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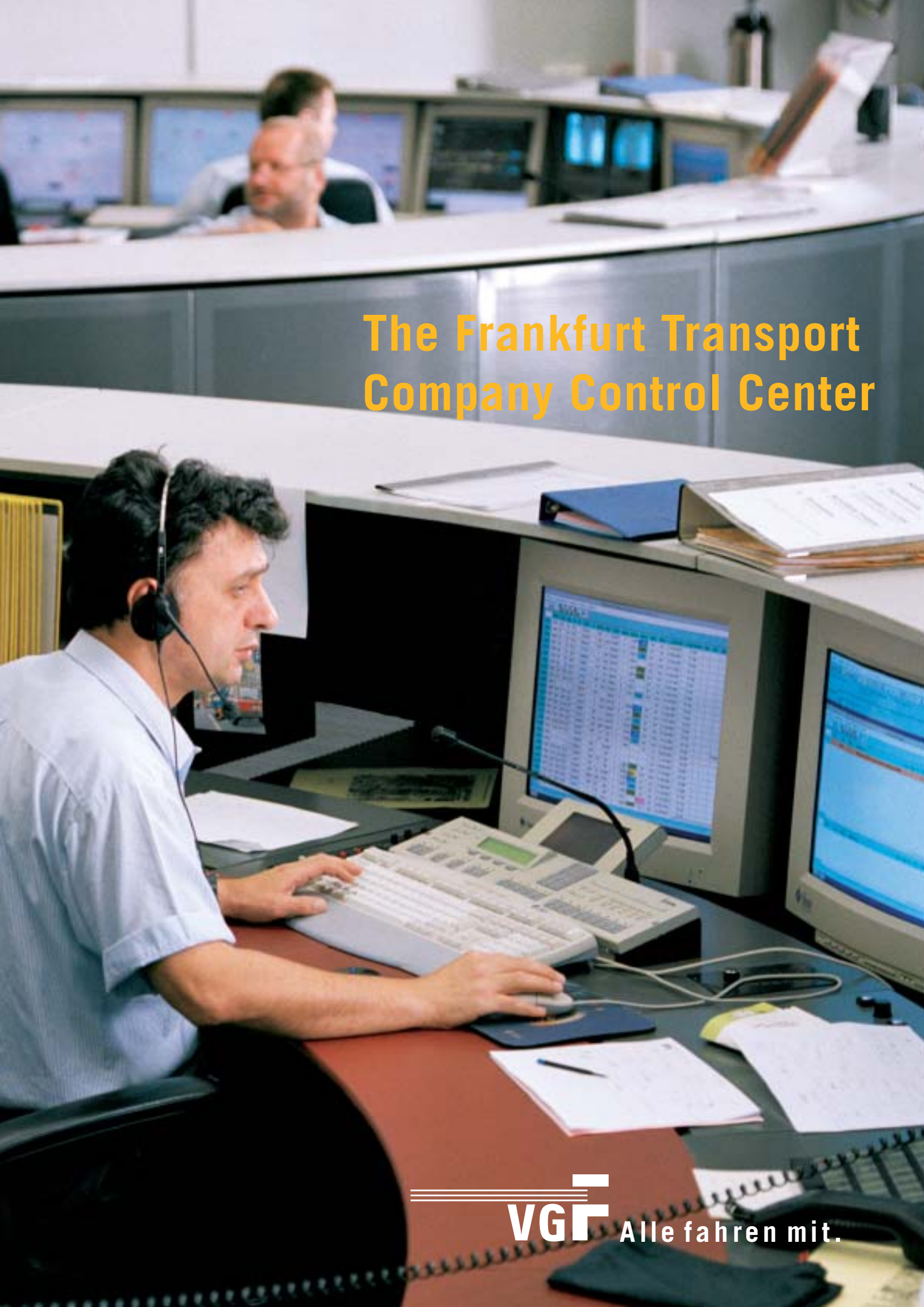
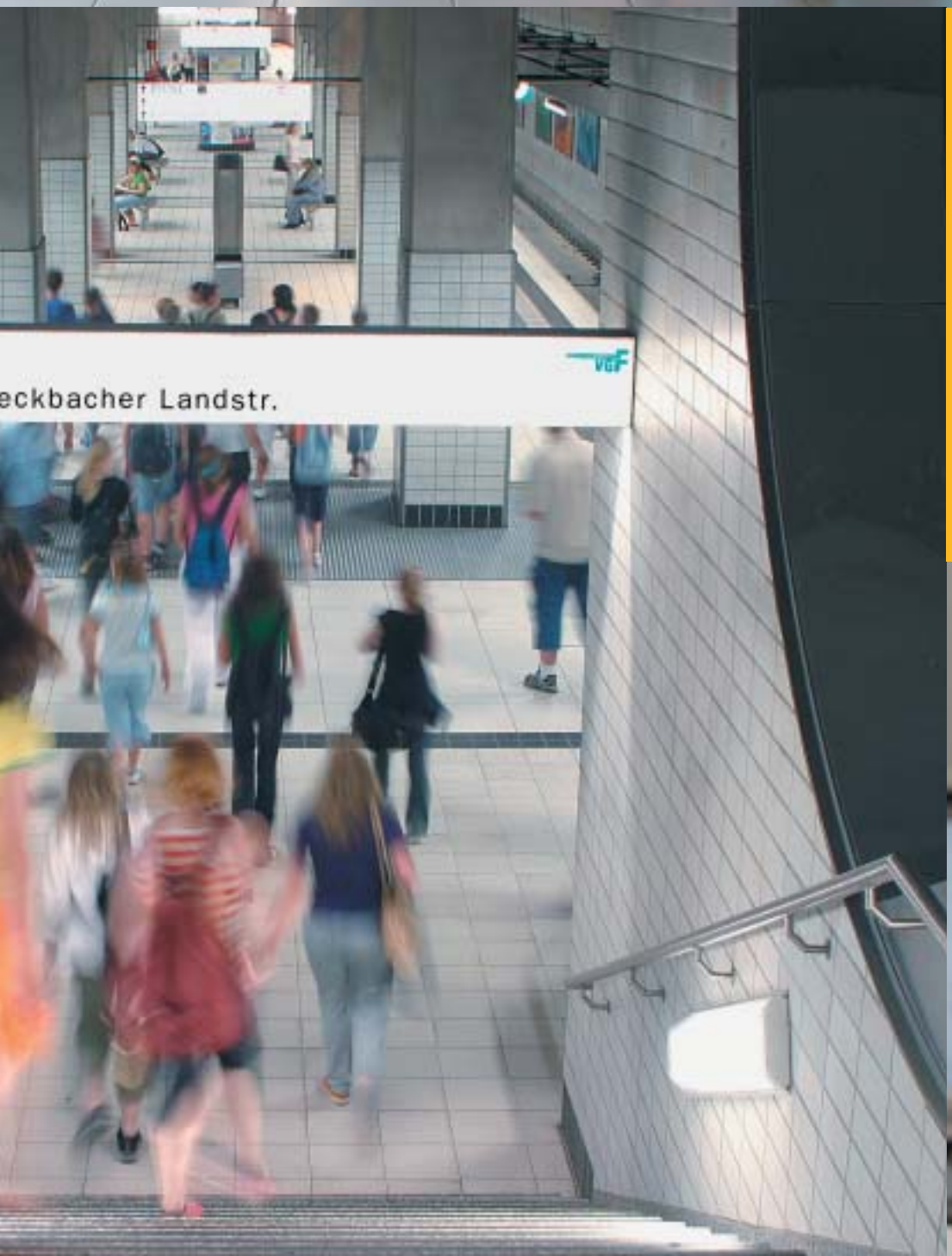


The Frankfurt Transport Company Control Center

VGF Alle fahren mit.



Annual number of passengers:

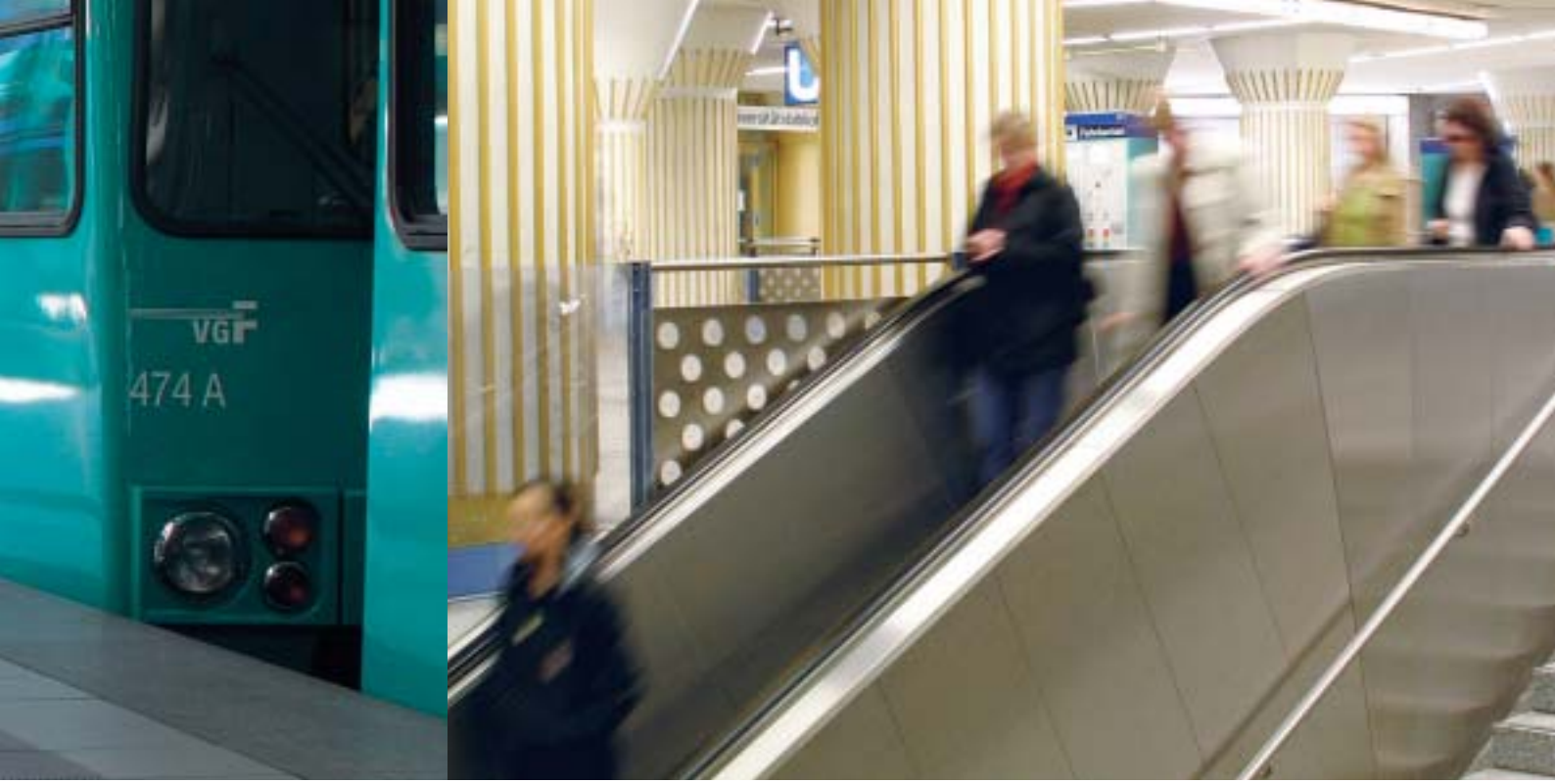
Underground: 95 million

Tram: 43 million

Bus: 37 million

Total: 154 million(1)

(1) Total figure is less than sum of individual sectors due to multiple entries.



The Control Centre – the heart of the VGF

The VGF (Frankfurt Transport Company) carries around 500,000 passengers daily – comfortably, safely and on time. Such a service requires highly qualified employees and a technically perfect operational system and facilities as the VGF strives for the highest standards with regards to reliability and quality. Already in 1979, the VGF had, as one of Germany's first transport companies, a central Control Centre. Since then, the three transport modes of bus, tram and underground are jointly monitored as well as signal boxes, infrastructure facilities, signal and train control systems, power supply and the operability of the escalators and lifts. In addition to this, passenger information is of increasing importance. This is given using various media but is centrally steered from the Control Centre. The operational Control Centre of the VGF is therefore of equal interest to technicians, passengers and the people of the Rhine-Main region who can all learn a great deal from a visit here.

This brochure aims to give you an overview of the main work of the operational Control Centre, on the technology used here and, last but not least, the people who work here who ensure that hundreds of thousands of passengers in the Rhine Main region remain mobile everyday.

The employees

The VGF operational Control Centre in the Elefantengasse 6 controls the entire tram, underground and bus network of the City of Frankfurt am Main with around 600 vehicles over 450 km. In peak times, this can involve 380 individual vehicles and transport associations at any one time (an underground train is made up of 2-4 vehicles). Seventy-five employees who work around the clock are responsible for this.

Transport officers

The transport officers are the eyes and ears of the operational Control Centre. As they have worked in driving service for at least three years, they know the network, the vehicles and the ins and outs of daily transport from first hand experience. They then go on a three-month training course and practical training which is also three months before they are allowed to work in the centre or as field staff.

When they work in field service – Frankfurt is divided into three districts – one employee travels with a radio van through each district to ensure that everything is running smoothly at all the stops. They check that everything is working at the stops, and the cleanliness there, they also check the signal systems, switch points and all other operational systems. If something isn't as it should be, they inform their colleagues in the Control Centre via radio who then call the responsible department.

The transport officer is particularly required if something which doesn't usually happen occurs. For example if there is an accident or a fire, he is in charge of operations at the VGF and is there, on the spot. He supports the driver, if necessary, and is the contact person for police, fire brigade as well as other aid which may be needed and he controls the underground traffic. But he primarily keeps the Control Centre up-to date so that the necessary measures can be implemented. This can involve staff changing underground trains or trams, diverting them or turning them around in time, calling for replacement buses and calling for repair staff. Everything, so that as few passengers are affected as little as possible.

During quieter periods, the transport officer also carries out minor repairs which do not necessarily require a specialist. During the night, between 9.00pm and 4.45am he is completely on his own as Frankfurt is only one district at this time.

Work in the centre and in field service alternates: when the transport officer is working in the centre he sits in the "Bus and Tram Control Point" or at the emergency services co-ordination position and controls the traffic from here. More on this on page 6.

Operators

Experienced transport officers can train to become operators. Training lasts three months in which the operator learns the basics of railway signal technology. This is necessary to control the traffic in the tunnel and to monitor it. The operator works mainly in the Control Centre and controls the traffic from the "Underground Control Point" (see page 6). He is only in field service if standing in for a colleague. Operators always work in pairs: one controls the traffic of the U1 to U5 underground lines and the other, the U6 and the U7 lines. They control the entire underground rail safety technology, set the signals in case of a failure or disturbance and provide support to the drivers, especially during rush hour traffic, by monitoring platform edges.

Controllers

The controllers have usually completed the transport officer and operator training and have several years experience before they go on a further three-month course to staff supervisor. They are the respective shift managers who co-ordinate the work of the control centre internally – also with VGF press office as well as externally (police, fire brigade etc) – in the case of disturbance and special operational cases.

Frankfurt on the move

652,000 inhabitants
476,000 employed
310,000 commuters

Number of lines/routes

Underground: 7
Tram: 9 (1)
Bus: 51 (2)
Total: 67 (1)

Number of stops (1)

Underground: 84
Tram: 126
Bus: 646
Total: 856 (3)

(1): Incl. Ebbelwei Express
(2): Incl. 9 night buses
(3): Total is less than sum of individual sectors due to multiple entries. All data from 2004 / sample day of 31.12.04.

The Workplaces

The Bus and Tram Control Point

The Bus and Tram Control Point is manned by three transport officers during the day who monitor bus and tram traffic. Two “steer” buses which can reach a maximum of 180 vehicles during the rush hour and one monitors the up to 80 trams on nine lines. On several monitors, the transport officers can check if the timetables are being kept, the location of the vehicles and also assist if vehicles are running very late or if there is a fault. They can also replace drivers if they are ill and also intervene if accidents are hindering the traffic. Especially buses, but also the trams, often face the problem of incorrect parking – drivers parking at a tram or bus stop or the access to them. If this happens, the transport officer informs the respective authority which then ensures that the obstruction is removed so that the VGF vehicles can resume their journeys. He gets the necessary information for this either from his colleague in field service or from the driver and is in contact with each vehicle via radio contact. At night, between 10.00pm and 4.00am, a staff member takes over sole responsibility for the co-ordination of the buses and trams.

Underground Control Point

There are three staff also here: two operators monitor the traffic on the seven underground routes and one transport officer or operator controls passenger information in the case of a disturbance. The operators, similar to their colleagues in the Bus and Tram Control Point, plan traffic on the underground routes, operate the signal systems (above the ground) and the underground train safety systems (underground). As the underground operates, with the exception of the U5, on its own tracks, this involves a network which is independent of the trams.

Passenger Information Point

As the VGF is aware of the importance of current passenger information it has created an independent workplace especially for this. The staff member at the Passenger Information Point uses different ways of informing passengers about disruptions. He can speak directly to passengers in the vehicles via radio, write texts for the train destination displays and the display for the dynamic passenger information. He also makes the announcements via loudspeaker which you can hear at the stops. He here sometimes uses set texts, individual texts or, in special circumstances, one-off

announcements at special stops. He can also switch to the platform cameras on his monitors – which monitor the entry and exit of passengers from vehicles as well as tunnel openings.

Causes of disruption

External
- Accidents involving the VGF
- External accidents
- Incorrect parking
- Police / rescue vehicles in operation
- Persons in need of assistance
- Demonstrations
- Network power failure
- Snow / ice
- Bomb threat
- Catastrophe alarm
- Vandalism
- Disruption with the suburban rail when in joint tunnel
- High traffic volume

Internal
- Building work
- Technical faults in vehicle
- Signal fault
- Switch point fault
- Traction current failure
- Damage at driver cable
- Operational accidents
- Staff shortage
- Strike
- Collision of two trams on switch point
- Derailment

OM

OM stands for “operational monitoring” – the monitoring of several systems which are available to the passenger. For example: the lifts, lighting, ticket machines as well as further technology. An overview of this can be found in the box on page 8. The experienced staff working here, usually specialists from an electrical profession with several years professional experience, can recognise faults here from their workplace. These are then immediately passed on to the relevant departments so that the appropriate staff can be sent in to repair the fault. Several systems, such as lighting in the stations and tunnels and the traction current, can also be switched on and off from here, minimising the disturbance to passengers and operation. This position is also manned 24-hours a day.

Emergency services co-ordinator

... is a transport officer who, in the case of a disturbance, co-ordinates the emergency services vehicles. He calls police, fire brigade and ambulances and keeps constant contact with them as well as to external transport officers and the maintenance and repair services

What do the control technology headquarters monitor?

- Lifts
- Rail crossings
- Fire alarm systems
- Rail signal technology
- Loudspeaker systems
- Ticket machines
- Traction current supply
- Escalators
- Emergency exit monitoring
- Radio systems
- Rectifier plant
- GSM (global system for mobile communication)
- Heating – air conditioning – temperature control
- High voltage
- Industry TV to monitor platform edges
- Electronic train destination displays
- Network replacement (battery systems and diesel generators to maintain power supply in the stations).
- Low voltage
- Security services
- PCM (pulse code modulation, data transmission type)
- Pumps (sump pumps in case of water leakage in tunnels in operation)
- Rescue route signs
- Rolling grill
- Sanitary facilities
- Telephone
- Stair heating (floor heating of outer stairs so that passengers don't slip on icy stairs)
- Clocks
- Flood prevention gate
- Switch point heating

of the various departments. He informs internally, for example the head of operations and the press office, on the disruption and is responsible for recording operational procedures as well as operational registration.

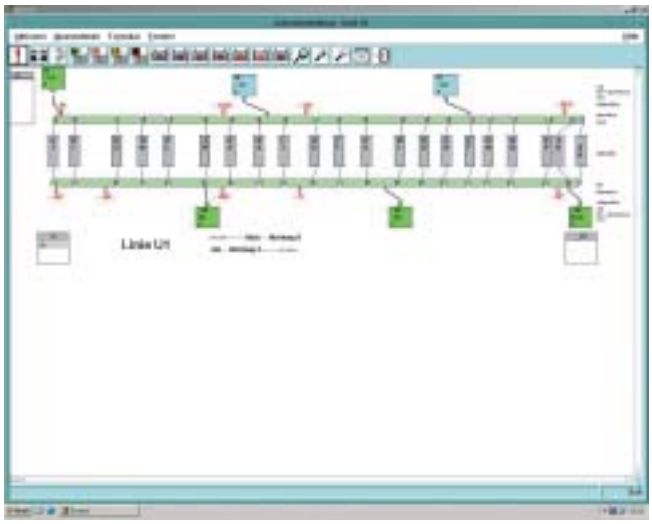
When Frankfurt is sleeping

… the Control Centre is busy. There is always plenty to do: on Friday and Saturday nights there are eleven operating night buses. Maintenance work and repairs on tracks and switch points must also be carried out as well as monitoring technical fittings. And, so that operation and passengers are affected as little as possible, many repairs are undertaken when operation has stopped – between 1.00am and 4.00am. The operator often has more work in the rail signal technology than in the day as the routes for building and maintenance vehicles as well as switch points where there is cleaning, must be set manually. In usual operation, however, the routes and switch points are set automatically via the train control of the vehicles. The member of staff at OM also supports the repair personnel on site with central switching, for example switching lighting on / off and co-ordinating work overall.

The technology

The Inter-Module Transport and Control System (ITCS)

The ITCS – formerly called the computer controlled operational control system – is an important aid for staff in the Control Centre but also for those driving vehicles. The entire data communication between vehicles and the Control Centre takes place through this. The system incorporates the Control Centre facility (the computer network here), the route facilities (infrared location code transmitter along vehicle routes) and the vehicle components (computer on the vehicles). The Control Centre computers get information via radio data transmission from the vehicles / vehicle computers. They then transmit their information, for example the route covered, if a door is open or closed, and the number of local code transmitter, (which the vehicles receive via infrared telegrams from the local code transmitters) on to the Control Centre computer. This data is then compared with the scheduled timetable which is stored in the system. From this, the current location and timetable status of every individual vehicle is calculated and transposed into various screen representations. On three colour screens, available on all workplaces, operational status can be shown in table and graphic form. From the data, taken at 20 second intervals, the ITCS develops the necessary



This screen shot from an operating station monitor in the Control Centre shows a line diagram – one of several possible visual representations for the monitoring of the bus and underground rail traffic.

measures to control the disruption which the transport officers and operators implement using their own professional experience and appropriate action. Communication with drivers also takes place via the monitors. If a driver requests voice contact, the transport officers and operators can read all important vehicle data in only one line. If driving personnel push the “emergency” key, this information displays first in red. The ITCS supports a series of further functions: it enables safe connections which means that vehicles wait longer for each other at stops where more people

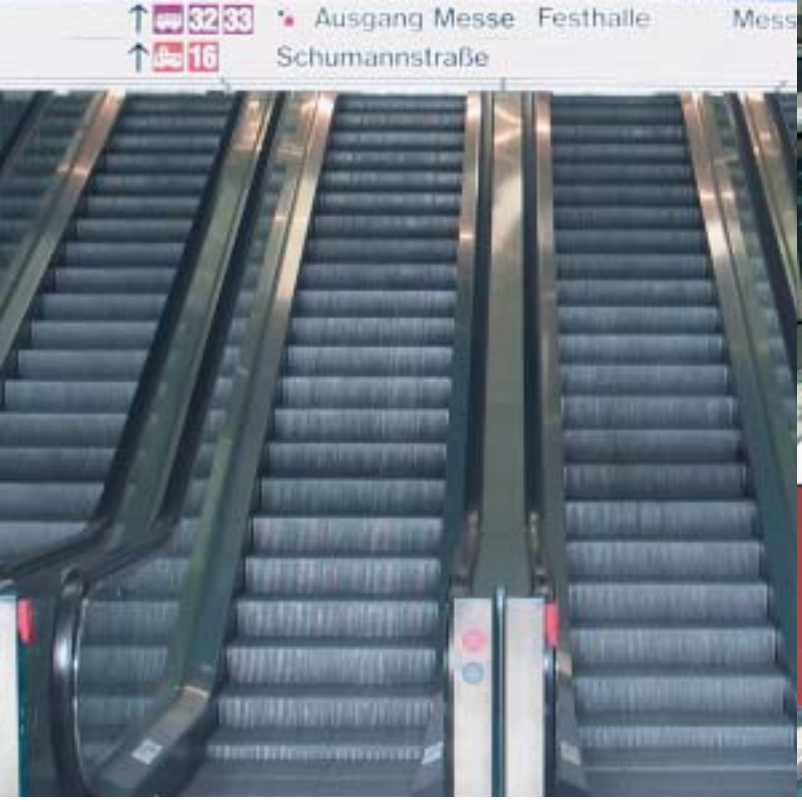
are changing. It incorporates an interactive statistic and analysis system with which changes in the timetables can be compiled and helps with the fitting and optimisation of the acceleration of traffic signal systems. With the ITCS, driving personnel also always have the current timetable status at hand – this is especially important if a vehicle is too early. Passengers also have access to the latest info. via the internet site of the RMV (www.rmv.de) and a WAP compatible mobile phone – very useful if you want to get home as quickly as possible on a wet night after the pubs have closed.

Another important function for the passenger service is "dynamic passenger information" (DPI) which also supports ITCS. Different to the timetables, the electronic displays at the stops indicate the actual time of arrival of bus and underground rail – right to the very minute. This is not only a good service during normal times but especially in the case of a disruption. Here, the staff in the Control Centre can quickly inform guests. Currently, tram lines 11, 17 and 21 have DPI displays, further lines are to follow.

The signal boxes

Of the 58 km underground network, 30 km are operated technically by signals via signal boxes. From the first relais signal boxes from 1968 to the electronic signal boxes which began operating in the mid eighties, different signal box technologies are used and monitored from the Control Centre. On the basis of networked computers and automatic functions, the control system and its facilities ensures the central operation of the signal boxes and the visualisation of everything taking place at the operating point.

The relais signal boxes are the oldest in the system and are remote controlled by special computer systems – making them network compatible. In this way, the relais signal boxes can also be driven and monitored via a uniform user interface from only one operating point. The first generation electronic signal boxes (1986-1993) are, on the other hand, connected through a special coupling computer to the Control Centre technology. The new route between the Central Station and Bockenheimer Warte has now enabled the connection of the most modern signal box to the operational Control Centre. This signal box controls and monitors a total of 18 main, four front and 16 emer-



gency signals as well as 20 switch points and rail locks on a stretch of around two kilometres. The new signal box also enabled operation of an interface to a relais switch box as well as to an older electronic signal point. In addition to the operating points in the operational Control Centre, further de-central operating points are also provided with signal box data.

The Central Control Technology

The systems in the stations don't always operate without disruption. In the event of this happening, reliable information is essential. This is necessary to be able to assist quickly and efficiently. This is where the Central Control Technology (CCT) comes in which supports staff at OM and visualizes operational status here. Disruptions and faults of all operational systems such as escalators, rolling gates, radio, video systems, signal systems, air conditioning, switch point heating etc. is compiled here. From the OM, various switches can be operated centrally. In this way, for example, tunnel lighting and traction current can be switched on / off via the CCT system.

For the users of the CCT system, user interfaces according to need are available. Different to other transport companies where this is carried out by manufacturer companies, VGF employees programme the CCT applications themselves as well as creating all the necessary operating graphics.

Transport in the Frankfurt am Main region

41 per cent by car

32 per cent by bus and underground

20 per cent on foot

7 per cent by bike