of agreements can be co-ordinated with the TC of the neighbouring sector using telephone lines on a ad hoc basis.

These are agreements like

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-W can delegate some or all of those co-ordination tasks to the PC-W.

If the main standing agreement (to fly over fixes during transfer) cannot be met for tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbouring sector PC/TC.

Class A aircraft specific:

In close co-operation with PC-W the TC-W monitors the flight progress of a Class A aircraft.

If no problem is detected by TC these aircraft will fly with no other R/T communications than initial call when entering and frequency change when leaving the sector.

Every time TC sees the necessity due to safety reasons, TC can guide the aircraft via R/T.

Every heading, speed and level change command given via R/T to this aircraft implies that this aircraft is treated further as a Class B aircraft manually guided via R/T. A negotiated contract between air and ground via datalink is no longer valid then.

The status of aircraft automatically changes from Class A to Class B as soon as the system is updated about a tactical intervention.

Before a Class A equipped aircraft has got the ETMA contract via datalink the support of the ground system for the controller is based on the calculations for a Class B aircraft.

If during the negotiation process via datalink a guidance command is applied by TC this aircraft is treated further as a Class B aircraft, even if the negotiation cycle via datalink will be completed successfully afterwards.

As a general rule R/T communication always overrules datalink communication.

On request by TC the guidance commands produced by the ground system for all aircraft for the support of 4D-Guidance can be displayed by the electronic system for selected *or all* Class A aircraft.

In the ORG 1 system the 4D-equipment of a Class A aircraft can be used only if a contract could be reached through the datalink negotiation.

If a Class A aircraft has been classified to a Class B aircraft no reclassification method back to a Class A category is available.

Class B aircraft specific:

For all arriving aircraft the Arrival Manager gives automation support for the 4D-Guidance of aircraft along the planned route.

The AM has only a limited set of methods available to obtain higher accuracy in time then achievable by conventional guidance.

The TC transmits the 4D-Guidance advisories produced automatically by the ground system via R/T to the aircraft. By this the scheduled delivery time of an aircraft at the TMA Metering Fix MF can be met more precisely.

These 4D-advisories consist of:

- Indication, where the Top of Descend TOD should be located,
- to which Flight Level an aircraft should descent,
- Speed advisories
- Holding at the MF (*Level and Number of Turns*)

The Flight Path Monitor Tool alerts the TC if deviations of the planned trajectory will probably need special attention.

If the 4D-Guidance support has reached its internal used controlability limits the TC will be alerted.

In those cases the TC tries to apply control methods for this aircraft, which are not yet available for the automation support system to find back to the trajectory on which the Arrival Manager is based on.

It is always possible to apply other guidance commands as advised by the automated system. This can be required by the momentary tactical situation due to safety reasons.

In those cases TC-W or PC-W on request of TC-W updates the electronic system with inputs of the commands applied.

These inputs serve keeping the system updated and for the information and co-ordination of the human operators purposes; they are not used to establish new plans and trajectories within the ground system.

The automated ground system calculations for conflict probing and monitoring of the flight path will be based on the latest update of the trajectories.

If the controller uses non standard control methods and procedures without informing the automated system, the application of manual control will normally lead to warnings produced by the Flight Path Monitor.

If the ground system is informed by the TC-W (or PC-W) about manual guidance of an selected aircraft some/all messages from the automated ground system regarding this aircraft can be suspended within the control sector.

Those aircraft have than to be guided further manually until the conditions for a Class B 4D-Guidance support are fulfilled again: The aircraft flies within a tube around a trajectory known by the Ground System.

5.2.2.2 Summary of TC-W Task

The tasks of TC-W can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-P for arrivals and other ACC TC for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather display,
- application of guidance and control commands in order to avoid separation conflicts (3 NM *min lateral* ,1000 ft vertical),
- **apply guidance commands and clearances from cruise to transfer point (MF for arrivals, Exit Fix for Overflights) in order to fulfil the schedule of Arrival Manager using the Arrival Management Display and 4D-advisories for Class B aircraft,**
- **delay and accelerate aircraft in the descent phase in accordance with the AM schedule,**
- Update the Ground System about any guidance command given,

- **Inform PC-W if the AM schedule cannot be met in terms of sequence,**
- negotiate with PC-W and PCs/TCs of adjacent sectors if standing agreements have to be changed,
- **hold aircraft within the sector either on request of AM or TC-P or in case of any doubt about the status of standing agreements.**

5.2.3 Planning Controller Approach PC-A

As in ORG 0 the role of the PC-A is one of co-ordination. Both intersector and intrasector co-ordination.

PC-A performs and co-ordinates the planning for all arrivals within the Extended Terminal Area ETMA.

5.2.3.1 Intersector Co-ordination:

The PC-A receives the flight plan information in an electronic representation about 30 Minutes in advance (at the same time as it is available for the ACC sectors of the ETMA).

The PC-A monitors the Arrival Management Display and checks if the sequence and schedule is workable by the Approach TCs taking into account the present and/or expected traffic situation within the TMA.

In case of potential problems PC-A either inputs planning changes into the electronic system and/or informs the PC-W about this.

If the planning proposals of the Arrival Manager system cannot be fulfilled, because the traffic rate delivered from the ACC sectors has to be reduced, PC-A applies inputs into the Arrival Manager.

If traffic reduction for a longer period (more than 5 minutes) is needed, PC-A increases the minimum spacing the AM planning is based on. (This method will not be applied within the PD/2 experiments since minimum spacing is one of the independent variables).

If a traffic reduction for a shorter period of time is sufficient (about 1 to 5 minutes), PC-A adds slots into the AM system.

Changes of the AM display are also displayed on the displays of the adjacent ACC sectors. It is a standing agreement that all changes in scheduled time and sequences induced by PC-A are accepted by default in the adjacent sectors.

These updates of the display serve for information between the human controllers mainly indicating plan changes due to tactical reasons. The ground system uses this information only to develop constraints and trajectories for new aircraft that have not yet a frozen plan. All affected aircraft have to be guided manually along the new plan without 4D-Guidance support.

Because those changes induced by tactical requirements within the TMA performed by PC-A could result in a large amount of aircraft which needs to be guided manually

within the ACC, the system will indicate all those aircraft automatically. *PC-A can then decide to execute or not (probing function).*

If PC-A is informed by a PC/TC of an adjacent ACC sector about problems to perform in accordance with the new plan, PC-A in close reconciliation with TC-P and/or TC-F negotiates work-around procedures with this PC/TC via telephone.

The downgrading of an aircraft from Class A to Class B can only be performed if the aircraft has been released by the ACC controllers. PC-A has to wait until it is released by TC-W or PC-A has the possibility to contact PC-W to initiate a clearance restriction via TC-W R/T.

5.2.3.2 Intrasector Co-ordination

The PC-A monitors the present traffic situation and informs the TC-P about any planned traffic which would require special attention by the TC-P.

The PC is responsible for the update of the electronic flight plan information, whenever the tactical situation requires deviation from the actual plan.

This decision is done in close co-ordination between PC-A and TC-P and /or TC-F.

The PC-A updates the AM Display if sequence or RWY allocation changes or larger delays as original planned are necessary due to the tactical situation.

Manual plan updates have the consequence that the affected aircraft are indicated as to be guided manually.

Because a plan update does not lead to a recalculation of the trajectories in ORG 1, affected aircraft are guided by the automated system along their system trajectories further.

The realization of the new plan has to be done 'manually' by the tactical controllers. As soon as a controller updates the system about a guidance command, which differs from the system trajectory, then this system trajectory is marked as being suspended automatically.

If the aircraft that enters the sector has no complete flight plan information yet, PC-A generates a new electronic plan for this aircraft (This feature is not used within the PD/2 experiments).

Either on request of TC-P or TC-F or by detection of a R/T command which makes a further flight in the Class A category no longer possible, PC-A updates the electronic system.

PC-A informs TC-P and TC-F about deviations from the 4D-tube the AM is based on. For this purpose PC-A monitors the FPM messages for Class B aircraft as for Class A aircraft when the AM plan has been frozen.

In case that the standard routes and means on which the AM plans are based are not sufficient due to tactical reasons, maybe only for a limited period in time, PC-A supports the TC-P and TC-F in marking the affected Class B aircraft as manually

guided in order to inform the electronic system to suppress senseless 4D Guidance advisories based on the old 4D-plan.

If those aircraft are brought back to the planned trajectory or if the system can produce a new trajectory for that aircraft with the help of controller input, the 4D-Guidance support possibility will be announced by the system.

5.2.3.3 Summary of PC-A Task

- **Use flight-plan information, AM data, FPM and CP messages and Radar data to identify and assess potential conflicts between aircraft offered into the sector.**
- Notify TC-P and TC-F about any special conditions about the traffic before entering the sector.
- **Update the electronic system if any difference between system plan and actual situation has occurred.**
- **Co-ordinate with TC-P and TC-F if a Class A to Class B aircraft change has to be applied.**
- Co-ordinate with PC/TC of adjacent sectors if entry and exit conditions have to be changed.
- **Update the AM Display for changes in the sequence and RWY allocation of inbound traffic that are planned or already have been assumed by the TC-P or TC-F.**

5.2.4 Pickup Approach TC-P

The main tasks of TC-P are to establish the AM landing sequence and to prepare a safe and effective runway allocation.

In close co-operation with TC-F the TC-P will be responsible for ensuring conflict-free passage of aircraft (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) through the TMA airspace.

The TC-P performs all direct communications via R/T with the aircraft and will be responsible for transfers of arrivals from the Metering Fix until transfer of control to TC-F is performed. This transfer is done as soon as the landing sequence is established and the aircraft are free of conflict.

The transfer from ACC is done near the sector boundaries under standing agreement procedures. The arrival traffic is accepted close to the Metering Fixes after initial call of the aircraft.

If the weather information received by the aircraft is out of time (information version received by ATIS will be reported during initial call by pilot), TC-P informs pilot about new weather update available.

The landing sequence has to be close co-ordinated with TC-F if the AM sequence is not chosen.

The aircraft are guided with radar vectors, descent and speed commands via R/T towards the Extended Centreline.

If the transition from Flight Level to Altitudes is advised or if QNH has changed, the pilot has to be informed about the actual QNH value.

TC-P informs the aircraft about the expected runway allocation (the allocation of RWY is done by AM for Class A aircraft or TC-F).

The predictability and accuracy in time by which the arrival traffic can be transferred to the Tower will be supported by an automated system which integrates air and ground computers.

The control methods used by the automated system either airborne within the 4D-FMS if a contract with the ground has been established via Datalink (4D-Guidance of Class A aircraft) or 4D-Guidance commands generated by the Arrival Manager on ground (4D-Guidance of Class B aircraft) are based on a standardised set of control methods.

These methods are compatible with the standing agreements for manual control in ORG 0.

The application domains and limits of the different 4D-Guidance methods are supposed to be well known by pilots and controllers. By this way the application of 4D-guidance is treated as permanent automated procedures like flight on an ILS or flying within a holding.

5.2.4.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Metering Fixes **MF** and also leave the sector over defined fixes (for overflights only). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors. The handover process for arrival traffic between Pickup TC-P and Feeder TC-F within the TMA is performed in a very close co-operation but also on the basis of ad hoc agreements.

Agreements can be co-ordinated with the TC of the neighbour sector using telephone lines on an ad hoc basis.

These are agreements e.g.:

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels,
- to transfer aircraft in distinct speeds.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-P can delegate some or all of those co-ordination tasks to the PC-A.

If the main standing agreement (to fly over fixes during transfer) cannot be met by tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbour sector PC/TC.

5.2.4.2 Intrasector Co-ordination:

The TC-P monitors the present traffic situation and informs the PC-A and/or TC-F about any traffic which would require special attention by the PC-A and/or TC-F.

If an aircraft is advised to contact TC-F, TC-P marks that aircraft as a "released" one.

If TC-F decides to change the sequence and/or runway allocation due to tactical problems, TC-P re-plans the aircraft on pickup frequency to adjust and optimise the traffic for the new condition.

Class A aircraft specific:

In close co-operation with PC-A the TC monitors the flight progress of a Class A aircraft.

If no problem is detected by TC Class A aircraft will fly with no other R/T communications than initial call when entering and frequency change when releasing to TC-F.

Every time TC sees the necessity due to safety reasons, TC guides the aircraft via R/T.

Every heading, speed and level change command given via R/T to this aircraft implies that this aircraft is treated further as a Class B aircraft manually guided via R/T.

A negotiated contract between air and ground via datalink is no longer valid then.

The status of aircraft automatically changes from Class A to Class B as soon as the system is updated about a tactical intervention.

On request by TC the guidance commands produced by the ground system for all aircraft for the support of 4D-Guidance can be displayed by the electronic system for selected *or all* Class A aircraft.

If a Class A equipped aircraft has been classified to a Class B aircraft, no method is available to bring an aircraft back to a Class A category in ORG 1.

Class B aircraft specific:

For all arriving aircraft the Arrival Manager gives automation support for the 4D-Guidance of aircraft along the planned route.

The AM has only a limited set of methods available.

The TC transmits the 4D-Guidance advisories produced automatically by the ground system via R/T to the aircraft. By this the scheduled delivery time of an aircraft at the Gate can be met more precisely.

These 4D-advisories consists of:

- **Indication, where the Top of Descend TOD2 should be located,**

- to which Flight Level an aircraft should descent,
- Speed advisories
- Heading advisories within a Fan area
- Indication where turns should start

The Flight Path Monitor Tool alerts the TC if deviations of the planned trajectory will probably need special attention.

In those cases the TC tries to apply control methods for this aircraft, which are not yet available for the automation support system to find back to the trajectory on which the Arrival Manager is based on.

It is always possible to apply other guidance commands as advised by the automated system. This can be required by the momentary tactical situation due to safety reasons.

In those cases TC-P or PC-A on request of TC-P updates the electronic system with inputs of the commands applied.

These inputs serve keeping the system updated and for the information and coordination of the human operators purposes only; they will not be used for planning updates of the ground system in ORG 1.

The automated ground system calculations for conflict probing and monitoring of the flight path will be based on the latest update of the trajectories.

If the controller uses non standard control methods and procedures without informing the automated system, the application of manual control will normally lead to warnings produced by the Flight Path Monitor.

If the ground system is informed by the TC-P (or PC-A) about manual guidance of an selected aircraft some/all messages from the automated ground system regarding this aircraft can be suspended within the control sector.

Those aircraft have then to be guided further manually *until the conditions for a Class B 4D-Guidance support are fulfilled again: The aircraft flies within a tube around a trajectory known by the Ground System.*

5.2.4.3 Summary of TC-P Task

The tasks of TC- P can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-F for arrivals and to other ACC TCs for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather display,
- application of guidance and control commands in order to avoid separation conflicts,

- **apply guidance commands to transfer point (vicinity of extended centreline for arrivals, Exit Fix for Overflights) in order to fulfil AM schedule and sequence using the AM display and 4D-advisories for Class B arrival aircraft,**
- **delay and accelerate aircraft in the descent phase in accordance with the AM schedule,**
- **Update the Ground System about any guidance command given,**
- **inform PC-A if the AM schedule cannot be met in terms of sequence and RWY allocation,**
- negotiate with TC-F and TCs (*and/or PCs*) of adjacent sectors if standing agreements have to be changed,
- if necessary hold aircraft within the sector either on request of TC-F or in case of any doubt about the status of standing agreements.

5.2.5 Feeder Approach TC-F

The main task of the Feeder Controller TC-F is to guide the aircraft conflict-free (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) to the extended centreline, to give ILS clearance and to establish separation over the threshold by speed commands up to the Outer Marker (4 NM from threshold).

Normally near the gate (10 NM from threshold) the transfer of communication to the Tower Controller takes place. In this case the transfer of communication is not coincident with transfer of control. TC-F is responsible for the guidance of aircraft up to the threshold.

Every control command from tower controller has to be approved by TC-F before, because otherwise the minimum separations at ILS could not be guaranteed (in PD/2 no Tower/TC-F interaction is modelled other than transfer of communication).

If an aircraft is established on ILS the minimum separation between two aircraft flying in trail on the same glidepath can be reduced to 2.5 NM for non Wake Vortex relevant pairs. For aircraft established on different ILS (25R and 25L) no minimum separation has to be applied (independent runways).

5.2.5.1 Intrasector Co-ordination:

The TC-F monitors the present traffic situation and informs the PC-A and/or TC-P about any traffic which would require special attention by the PC-A and/or TC-P.

If an aircraft is advised to contact Tower, TC-F marks that aircraft as a " released" one.

If TC-F is informed by Tower controller or by the ground system about problems at the runway (e.g.: Runway blocked) or in the last phase of flight (e.g.: Missed Approach), TC-F re-plans the aircraft on Feeder frequency to adjust and optimise the traffic for the new condition (In PD/2 no Tower/TC-F interaction is modelled other than frequency change).

The specific handling of Class A and Class B aircraft follows the same rules as described for TC-P above.

5.2.5.2 Standing Agreement

The main standing agreement is that each aircraft will leave the frequency near the Gate already established on ILS for 25R or 25L.

Other agreements can be co-ordinated with the Tower Controller on an ad hoc basis.

These are agreements e.g.:

- to use only one runway (not in PD2),
- to open a gap for departing aircraft.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-F can delegate some co-ordination tasks to the PC-A.

5.2.5.3 Summary of TC-F Task

The tasks of TC-F can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation, ILS clearance and frequency change command to initiate handover to Tower Controller for arrivals),
- surveillance of aircraft using the radar display and weather display,
- apply guidance and control commands in order to avoid separation conflicts,
- **guide the aircraft to the localizer in order to fulfil AM schedule and sequence using the AM display and 4D-advisories for Class B arrival aircraft,**
- **Update the Ground System if an aircraft has to be guided manually, if the AM guidance support can not be applied,**
- give clearance for allocated ILS,
- establish separation on ILS,
- inform PC-A and TC-P if the schedule cannot be met in terms of sequence,
- negotiate with TC-P and Tower Controller if standing agreements have to be changed,
- **update the electronic system if changes in aircraft status and applied commands are not in agreement with the recommended advisories from the 4D-Guidance support system**

5.3

5.3 ORGANISATION 2

The procedures used for ORG 2 will be based on those of ORG 1 but with additional support by automated system.

This system consists of:

A more advanced mode, additionally to ORG 1, with detection and resolution of tactical conflicts.

An arrival planning system Arrival Manager (Version 2) will support the tactical probing and resolution task instead of leaving this to the controller's manual work. For this the Arrival Manager has additional functionality to assist problem solving.

In general the order of priorities for the work of all controllers is:

- first safety;
- second efficiency (optimal use of airspace capacity available in terms of delay reduction, minimal fuel consumption and noise abatement)of the overall traffic;
- third efficiency for flights on the basis of individual aircraft performance and airborne requests.

5.3.1 Planning Controller West Sector PC-W

As in ORG 0 the role of the PC is one of co-ordination, both intersector and intrasector co-ordination.

In addition to ORG 0 the PC-W is also responsible for the co-ordination and performance of air-ground communications via datalink for Class A aircraft.

Since co-ordination only with the Approach is available in the PD/2 experiment (as it would be the case in a real system in case of low traffic rate of overflight and independent departures), the tasks of PC-W could be performed by the TC-W. Therefore an extra PC position is not necessary.

5.3.1.1 Intersector Co-ordination:

The PC-W receives the flight plan information in form of paperstrips 10 minutes before the aircraft enters the sector.

After consideration of the level, routing and displayed radar data and aircraft category (Class A equipment) the PC may accept the traffic. The PC determines if potential conflicts exist by comparing the Entry Flight Level or Cleared Flight Level with traffic already on FRANKFURT RADAR frequency.

If a potential problem is detected the PC-W telephones with the ATCO of the sector where the aircraft is controlled and achieves a revised coordination. In PD/2 this is only possible with the TMA sector.

For adjacent sectors equipped with electronic co-ordination support (e.g. PD/1 system) this negotiation can be performed by an electronic co-ordination procedure based on e.g. label interaction or message windows (see reference 1).

With the PC-A the PC-W co-ordinates changes that could have impact on the overall planning within the ETMA resulting from the tactical situation in the ACC.

Any new coordinated information like new Entry Flight Level etc. the PC will input on the electronic flight plan representation.

The PC-W monitors the AM Display for changes introduced by the PC-A of the TMA sector. In case of potential problems PC-W telephones the PC-A and informs the PC-A.

If the planning proposals of the Arrival Manager cannot be fulfilled due to problems within the sector the PC informs the PC-A about this situation. *PC-W works out all aircraft that take part on the problem. After co-ordination with TC-W the information about new planned route, exit flight level, speed and sequence of affected aircraft based on manually control procedures will be input to the electronic flight plan system for co-ordination with PC-A.*

Class A aircraft specific:

Class A aircraft affected by manual control will be declared to Class B aircraft by R/T communication performed by TC-W.

5.3.1.2 Intrasector Co-ordination:

The PC-W monitors the present traffic situation and informs the TC-W about any planned traffic which would require special attention by the TC-W.

The PC is responsible for the update of the electronic flight plan information, whenever the tactical situation requires deviation from the actual plan.

The PC-W updates the AM Display if sequence changes or larger delays as original planned are necessary due to the tactical situation.

If the aircraft that enters the sector has no complete flight plan information yet, PC-W generates a new electronic plan for this aircraft (This function is not used within PD/2).

Either on request of TC-W or by detection of a R/T command which makes a further flight in the Class A category no longer possible *or efficient*, PC-W updates the electronic system.

Class A aircraft specific:

The PC-W monitors the automatic performance of trajectory negotiation with Class A aircraft.

Those negotiations will be initiated every time a new trajectory is produced within the system as a result of planning updates either produced by the system (major change in weather) or induced by system updates performed by the controllers.

In the West sector this negotiation consists of three steps:

1. Uplink of Tube (route allocation and constraints at MF and Gate at least)

This requires that the AM Manager has frozen the 4D-planning of this aircraft (about EF, but timely before the first TOD, where the aircraft leaves its cruise level).

2. Downlink of Trajectory

If the aircraft has accepted the uplinked constraints it downlinks a trajectory which fulfils the constraints.

If the aircraft cannot fulfil the constraints it sends down a message, which declares itself as a Class B aircraft.

Every downlink of trajectory causes a new check of this trajectory in terms of conflicts and constraints against all other active system plans.

3. Class A Clearance

If as normally expected there is no conflict, a „contract given“ message is exchanged either by an automatic uplink or a manual uplink initiated by PC-W.

This message exchange would imply a standard clearance to progress up to the *Threshold (the GATE)*.

In case of restrictions for a clearance on request of TC-W (e. g.: trajectory cleared up to a special fix or until a given point in time or for a number of miles or minutes) PC-W has to input these restrictions to the electronic system. For those cases the „contract given“ message is initiated by the PC-W manually after input of the restrictions.

After establishment of contract the PC-W monitors as TC-W does the flight progress along the contracted trajectory with the support of the FPM and CP tools.

In case of restricted contracts which will expire soon PC-W contacts TC-W about contract extension to the standard limits.

If the TC-W accepts or advises to extend the contract to the standard limits PC-W updates the electronic system by initiating a standard clearance via datalink.

Every aircraft reaching its contract limits without getting a new clearance will be treated as Class B aircraft by the system automatically.

Every deviation or conflict indicated by a Flight Path Monitor or a Conflict Probe message has to be assessed in terms of relevance for the status of Class A aircraft in close co-operation with TC-W.

If it becomes necessary (e.g.: deviations to large, conflicts cannot be solved by touching other Class B aircraft) to guide Class A aircraft manually the status of aircraft would be changed from Class A to Class B automatically as soon as PC-W updates the system about the tactical intervention.

Affected Class A aircraft will become aware of their status change by R/T control performed by TC-W.

A Class A equipped aircraft, which has been guided as a Class B aircraft due to tactical reasons for a while, can be brought back to a Class A aircraft category, if a successful negotiation about the further trajectory has been achieved via datalink.

Class B aircraft specific:

PC-W informs TC-W about deviations of Class B aircraft. For this purpose PC-W monitors the FPM and CP messages for Class B aircraft as well as for Class A aircraft.

In case that the standard routes and means on which the AM plans are based are not sufficient due to tactical reasons, maybe only for a limited period in time, PC-W supports the TC-W in marking the affected Class B aircraft as manually guided in order to inform the electronic system to suppress senseless 4D Guidance advisories based on the old 4D-plan.

If those aircraft are brought back to the planned trajectory or if the controller can produce a new trajectory for that aircraft, the 4D-Guidance support possibility will be announced by the system.

For a 4D-equipped aircraft the PC-W can initiate a new conflict-free contract via datalink to achieve a reclassification as a Class A aircraft.

5.3.1.3 Summary of PC-W Task

- Use flight-plan information, AM data, FPM and CP messages and Radar data to identify and assess potential conflicts between aircraft offered into the sector.
- Notify TC-W about any special conditions about the traffic before entering the sector.
- Update the electronic system if any difference between system plan and actual situation has occurred.
- Monitor the air/ground negotiation process for Class A aircraft.
- Co-ordinate with TC-W if a Class A to Class B aircraft change has to be applied.
- Co-ordinate with PC/TC of adjacent sectors if entry (not performed in PD2) and exit conditions have to be changed.
- Update the AM Display for changes in the sequence of west inbound traffic that are planned or already have been assumed by the TC-W.
- Co-ordinate with PC-A if the arrival planning generated by PC-A would induce major problems within the ACC-W sector.

5.3.2 Tactical Controller West Sector TC-W

The TC-W will be responsible for ensuring conflict-free passage of aircraft through his airspace.

The TC performs all direct communications via R/T with the aircraft and will be responsible for all transfers to and from the neighbouring sectors.

Transfer of control is coincident with transfer of communication.

The transfer of traffic is done near the sector boundaries based on standing agreement procedures.

The predictability and accuracy in time by which the arrival traffic can be transferred to the TMA will be supported by an automated system which integrates air and ground computers.

The control methods used by the automated system either airborne within the 4D-FMS if a contract with the ground has been established via Datalink (4D-Guidance of Class A aircraft) or 4D-Guidance commands generated by the Arrival Manager on ground (4D-Guidance of Class B aircraft) are based on a standardised set of control methods.

These methods are compatible with the standing agreements for manual control in ORG 0.

The application domains and limits of the different 4D-Guidance methods are supposed to be well known by pilots and controllers. By this way the application of 4D-guidance is treated as permanent automated procedures like flight on an ILS or flying within a holding.

For a 4D equipped aircraft it is necessary that the pilot is in the loop during the negotiation process via datalink. This guarantees that the pilot knows if the aircraft is guided along the Class A aircraft procedures.

5.3.2.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Entry Fixes **EF** and also leave the sector over defined fixes (for arrival traffic these are the Metering Fixes **MF**). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors.

If an aircraft is advised to contact next TC, TC-W marks that aircraft as a "released" one.

Modifications of agreements can be co-ordinated with the TC of the neighbouring sector using telephone lines on an ad hoc basis.

These are agreements like

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-W can delegate some or all of those co-ordination tasks to the PC-W.

If the main standing agreement (to fly over fixes during transfer) cannot be met for tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbouring sector PC/TC.

Class A aircraft specific:

In close co-operation with PC-W the TC-W monitors the flight progress of a Class A aircraft.

If no problem is detected by TC these aircraft will fly with no other R/T communications than initial call when entering and frequency change when leaving the sector.

Every time TC sees the necessity due to safety **and traffic efficiency** reasons, TC can guide the aircraft via R/T.

Every heading, speed and level change command given via R/T to this aircraft implies that this aircraft is treated further as a Class B aircraft manually guided via R/T. A negotiated contract between air and ground via datalink is no longer valid then.

The status of aircraft automatically changes from Class A to Class B as soon as the system is updated about a tactical intervention.

Before a Class A equipped aircraft has got the ETMA contract via datalink the support of the ground system for the controller is based on the calculations for a Class B aircraft.

If during a negotiation process via datalink a guidance command is applied by TC this aircraft is treated further as a Class B aircraft, even if this negotiation cycle via datalink will be completed successfully afterwards.

As a general rule R/T communication always overrules datalink communication.

On request by TC the guidance commands produced by the ground system for all aircraft for the support of 4D-Guidance can be displayed by the electronic system for selected *or all* Class A aircraft.

In the ORG 2 system a Class A aircraft is generated only if a contract could be reached through the datalink negotiation.

If a Class A aircraft has been classified to a Class B the possibility for reclassification to a Class A category is available by re-negotiating a new trajectory with the aircraft.

Class B aircraft specific:

For all arriving aircraft the Arrival Manager gives automation support for the 4D-Guidance of aircraft along the planned route.

The AM has only a limited set of methods available to obtain higher accuracy in time then achievable by conventional guidance.

The TC transmits the 4D-Guidance advisories produced automatically by the ground system via R/T to the aircraft. By this the scheduled delivery time of an aircraft at the TMA Metering Fix MF can be met more precisely.

These 4D-advisories consists of:

- Indication, where the Top of Descend TOD should be located,
- to which Flight Level an aircraft should descent,
- Speed advisories
- Holding at the MF (*Level and Number of Turns*)

The Flight Path Monitor Tool alerts the TC if deviations of the planned trajectory will probably need special attention.

If the 4D-Guidance support has reached its internal used controlability limits the TC will be alerted.

In those cases the TC tries to apply control methods for this aircraft, which are not yet available for the automation support system to find back to the trajectory on which the Arrival Manager is based on.

It is always possible to apply other guidance commands as advised by the automated system. This can be required by the momentary tactical situation due to safety **or traffic efficiency** reasons.

In those cases TC-W or PC-W on request of TC-W updates the electronic system with inputs of the commands applied.

In ORG2 these updates not only serve keeping the ground system updated and for the information and co-ordination of the human operators purposes. But additionally

the inputs will trigger the tools to support the controllers by calculating new conflict-free trajectories, re-negotiating them with Class A aircraft and generating corresponding 4D-advisories for Class B aircraft.

The automated ground system calculations for conflict probing and monitoring of the flight path will be based on the latest update of the trajectories .

If the controller uses non standard control methods and procedures without informing the automated system, the application of manual control will normally lead to warnings produced by the Flight Path Monitor.

If the ground system is informed by the TC-W (or PC-W) about manual guidance of an selected aircraft some/all messages from the automated ground system regarding this aircraft can be suspended within the control sector.

Those aircraft have than to be guided further manually until the conditions for a Class B 4D-Guidance support are fulfilled again: The aircraft flies within a tube around a trajectory known by the Ground System.

5.3.2.2 Summary of TC-W Task

The tasks of TC-W can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-P for arrivals and other ACC TC for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather display,
- application of guidance and control commands in order to avoid separation conflicts (*3 NM min lateral* , 1000 ft vertical),
- apply guidance commands and clearances from cruise to transfer point (MF for arrivals, Exit Fix for Overflights) in order to fulfil the schedule of Arrival Manager using the Arrival Management Display and 4D-advisories for Class B aircraft,
- delay and accelerate aircraft in the descent phase in accordance with the AM schedule,
- Update the Ground System about any guidance command given,
- Inform PC-W if the AM schedule cannot be met in terms of sequence,
- negotiate with PC-W and PCs/TCs of adjacent sectors if standing agreements have to be changed,
- hold aircraft within the sector either on request of AM or TC-P or in case of any doubt about the status of standing agreements.

5.3.3 Planning Controller Approach PC-A

As in ORG 0 the role of the PC-A is one of co-ordination. Both intersector and intrasector co-ordination.

In addition to ORG 0 and ORG 1 the PC-A is also responsible for the co-ordination and performance of air-ground communications via datalink for Class A aircraft within the TMA.

PC-A performs and co-ordinates the planning for all arrivals within the Extended Terminal Area ETMA.

5.3.3.1 Intersector Co-ordination:

The PC-A receives the flight plan information in an electronic representation about 30 Minutes in advance (at the same time as it is available for the ACC sectors of the ETMA).

The PC-A monitors the Arrival Management Display and checks if the sequence and schedule is workable by the Approach TCs taking into account the present and/or expected traffic situation within the TMA.

In case of potential problems PC-A either inputs planning changes into the electronic system and/or informs the PC-W about this.

If the planning proposals of the Arrival Manager system cannot be fulfilled, because the traffic rate delivered from the ACC sectors has to be reduced, PC-A applies inputs into the Arrival Manager.

If traffic reduction for a longer period (more than 5 minutes) is needed, PC-A increases the minimum spacing the AM planning is based on. (This method will not be applied within the PD/2 experiments since this would change one of the independent variables).

If a traffic reduction for a shorter period of time is sufficient (about 1 to 5 minutes), PC-A adds slots into the AM system.

Changes of the AM display are also displayed on the displays of the adjacent ACC sectors. It is a standing agreement that all changes in scheduled time and sequences induced by PC-A are accepted by default in the adjacent sectors.

These updates of the display serve for information between the human controllers indicating plan changes due to tactical reasons and for the ground system to develop plan and trajectory updates.

This new information will be used in ORG 2 by the automated ground system in its support of 4D-Guidance monitoring and control for an Class B aircraft.

For Class A aircraft these updates will be used to establish a new contract via datalink negotiation.

Because those changes induced by tactical requirements within the TMA performed by PC-A could result in a large amount of aircraft which needs to be re-negotiated within the ACC, the system will indicate all those aircraft automatically. PC-A can then decide to execute or not (probing function).

If PC-A is informed by a PC/TC of a adjacent ACC sector about problems to perform in accordance with the new plan, PC-A in close reconciliation with TC-P and/or TC-F negotiates work-around procedures with this PC/TC via telephone.

The downgrading of an aircraft from Class A to Class B can only be performed if the aircraft has been released by the ACC controllers.

If e.g.: the re-negotiation process via datalink (see below) fails when the aircraft is within the West-Sector. PC-A has to mark this aircraft as a potential Class B aircraft and to wait until it is released by TC-W or PC-A has the possibility to contact PC-W to initiate a clearance restriction via TC-W R/T or PC-W datalink.

5.3.3.2 Intrasector Co-ordination

The PC-A monitors the present traffic situation and informs the TC-P about any planned traffic which would require special attention by the TC-P.

The PC-A is responsible for the update of the electronic flight plan information, whenever the tactical situation requires deviation from the actual plan.

The PC-A updates the AM Display if sequence or RWY allocation changes or larger delays as original planned are necessary due to the tactical situation.

Before manual plan updates are applied an evaluation which of the indicated aircraft should continue to follow their old trajectories and for which aircraft a new trajectory has to be calculated by the system has to be done.

This decision is done in close co-ordination between PC-A and TC-P and /or TC-F.

It is necessary to inform the automated system about the result of this evaluation.

This has to be done at least before the R/T commands to implement the new planning have been given by TCs. Otherwise those aircraft with new plans will have to be guided without 4D support further (as in ORG 1).

If the aircraft that enters the sector has no complete flight plan information yet, PC-A generates a new electronic plan for this aircraft (This feature is not used within the PD/2 experiments).

Either on request of TC-P or TC-F or by detection of a R/T command which makes a further flight in the Class A category no longer possible, PC-A updates the electronic system.

Class A aircraft specific:

The PC-A monitors the automatic performance of trajectory update re-negotiations with a Class A aircraft.

This process consist of three steps :

1. Uplink of Tube (route identifier and constraints at Gate at least)

This requires that the AM Manager has updated the 4D-planning of this aircraft.

If no update is necessary a clearance message as in the third negotiation step below is transferred.

2. Downlink of Trajectory

If the aircraft has accepted the uplinked constraints it downlinks a trajectory which fulfils the constraints.

If the aircraft cannot fulfil the constraints it sends down a message, which declares itself as a Class B aircraft.

If the aircraft got a clearance message it sends down a trajectory based on the newest weather information obtained.

Every downlink of trajectory causes a new check of this trajectory in terms of conflicts and constraints against all other active system plans.

3. Class A Clearance

If as normally expected there is no conflict, a „contract given“ message is exchanged *either by an automatic uplink or a manual uplink initiated by PC-A.*

This message exchange would imply a standard clearance to progress up to the Threshold (*Gate, OM*).

In case of restrictions for a clearance on request of TC-P or TC-F (e. g.: trajectory cleared up to a special fix or until a given point in time or for a number of miles or minutes) PC-A has to input these restrictions to the electronic system.

For those cases the „contract given“ message is initiated by the PC-A manually after input of the restrictions.

After establishment of contract the PC-A monitors as TC-F/TC-P do the flight progress along the contracted trajectory with the support of the FPM and CP tools.

In case of restricted contracts which will expire soon PC-A contacts TC-P and/or TC-F about contract extension to the standard limits.

If the TC-P and TC-F accept or advises to extend the contract to the standard limits PC-A updates the electronic system after the clearance has been given by TC-P or TC-F *via R/T or automatically by initiating a standard clearance via datalink.*

Every aircraft reaching its contract limits without getting a new clearance will be treated as Class B aircraft by the system automatically.

Every deviation or conflict indicated by a Flight Path Monitor or a Conflict Probe message has to be assessed in terms of relevance for the status of Class A aircraft in close co-operation with TC-P and TC-F.

If it becomes necessary (e.g.: deviations to large, conflicts cannot be solved by touching other Class B aircraft) to guide Class A aircraft manually the status of aircraft

would be changed from Class A to Class B automatically as soon as PC-A updates the system about the tactical intervention.

Affected Class A aircraft will become aware of their status change by R/T control performed by TC-P or TC-F.

Class B aircraft specific:

PC-A informs TC-P and TC-F about deviations of Class B aircraft from the 4D-tube the AM is based on.

For this purpose PC-A monitors the FPM messages for Class B aircraft as for Class A aircraft when the AM plan has been frozen **or updated**.

In case that the standard routes and means on which the AM plans are based are not sufficient due to tactical reasons, maybe only for a limited period in time, PC-A supports the TC-P and TC-F in marking the affected Class B aircraft as manually guided in order to inform the electronic system to suppress senseless 4D Guidance advisories based on the old 4D-plan.

If those aircraft are brought back to the planned trajectory or if the system can produce a new trajectory for that aircraft with the help of controller input, the 4D-Guidance support possibility will be announced by the system.

For Class A equipped aircraft PC-A can initiate a new conflict-free contract via datalink to achieve a reclassification as a Class A aircraft.

5.3.3.3 Summary of PC-A Task

- Use flight-plan information, AM data, FPM and CP messages and Radar data to identify and assess potential conflicts between aircraft offered into the sector.
- Notify TC-P and TC-F about any special conditions about the traffic before entering the sector.
- Update the electronic system if any difference between system plan and actual situation has occurred.
- **Monitor the air/ground negotiation process for Class A aircraft.**
- Co-ordinate with TC-P and TC-F if a Class A to Class B aircraft change has to be applied.
- Co-ordinate with PC/TC of adjacent sectors if entry (not performed in PD2) and exit conditions have to be changed.
- Update the AM Display for changes in the sequence and RWY allocation of inbound traffic that are planned or already have been assumed by the TC-P or TC-F.
- **As long as an aircraft is not under control yet co-ordinate with PCs of adjacent sectors if a negotiation via datalink for Class A aircraft is required.**

5.3.4 Pickup Approach TC-P

The main tasks of TC-P are to establish the AM landing sequence and to prepare a safe and effective runway allocation.

In close co-operation with TC-F the TC-P will be responsible for ensuring conflict-free passage of aircraft (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) through the TMA airspace.

The TC-P performs all direct communications via R/T with the aircraft and will be responsible for transfers of arrivals from the Metering Fix until transfer of control to TC-F is performed. This transfer is done as soon as the landing sequence is established and the aircraft are free of conflict.

The transfer from ACC is done near the sector boundaries under standing agreement procedures. The arrival traffic is accepted close to the Metering Fixes after initial call of the aircraft.

If the weather information received by the aircraft is out of time (information version received by ATIS will be reported during initial call by pilot), TC-P informs pilot about new weather update available.

The landing sequence has to be close co-ordinated with TC-F if the AM sequence is not chosen.

The aircraft are guided with radar vectors, descent and speed commands via R/T towards the Extended Centreline.

If the transition from Flight Level to Altitudes is advised or if QNH has changed, the pilot has to be informed about the actual QNH value.

TC-P informs the aircraft about the expected runway allocation (the assignment of RWY is done by AM for Class A aircraft or TC-F).

The predictability and accuracy in time by which the arrival traffic can be transferred to the Tower will be supported by an automated system which integrates air and ground computers.

The control methods used by the automated system either airborne within the 4D-FMS if a contract with the ground has been established via Datalink (4D-Guidance of Class A aircraft) or 4D-Guidance commands generated by the Arrival Manager on ground (4D-Guidance of Class B aircraft) are based on a standardised set of control methods.

These methods are compatible with the standing agreements for manual control in ORG 0.

The application domains and limits of the different 4D-Guidance methods are supposed to be well known by pilots and controllers. By this way the application of 4D-guidance is treated as permanent automated procedures like flight on an ILS or flying within a holding.

For a 4D equipped aircraft it is necessary that the pilot is in the loop during the negotiation process via datalink. This guarantees that the pilot knows if the aircraft is guided along the Class A aircraft procedures.

5.3.4.1 Standing Agreement

The main standing agreement is that each aircraft will enter the sector over Metering Fixes **MF** and also leave the sector over defined fixes (for overflights only). These standing agreements allow the TC to ensure a conflict free situation also during the handover phase between two sectors. The handover process for arrival traffic between Pickup TC-P and

Feeder TC-F within the TMA is performed in a very close co-operation but also on the basis of ad hoc agreements.

Agreements can be co-ordinated with the TC of the neighbour sector using telephone lines on an ad hoc basis.

These are agreements e.g.:

- to handover aircraft only laterally spaced,
- to apply vertical spacing to groups of aircraft (so-called 'packets'),
- to apply heading commands to aircraft before handover in order to achieve lateral deconflicting, if only vertical spacing is used at the handover fix,
- to fill and to empty holding stacks,
- to transfer aircraft in distinct flight levels,
- to transfer aircraft in distinct speeds.

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-P can delegate some or all of those co-ordination tasks to the PC-A.

If the main standing agreement (to fly over fixes during transfer) cannot be met by tactical reasons the TC has to negotiate a new agreement for all affected aircraft with the neighbour sector PC/TC.

5.3.4.2 Intrasector Co-ordination:

The TC-P monitors the present traffic situation and informs the PC-A and/or TC-F about any traffic which would require special attention by the PC-A and/or TC-F.

If an aircraft is advised to contact TC-F, TC-P marks that aircraft as a " released" one.

If TC-F decides to change the sequence and/or runway allocation due to tactical problems, TC-P re-plans the aircraft on pickup frequency to adjust and optimise the traffic for the new condition.

Class A aircraft specific:

In close co-operation with PC-A the TC monitors the flight progress of a Class A aircraft.

If no problem is detected by TC Class A aircraft will fly with no other R/T communications than initial call when entering and frequency change when releasing to TC-F.

Every time TC sees the necessity due to safety reasons, TC guides the aircraft via R/T.

Every heading, speed and level change command given via R/T to this aircraft implies that this aircraft is treated further as a Class B aircraft manually guided via R/T.

A negotiated contract between air and ground via datalink is no longer valid then.

The status of aircraft automatically changes from Class A to Class B as soon as the system is updated about a tactical intervention.

If during *or before* a negotiation process via datalink a guidance command is applied by TC this aircraft is treated further as a Class B aircraft, even if the negotiation cycle via datalink will be completed successfully afterwards.

As a general rule R/T communication always overrules datalink communication.

On request by TC the guidance commands produced by the ground system for all aircraft for the support of 4D-Guidance can be displayed by the electronic system for selected *or all* Class A aircraft.

In the ORG 2 system a Class A aircraft is generated only if a contract could be reached through the datalink negotiation.

If a Class A aircraft has been classified to a Class B the possibility for reclassification to a Class A category is available by renegotiating a new trajectory with the aircraft.

Class B aircraft specific:

For all arriving aircraft the Arrival Manager gives automation support for the 4D-Guidance of aircraft along the planned route.

The AM has only a limited set of methods available.

The TC transmits the 4D-Guidance advisories produced automatically by the ground system via R/T to the aircraft. By this the scheduled delivery time of an aircraft at the Gate can be met more precisely.

These 4D-advisories consists of:

- Indication, where the Top of Descend TOD2 should be located,
- to which Flight Level an aircraft should descent,
- Speed advisories
- Heading advisories within a Fan area
- Indication where turns should start

The Flight Path Monitor Tool alerts the TC if deviations of the planned trajectory will probably need special attention.

If the 4D-Guidance support has reached its internal used controlability limits the TC will be alerted.

In those cases the TC tries to apply control methods for this aircraft, which are not yet available for the automation support system to find back to the trajectory on which the Arrival Manager is based on.

It is always possible to apply other guidance commands as advised by the automated system. This can be required by the momentary tactical situation due to safety *or traffic efficiency* reasons.

In those cases TC-P or PC-A on request of TC-P updates the electronic system with inputs of the commands applied.

In ORG2 these updates not only serve keeping the ground system updated and for the information and co-ordination of the human operators purposes. But additionally the inputs will trigger the tools to support the controllers by calculating new conflict-free trajectories, re-negotiating them with Class A aircraft and generating corresponding 4D-advisories for Class B aircraft.

The automated ground system calculations for conflict probing and monitoring of the flight path will be based on the latest update of the trajectories .

If the controller uses non standard control methods and procedures without informing the automated system, the application of manual control will normally lead to warnings produced by the Flight Path Monitor.

If the ground system is informed by the TC-P (or PC-A) about manual guidance of an selected aircraft some/all messages from the automated ground system regarding this aircraft can be suspended within the control sector.

Those aircraft have than to be guided further manually until the conditions for a Class B 4D-Guidance support are fulfilled again: The aircraft flies within a tube around a trajectory known by the Ground System.

5.3.4.3 Summary of TC-P Task

The tasks of TC- P can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation and frequency change command to initiate handover to TC-F for arrivals and to other ACC TCs for overflights),
- check if aircraft have got the latest weather information,
- surveillance of aircraft using the radar display and weather display,
- application of guidance and control commands in order to avoid separation conflicts,
- apply guidance commands to transfer point (vicinity of extended centreline for arrivals, Exit Fix for Overflights) in order to fulfil AM schedule and sequence using the AM display and 4D-advisories for Class B arrival aircraft,
- delay and accelerate aircraft in the descent phase in accordance with the AM schedule,
- Update the Ground System about any guidance command given,
- inform PC-A if the AM schedule cannot be met in terms of sequence and RWY allocation,
- negotiate with TC-F and TCs (or PCs) of adjacent sectors if standing agreements have to be changed,
- if necessary hold aircraft within the sector either on request of TC-F or in case of any doubt about the status of standing agreements.

5.3.5 Feeder Approach TC-F

The main task of the Feeder Controller TC-F is to guide the aircraft conflict-free (minimum separation: vertical 1000 ft; lateral 3 NM, for Wake Vortex relevant combinations of aircraft up to 6 NM) to the extended centreline, to give ILS clearance and to establish separation over the threshold by speed commands up to the Outer Marker (4 NM from threshold).

Normally near the gate (10 NM from threshold) the transfer of communication to the Tower Controller takes place. In this case the transfer of communication is not coincident with transfer of control. TC-F is responsible for the guidance of aircraft up to the threshold.

Every control command from tower controller has to be approved by TC-F before, because otherwise the minimum separations at ILS could not be guaranteed (in PD/2 no Tower/TC-F interaction is modelled other than transfer of communication).

If an aircraft is established on ILS the minimum separation between two aircraft flying in trail on the same glidepath can be reduced to 2.5 NM for non Wake Vortex relevant pairs. For aircraft established on different ILS (25R and 25L) no minimum separation has to be applied (independent runways).

5.3.5.1 Intrasector Co-ordination:

The TC-F monitors the present traffic situation and informs the PC-A and/or TC-P about any traffic which would require special attention by the PC-A and/or TC-P.

If an aircraft is advised to contact Tower, TC-F marks that aircraft as a "released" one.

If TC-F is informed by Tower controller or by the ground system about problems at the runway (e.g.: Runway blocked) or in the last phase of flight (e.g.: Missed Approach), TC-F re-plans the aircraft on Feeder frequency to adjust and optimise the traffic for the new condition (In PD/2 no Tower/TC-F interaction is modelled other than frequency change).

The specific handling of Class A and Class B aircraft follows the same rules as described for TC-P above.

5.3.5.2 Standing Agreement

The main standing agreement is that each aircraft will leave the frequency near the Gate already established on ILS for 25R or 25L.

Other agreements can be co-ordinated with the Tower Controller on a ad hoc basis. These are agreements e.g.:

- to use only one runway (not in PD2),
- to open a gap for departing aircraft

Those agreements can be negotiated not only for groups of aircraft but also for individual aircraft if necessary. The TC-F can delegate some co-ordination tasks to the PC-A.

5.3.5.3 Summary of TC-F Task

The tasks of TC-F can be summarised as follows:

- Perform R/T Communication with aircraft (At least initial contact confirmation, ILS clearance and frequency change command to initiate handover to Tower Controller for arrivals),
- surveillance of aircraft using the radar display and weather display,
- apply guidance and control commands in order to avoid separation conflicts,

- guide the aircraft to the localizer in order to fulfil AM schedule and sequence using the AM display and 4D-advisories for Class B arrival aircraft,
- **Update the Ground System if a re-classification from Class A to Class B aircraft or back is necessary,**
- Update the Ground System if an aircraft has to be guided manually, if the AM guidance support can not be applied,
- give clearance for allocated ILS,
- establish separation on ILS,
- inform PC-A and TC-P if the schedule cannot be met in terms of sequence,
- negotiate with TC-P and Tower Controller if standing agreements have to be changed,
- update the electronic system if changes in aircraft status and applied commands are not in agreement with the recommended advisories from the 4D-Guidance support system.

6. COMMUNICATIONS

The sequence of events that take place if no problems are encountered is shown in figure 6.1.

The top view shows in a schematic way a typical route (trombone type), the side view shows the schematic altitude profile of the same flight; on the bottom there is a time axis.

The regions/time where/when events would normally take place are indicated by the underlying numbers. The events related to those numbers are listed in the table at the bottom.

6.1 SEQUENCE OF EVENTS FOR AIR/GROUND NEGOTIATION

Data exchange will be performed in an air/ground dialogue via datalink.

The formats of the dialogue messages are described in reference 2.

The exchange of weather information with Class A aircraft is assumed to be a form of a background process performed by the datalink system automatically.

All dialogues are treated by the same procedures, which will be performed by an air-ground negotiation.

A complete negotiation consists of three steps:

1. Uplink of constraint list (tube)
2. Downlink of a trajectory which fulfils the constraints
3. Uplink of a clearance

In ORG 1 this full negotiation cycle has to be completed before the first Top of Descend within an ACC Sector of the ETMA has been reached.

In ORG 1 this is the only chance for an equipped aircraft to be treated as a Class A aircraft.

Only one negotiation cycle for an aircraft is foreseen. Therefore the contract (clearance of the trajectory) established by the negotiation process governs the whole flight until *threshold* (Gate, OM).

Every event which makes a change of the contracted trajectory necessary leads in ORG 1 to a reclassification as Class B aircraft.

In all ORGs the main goal of the automation support is to deliver the aircraft as precise as possible at the Gate.

In ORG 1 the contract is given about 20 to 30 minutes before the target of precision is reached.

The contracted trajectory needs therefore some inherent flexibility to cope with the events which are expected to produce some deviation in the arrival time even if no change would be required due to other traffic.

The main effect for this will be the weather.

A trajectory is defined as a route (horizontal plan of flight, defined by a series of waypoints) plus a associated profile (height and time at points along the route).

Variable elements within the profile are 4D-location of TOD points, descend rates, speeds which influence the vertical shape and the time at different waypoints.

Variable elements within the route are the location of the turning point of the trombone path for a west approach and the headings within a Fan area for all other approaches.

The risk for a Class A aircraft to be reclassified as a Class B aircraft due to deviation events depends on the constraints on the variability which are implicit (*explicit*) given within a clearance.

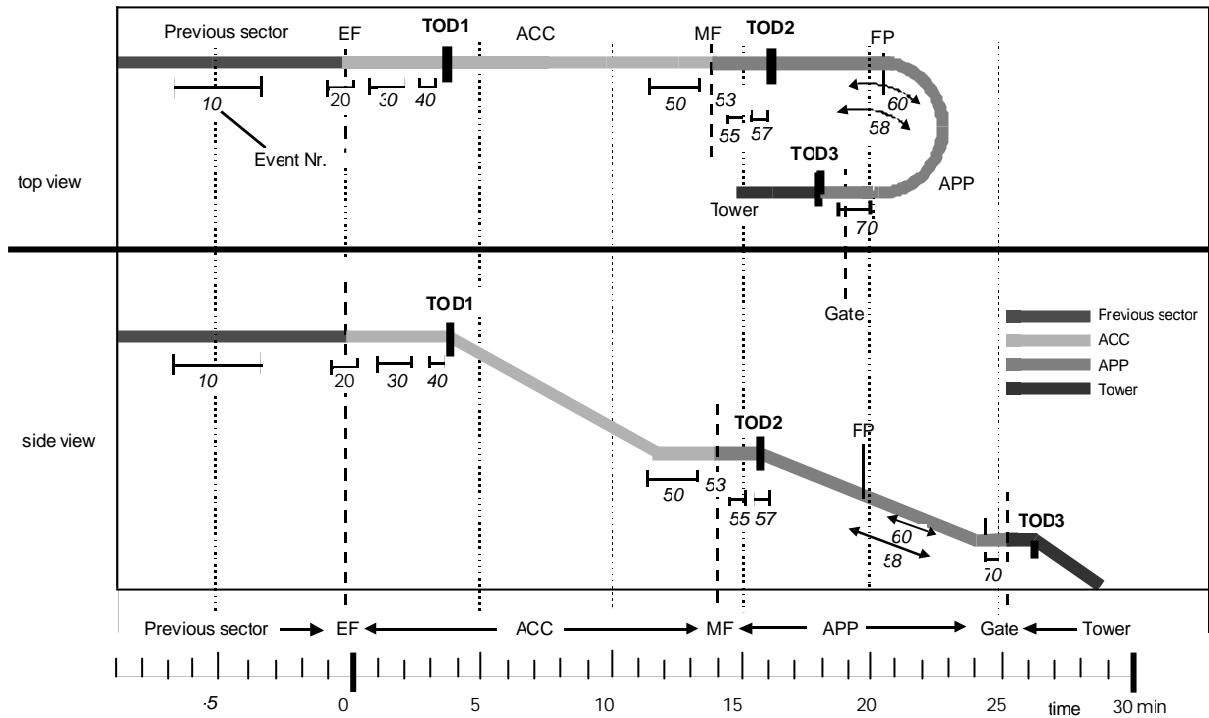
In case of very small changes on the trajectory allowed, the risk will be high that minor events will lead to a loss of Class A status, but will allow to ensure conflict-freeness and predictability during all phases of flight.

In case of wider limits the aircraft can better cope with disturbances but the areas where the flexibility (this mean a trajectory change) is needed are not necessarily conflict-free with the flexible regions of other aircraft.

In those regions the ground based calculations for Class B aircraft, which will be done for all aircraft could be used as a decision criteria for a Class A to Class B re-classification: As long as the Class A aircraft follows a trajectory which is in agreement with the Class B counterpart a re-classification is not necessary for that aircraft

The optimal degree of variability and predictability of the 4D-tube to run both ORGs has to be determined at least during the facility test.

In case that the controller do not accept to give a clearance which contains implicitly the necessary flexible regions additional downlinks of the flexible parts of the trajectory as in ORG 2 described have to be introduced if those parts deviate from the latest downlinked trajectory.



EVENT LIST		
Nr.	Class A	Class B
10	<ul style="list-style-type: none"> a/c gets advanced info state AM gets data AM internally starts allocating (runway), sequencing and scheduling conflict-free plan through ACC is produced => a/c has clearance up to MF, SPL updated 	<ul style="list-style-type: none"> a/c gets advanced info state AM gets data AM internally starts allocating (runway), sequencing and scheduling conflict-free plan through ACC is produced => a/c has clearance up to MF, SPL updated
20	<ul style="list-style-type: none"> transfer to ACC (R/T) 	<ul style="list-style-type: none"> transfer to ACC (R/T)
30	<ul style="list-style-type: none"> plan (incl. 4D-constraints for MF and gate) is „frozen“ 	<ul style="list-style-type: none"> plan is „frozen“ 4D advisories for ACC are ready => SPL updated
40	<ul style="list-style-type: none"> tube up to gate uplinked a/c downlinks trajectory => SPL updated 	<ul style="list-style-type: none"> 4D-advisories for TOD1 are transmitted
50	<ul style="list-style-type: none"> transfer to Pick-up (R/T) a/c fulfills constraints for MF 	<ul style="list-style-type: none"> transfer to Pick-up (R/T)
53		<ul style="list-style-type: none"> a/c fulfills constraints for MF
55		<ul style="list-style-type: none"> 4D-advisories for APP are ready => SPL updated
57		<ul style="list-style-type: none"> 4D-advisories for TOD2 are transmitted
58		<ul style="list-style-type: none"> 4D-advisories for trombone /fan area are transmitted
60	<ul style="list-style-type: none"> transfer to Feeder (R/T) 	<ul style="list-style-type: none"> transfer to Feeder (R/T) end of 4D-advisories
70	<ul style="list-style-type: none"> transfer to Tower (R/T) a/c fulfills constraints for gate 	<ul style="list-style-type: none"> transfer to Tower (R/T) a/c fulfills constraints for gate

Figure 6.1: Events for arrival flights in ORG 1 and ORG 2

In ORG 2 a first negotiation will take place as in ORG 1 but here the Class A aircraft have to downlink a new trajectory if its trajectory needs to be modified to meet the constraints.

Those trajectory update messages need only part 2 and 3 of the negotiation process above.

Every time new constraints are available from the ground system a complete new negotiation process will be initiated.

6.2 COMMUNICATION FACILITIES

The following sections provide an overview of the communication facilities to support the demonstrations. A full description is given in the Facility Specification (see Related Documents chapter).

6.2.1 Air/Ground Communications

Simulated R/T channels will be provided for communication with pseudo pilot positions and a R/T channel will be provided with the ATTAS aircraft via the telemetry link.

Datalink communications with the ATTAS aircraft will utilise the DLR telemetry datalink which will be connected with a simulated datalink facility which models Modes S or Satellite delays. The simulated datalink facilities will also be provided for the air server Class A aircraft.

6.2.2 Ground/Ground Communications

Voice communications between the controller working position ACC and APP and to external ATC positions which are not explicitly simulated and for that reason stuffed with a dummy operator will be achieved by an extra telephone equipment.

Ground /ground data communication is provided by datalink.

The GHMI design of the PD/2 system has to assure that all formalised information about system updates are visible to all controller positions, which may need them.

The exchange of free format messages via the graphical interface would be possible but requires an extra input device and space for displaying these information.

Therefore verbal exchange of information in natural language between humans is preferred.

For the human point of view the exchange of messages via voice by a digitised datalink line or an analogue telephone line makes no difference in terms of functionality.

6.2.3 Communication Logging

Provision will be made for logging of the live aircraft communications channel, the simulated R/T channel and the telephone circuits at all operator positions.

7. AUTOMATION SUPPORT

All controller working positions will comprise the same interface components. The PC and TCs of one working position can observe each other's displays.

The PC is expected to make more use of the long and medium term planning facilities (AM interface, Flight plan representation, NM Datalink interaction).

The TC will work in a more immediate timeframe and hence will make less use of tool interaction, relying on the information given by the tools and the PC.

Here the 4D-advisories produced by the AM are of primary interest.

Also the information about deviations from 4D-tubes produced by FPM and conflicts indicated by the CP which could result in the need for manual guidance have to be assessed by a TC.

The GHMI is window based. Most inputs will be effected by using a three-button mouse.

The general requirements for the GHMI are found in the Facility Specification (see Related Documents chapter).

The Details of the GHMI will be designed by a GHMI design team for PD/2 and developed in a rapid prototyping course together with expert controllers. A description will be given in the PD/2 GHMI Specification document currently under production (reference 3).

8. TRAFFIC SAMPLES

The traffic samples to be used for the simulations will be developed to cover the varying requirements of the different phases of the demonstrations.

Only IFR traffic is considered.

The traffic flow rates of the arrival traffic will be doubled in comparison with the today situation. A demand of 70 arrivals per hour will be produced.

The rate of overflight traffic will be determined during the Facility Test.
The departure traffic rate depends on the arrival traffic rate.

Every time a departure would be possible under ideal conditions an aircraft will depart (Ideal Departure Manager assumption).

The average distribution of wake turbulence categories will be:

Light aircraft	5%
Medium aircraft	63%
Heavy aircraft	32%

The Jet to Turboprop mixture will be:

Jet aircraft	90%
Turboprop aircraft	10%

The spatial distribution of the arrival traffic will be:

North Sector	35%
South Sector	40%
West Sector	25%

To increase the workload of the (staffed) west sector it is under discussion to exchange the values for South and West.

Three samples with different mixtures of Class A (Datalink and 4D-FMS equipped) to Class B aircraft (all other) will be used:

0%, 30% and 70% share of Class A aircraft.

For testing and demonstration purposes also samples with 100% Class A aircraft will be available.

The concrete specification of the available traffic samples will be found in the PD/2 Airspace Scenarios and Scripts documents (see Related Documents).

9. ABBREVIATIONS

a/c	aircraft
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATS	Air Traffic Services
ATTAS	Advanced Technologies Testing Aircraft System (DLR)
COMPAS	Computer Oriented Metering Planning and Advisory System (DLR)
CP	Conflict Probe
CWP	Controller Working Position
DLR	Deutsche Forschungsanstalt für Luft- und Raumfahrt e.V.
DPP	Demonstration Project Plan
EF	Entry Fix
EFMS	Experimental Flight Management System
FAC	Facility Specification
ETMA	Extended TMA
GHMI	Ground Human Machine Interface
IFR	Instrument Flight Rules
ILS	Instrument Landing System
MF	Metering Fix
NM	Negotiation Manager
OPP	Outline Project Plan
OPS	Operational Specification
ORG	Organisation
OSD	Operational Scenarios Document
PATN	PHARE Aeronautical Telecommunication Network
PATs	PHARE Advanced Tools
PD/1	PHARE Demonstration 1
PD/2	PHARE Demonstration 2
PHARE	Program for Harmonized ATM Research in EUROCONTROL
PRT	PD Review Team
QNH	Static air pressure at mean sea level
R/T	Radio/ Telephony
RWY	Runway
SIDs	Standard Instrument Departure routes
STARs	Standard Arrival Routes
TC	Tactical Controller
TMA	Terminal Manoeuvring Area
TOD	Top of Descent
VAL	Validation
VFR	Visual Flight Rules

10. GLOSSARY OF TERMS

Clearance	Process by which the aircraft get the allowance to fly within a tube .
Constraints	Windows in space and time through which a trajectory must be planned. Because a single constraint is related to a geographical location, often combined with altitude and time limits, a precise advisory for the interpolation between those locations is necessary in order to define the tube .
ETMA	Extended Terminal Manoeuvring Area , a TMA with its adjacent sectors, where at least the transition point from and to Enroute flying lies within that area.
Handover	Handover is used equivalent to transfer here.
(non) Wake vortex relevant pairs	two aircraft with a weight category combination, for which (not) an extra separation compared to the minimum separation has to be added due to the risk of wake vortices.
Profile	Series of points along a route joined by straight or curved segments by which the altitude and time along a route is specified.
Release	Process when a controller announces that the authority over an aircraft can be taken over by another controller.
Route	Series of points joined by straight or curved segments defining the horizontal path of an aircraft.
Trajectory	series of profile and route points defining a potential 4D-path for an aircraft joined by straight or curved segments.
Transfer	Whole process of giving and taking the authority over an aircraft.
Tube	A volume of 4D space time around an trajectory within which an aircraft can be contracted to fly (Tolerance tube). The tube volume is determined by the constraints associated to a trajectory.
Working position	Functional unit, where a team of controller works on. In PD/2 these are the working position within the ACC-W sector for Approaches and Overflights (for Departures an extra working position would be needed) and one for Approaches within the TMA.

ANNEX A: REFERENCES

1. PD/1 OPERATIONAL SCENARIOS,
R.M. Gingell, S.A. Fox
PHARE/CAA/PD1-7.1/OSD, DOC 94-70-28
2. EFMS PHASE 1b AIR/GROUND DATALINK COMMUNICATIONS FOR PD/1 AND PD/2,
R. Rawlings, R. Harlow
PHARE DOC 94-70-21;Draft Version 2.2; 1/5/95
3. PD/2 GHMI SPECIFICATION
GHMI Design Team for PD/2

ANNEX B: RELATED DOCUMENTS

A list of all PD/2 related documents will be maintained in a PHARE data base. The rules for document identification are given in Annex C.

The following is a list of the key documents for PD/2.

1. PD/2 Operational Specification, PHARE/DLR/PD2-1.2/OPS;

This document defines the broad operational objectives of PD/2.

2. PD/2 Outline Project Plan, PHARE/DLR/PD2-2.1/OPP;

This document provided the PD/2 outline project information on which the PD/2 Agreements has been based. The information is now superseded by the following document:

3. PD/2 Demonstration Project Plan, PHARE/DLR/PD2-2.4/DPP;

This document provided the PD/2 project information

4. PD/2 Facility Specification, PHARE/DLR/PD2-2.2/FAC;

The Facility Specification is a detailed description of the technical, operational and analysis requirements to be met by the simulation environment in support of PD/2.

5. PD/2 Operational Scenario, PHARE/DLR/PD2-7.1/OSD;

This document describes the modus operandi for the Planning Controller (PC) and Tactical Controllers (TC) necessary to support the organisations in PD/2. It concentrates on the task and operations to be performed rather than the mechanism available to implement the tasks.

6. PD/2 Airspace Scenarios and Scripts

This document will describe the detailed scenarios and air server scripts used for each of the traffic samples.

7. PHARE Document Database

This document will contain the status in terms of version of all the PHARE related documents and will be re-issued whenever a document is updated. The latest version will be held by the PHARE Cell