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Final Report

Economic Benefits of Competition in European Air Traffic Management - Germany as an Example

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1. Introduction

In Europe, delays in air traffic are roughly estimated to damage the economy by 10 billion Euros per year, half of which is due to poor coordination in the European airspace.¹ It is thus not surprising that the organisational efficiency of the European air traffic management system is questioned. In spite of the recent slowdown in the growth of air traffic, the prospects for further growth in the coming years and decades are still regarded as excellent. However, faced with the limited capabilities of the European air traffic management system, it is to be feared that the air traffic management (ATM) will gradually develop into serious brake on further growth.

The European system of air traffic management is operated by national-area monopolists who operate with only slight market risks. This, in combination with national egoism, means that the necessary technological and organisational progress cannot keep up with the requirements of the users. For this reason, better market orientation of the ATM service providers is being demanded at the European level. Competition is a common and effective instrument for achieving more market orientation of services.

The objective of this plan is therefore to develop competition models for ATM services, to evaluate these on the basis of suitable criteria and present suggestions for the implementation of suitable models. Since competition is a public process whose detailed results are not known in advance, this study does not, in general, make any concrete organisational or technical proposals. Instead, the authors examine the political instruments under which competition can develop, permitting the evolution of efficient organisational and technical innovations.

Part I of this study presents some theoretical and practical principles which also function as building bricks for the development of comprehensive approaches to the solution. The discussion begins with the most important basic terminology of economics (Chapter 2). The service "air traffic management" is defined precisely in Chapter 3. Chapter 4 is devoted to a presentation of the status quo in Germany, Europe and selected countries outside Europe. Chapter 5 deals with the question of whether the special demands placed on air traffic management with respect to safety, protection of life and shared use of the airspace by military aircraft could prevent a stronger market orientation. Chapter 6 briefly summarises the results of some recent studies and Chapter 7 draws an initial conclusion.

Part II of the study develops a comprehensive approach to the solution of the problem, which primarily affects the ATM services in the upper and lower airspace. After an introduction in Chapter 8, Chapter 9 deals with the question of which instruments can be used, with today's technology, for management of the upper airspace. For this, it also introduces the concept of the *functional block of airspace* which, in the opinion of the EU, is to be used in the future for subdivision of the upper airspace. Chapter 10 presents similar considerations for the lower airspace which, although not yet a part of the European *Single Sky-Initiative*, will in the medium term be subjected to similar regulation mechanisms for economic, legal and political reasons. The organisation and regulation of the ATM infrastructure is examined in Chapter 11. The study closes with a conclusion and summarised recommendations for action in Chapter 12.

¹ See also the calculations and methodic results presented by the Association of European Airlines, AEA (1989), Towards a Single System for Air Traffic Control in Europe, Brussels, p. 16 ff.

Part I
Basic Principles

2. Basic Terminology and Methods

2.1 The Functions of Competition

Why do we need competition in the European air traffic management? Economists would not ask this question in this manner. Instead, they would ask: why should there *not* be competition in the European air traffic management? From the viewpoint of economics, competition is the superior means of coordinating economic activities, because competition

- creates a balance between supply and demand in markets (*market clearing function*),
- avoids permanent innovation arrears by holding out a prospect of pioneer profits to potential innovators (*innovation function*),
- tempts further actors into the market in the case of realised pioneer profits and induces the installation of additional capacities, so that the profits which can be earned in the market will gradually normalise themselves (*profit normalisation function*),
- does away with unbalances of power of individual market participants by the entry of other participants on the other side of the market (*predominance erosion function*).

If the government decides not to use competition as a form of coordination, good economic reasons must be presented for this decision. It is not sufficient to refer to higher-order political interests, to public welfare or a majority decision. Instead, any state intervention in the market requires *good, legitimate reasons*, which can be found, above all, in the *Theory of Market Failure*.²

If, on the other hand, certain markets are generally managed by the state, as the result of historical developments, then this organisation form must be examined regularly in a market economy, because the political system does not include any automatically effective mechanisms for testing inherited concepts and implementing measures which could improve efficiency.³ In this respect, the system of political management of markets differs from a competitive system where the pressure of competition from existing and potential newcomers provides a permanent incentive for the established companies to optimise their economic activities.

Insofar as the state carries out functions related to sovereignty or law and order, one could also ask how far the activities of the state may extend into the "operative business" or whether it is sufficient to define general rules and to enforce these with the aid of regulatory authorities. Many things which were previously regarded as sovereign tasks – such as travel by rail or the simple connection of a telephone – are carried out today by private companies without negative effects on the society.

² See also p. 7 f for more details of the Theory of Market Failure.

³ In fact, the results of the New Political Economy indicate that politicians are primarily interested in being elected again, and bureaucrats are primarily interested in maximising their sphere of influence. See also G. Kirsch (1993), *Neue Politische Ökonomie (New Political Economy)*, 3. Aufl., Düsseldorf, on the behaviour of politicians and W.A. Niskanen (1971), *Bureaucracy and Representative Government*, Aldine u.a.O., on the behaviour model of bureaucracy.

2.2 Privatisation and Deregulation

The economic discussion about the *privatisation and deregulation of markets* arises from this philosophy. Privatisation and deregulation, often lumped together under the term "liberalisation", aim to improve the efficiency of markets⁴ which are currently subject to state management or regulation. On the other hand, the maximisation of the state's income, for example by achieving the highest possible privatisation proceeds, is *not a legitimate objective* of the privatisation and deregulation policy.⁵

Privatisation means that the relative proportion of the gross domestic product generated by the private (non-state) sector increases, compared with the state-owned sector. This may happen as the result of the *explicit privatisation* of state-owned companies or the sale of state-owned shares in private companies and/or by the *implicit privatisation*, where the general conditions are changed in order to permit a greater economic influence. *Deregulation*, i.e. a modification of the general economic policy which opens up additional action parameters for the economic subjects, thus corresponds to an implicit privatisation.⁶

Privatisation is referred to as *formal privatisation* (or organisational privatisation) if a state-owned company remains the property of the state but its organisational shape is changed to that of a private company. In the case of a *material privatisation* (also called a capital privatisation), in contrast, private economic subjects also take over the ownership and control of the previously state-owned company.

The term *partial privatisation* is used if the state-owned company is only partially privatised (e.g. only 49% of the company passes to private ownership). Such constructions are often called public private partnerships (PPP). This frequently involves the risk that the selected private partial owners receive priority over other companies who do not have a share of the previously state-owned company. Such an advantage is generally detrimental to competition and is thus undesirable.

Privatisation may be unlimited or limited in time. If, for example the state grants a private company a concession with a time limit, then this can be regarded as a time-limited, material full privatisation.⁷

Finally, the functional extent of a privatisation may differ greatly. In the case of *outsourcing* of services previously provided by the state, only peripheral functions are generally transferred to private companies. The privatisation of funding or even of the production (manufacture) goes further, but it may still be subject to conditions defined by the state (e.g. as the result of an invitation for tenders). The most extensive form of privatisation is the case where the private company not only decides the production of goods but also their *supply*, i.e. the company independently defines the price, the quantities and the quality of the goods.

⁴ See also the comments on efficiency on the next page.

⁵ See also H. Grosseckttler (1989), *Deregulierung und Privatisierung: Erscheinungsformen, Legitimationskriterien und politische Verhaltenstendenzen*, (Deregulation and Privatisation, types of appearances, criteria for legitimisation and tendencies in political behavior), from: *Wirtschaftswissenschaftliches Studium* Vol. 18 (1989), pp. 437-445.

⁶ Unless, of course, without explicit privatisation the deregulation measures are primarily to the advantage of state-owned companies.

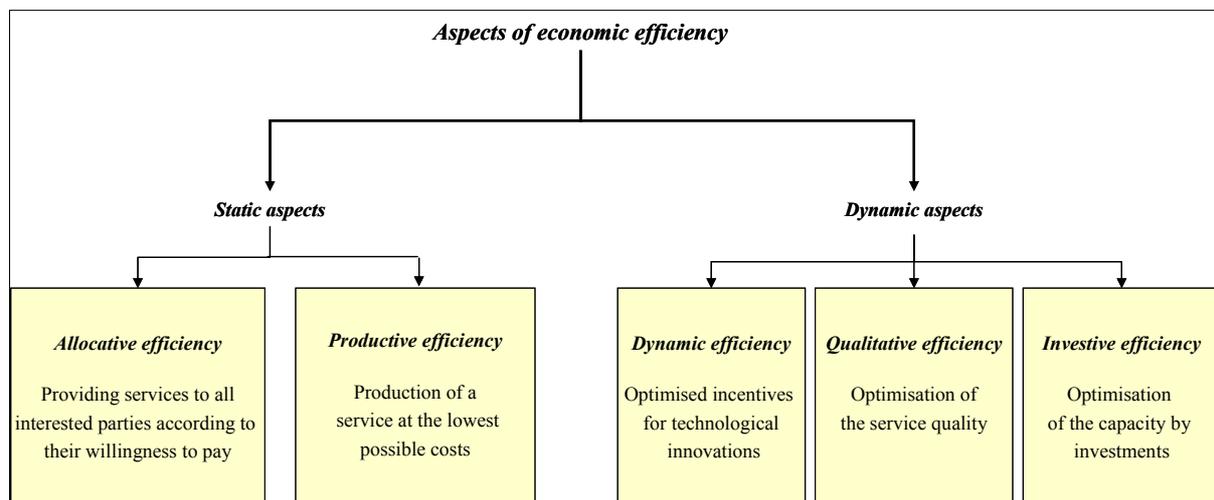
⁷ In this respect, the German jurisprudence does not speak of privatisation since, in Germany, the legal property rights remain with the state in the case of a concession agreement. In other countries, such as Great Britain, the situation is different: in all cases, most of the economic disposal rights are transferred to the private concessionaire.

2.3 Efficiency Characteristics of Functioning Markets

The economic scale for the evaluation of various privatisation and deregulation measures is the *aggregate efficiency*. This can be defined in various ways.⁸ A very common method is to split the term "efficiency" into several sub-terms:

- *Allocative efficiency*: allocative efficiency exists if no-one who is willing to pay the resulting additional costs is excluded from the use of goods. In competitive markets, the price of goods or services corresponds precisely to these additional costs (marginal costs) caused by the last prospective purchaser.
- *Productive efficiency* is achieved when goods or services are produced at the lowest possible costs. In a monopoly, which can withdraw from the competition, this is generally not the case – at least in the long term. However, the productive efficiency is also reduced if the companies are, for example for regulatory reasons, so small that they cannot achieve their minimum optimum size. A prerequisite for productive efficiency is that the minimum optimum company sizes are reached.
- Considered dynamically, efficiency increases if the companies improve the quality of the goods or services they offer (*qualitative efficiency*), if they have an incentive for technological innovations (*dynamic efficiency*) and have an incentive to invest just as they would do in a competitive market (*investive efficiency*).

In competitive markets, experience has shown that there are sufficient incentives for the actors in the market to ensure that these efficiency conditions exist. In markets in which primarily state-owned companies are active, or markets characterised by *market failure*, the incentives are in many cases distorted or systematically deactivated.



⁸ The basis of all definitions is the criterion of Vilfredo Pareto, which states that efficiency is achieved when the situation of one individual cannot be improved without worsening the situation of another individual.

2.4 Efficiency Reductions due to Market Failure

In accordance with the "*theory of market failure*"⁹, the allocation of scarce goods – from the economic viewpoint, all goods are scarce since there is not an infinite supply – should always be done by means of markets and/or competition. The state should intervene only if there is a clear indication of a market failure. If it intervenes in cases which are not due to market failure it is acting, from the economic viewpoint, without the appropriate legitimization. Possible causes of market failure are:

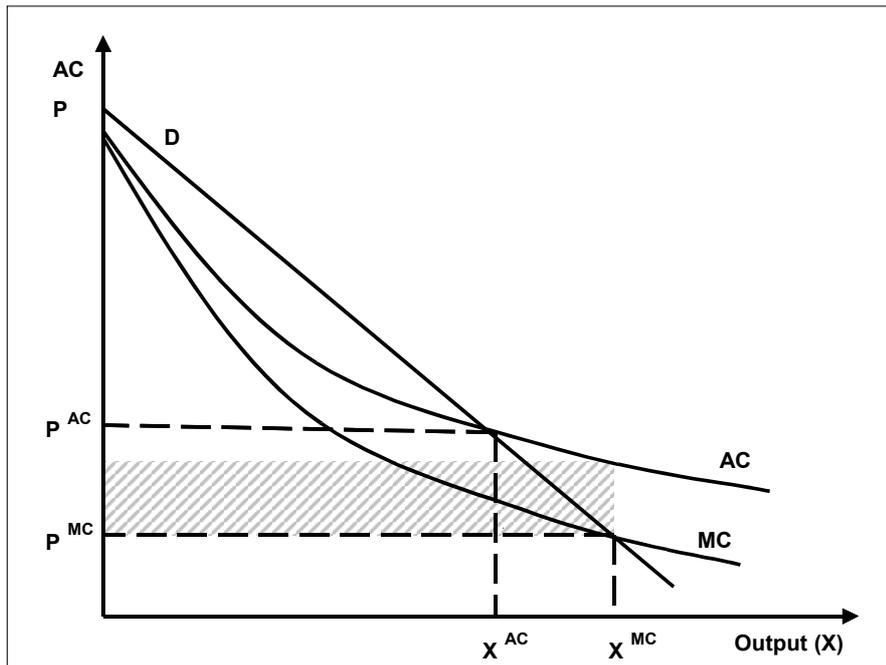
- *External effects*: external effects are costs or benefits which are caused by an economic subject but affect third parties and cannot be charged (or reimbursed) to the subject causing them. The most important example of negative external effects is damage to the environment, while a frequently cited example of a positive external effect is a beekeeper, whose production activities are advantageous for fruit farmers (or vice versa), The objective of economic policy should be to *internalise* the external costs or benefits so that they can be included in the calculations of the subject causing them. An extreme case of external benefits is the so-called *public goods*, whose benefits the producer cannot acquire because he cannot prevent the non-paying users ("free-riders") from using the product or because preventing this would be prohibitively expensive (example: lighthouses). The *provision of a public good* is made possible by a procedure where a central authority (generally the state) determines what the potential users are willing to pay, aggregates these values, orders the appropriate amount and quality of the good (it does not necessarily actually produce the good) and refinances its activities by means of compulsory charges.
- *Lack of information*: some goods (such as education, used cars, complex services, etc.) are subject to a lack of information because the potential users cannot monitor their quality or because such monitoring would be too expensive. The same also applies frequently to the question of how safe a good or a service is – safety is a trust good.¹⁰ In order to avoid market failures as the result of a lack of information, it is generally necessary to implement special contractual or private-law regulations such as product liability, warranties, long-term contracts, etc.
- *Natural monopolies*: a natural monopoly exists when a single supplier in the sector of the relevant demand can, for cost-degression reasons, offer a service more cheaply than a group of several suppliers¹¹ and when his investments are irreversible to such a degree that he can threaten potential newcomers that he will offer marginal prices in the long term. This is often the case, particularly in infrastructures. These prices would not cover the costs of a newcomer who has not yet invested, which means that he will decide not to invest. A natural monopoly must therefore be regulated. The privatisation of a natural monopoly without accompanying regulation (*naive privatisation*) is impermissible from the economic viewpoint. In contrast, natural monopolies whose markets are contestable are less damaging, since the contests resulting from potential newcomers has a

⁹ See also M. Fritsch/T. Wein/H.-J. Ewers (2001), Marktversagen und Wirtschaftspolitik (Market failure and economic politics), 4th ed., Munich.

¹⁰ For a definition of a trust good, see P. Nelson (1970), Information and Consumer Behavior, in: Journal of Political Economy 78 (1970), S. 309-329.

¹¹ In economic terminology, the marginal costs of the supplier the sector of the relevant demand lie in this case below the average costs.

disciplinary effect on the monopolist. The following figure demonstrates the problems of a natural monopoly:



If the criterion of *allocative efficiency* is to be met (see Section 2.3), a marginal price (P^{MC}) must be set. In this case, a natural monopoly has a production or service quantity of X^{MC} . However, it cannot cover its average costs AC with this production quantity – a deficit (shown by the shaded area in the diagram) will result. If the natural monopoly is not regulated, it will attempt to set very high monopolistic prices, to the detriment of the purchasers. If the monopoly is regulated and required to employ the full-cost or average-cost principle, the resulting demand quantity X^{AC} will lie below the optimum-welfare quantities X^{MC} and a loss of welfare will result. This can be avoided by forcing the natural monopolist to charge marginal prices but permitting him to demand an annual or monthly charge in order to cover his fixed costs or his deficit (also called a split or *two-part tariff*). Such split tariff structures are today commonly used by water and electricity companies and by telephone and mobile telephone companies.

2.5 Privatisation and Regulation

On the basis of *privatisation rules*, it can be shown how markets with indications of market failure can be subjected to an efficient and competitive regime. In contrast, a monopolistic supply of goods or services by the state is basically suspected of being inefficient, because

- the "day-to-day economic experience", documented in numerous empirical studies, shows that this is so,¹²
- the sanction function of the capital market is disabled in public companies (no hostile takeovers, no bankruptcy),
- the motivation function of competition is disabled for managers and employees.

This results in the following *privatisation criteria*:

1. A service should be privatised if there is no indication of market failure, since there is no legitimation for supply, production or regulation activities by the state if there is no market failure.¹³
2. If there is an indication of market failure, it should be determined whether this can be rectified by the introduction of general rules (such as the internalisation of external costs by means of environmental charges). If this is the case, these rules should be defined by the state, but the supply and production activities within the framework of these rules should be left in the hand of private persons or companies.
3. If it is not possible to introduce general rules in order to rectify the market failure, as in the case, for example, of a natural monopoly, the market activity must be subjected to special regulation rules in order to prevent exploitation of the buyers. The regulation rules must create clear incentives for the regulated company to optimise its market behaviour with respect to the structure of its prices, quality and costs. In this case, the regulation, instead of the competition, must act as the instrument of sanction.

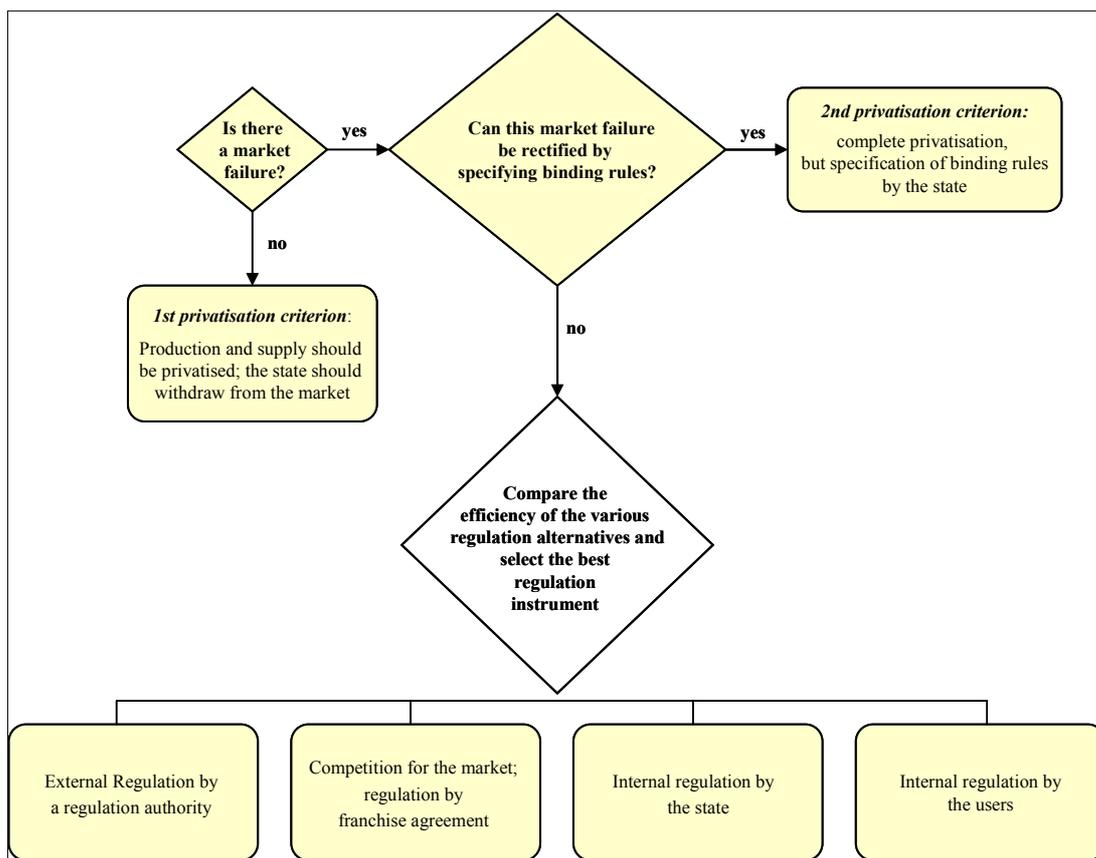
The regulation solution which promises the most efficiency should be selected. This may be:

- a competition for the market (competitive tendering),¹⁴
- privatisation with simultaneous external regulation by a regulation authority,
- privatisation with simultaneous internal regulation by the users (the so-called club solution; such as the solution selected for NATS),
- continuation of the public production (public internal regulation).

¹² See J. Vickers/G. Yarrow (1988), *Privatization: An Economic Analysis*, Cambridge/Mass.

¹³ The provision decision is the definition of the price and quality of a service. This decision may be made separately from the actual production or manufacture. This is not the case in competitive markets; in the case of tenders, the provision decision is made by the state and the manufacture is carried out by private companies.

¹⁴ From the political viewpoint, the tender has the advantage that public-sector services can be imposed on the bidder who is prepared to execute them at the best conditions, thus permitting two objectives to be achieved by a single instrument.



Public internal regulations frequently fail because the state is in most cases unable to achieve the protection of the customers (the objective of regulation) in the face of its own interests as the owner of the public company (fiscal objective).

Only a few examples exist for the internal regulation by the users. A decisive element for the success of this regulation model is that the charter of the club takes the interests of the member companies, whose sizes may vary widely, in a suitable manner and that entry to the club remains open for newcomers.

Privatisation with simultaneous establishment of a regulation authority, such as is the case for telecommunications, requires a powerful set of regulation instruments. Once this course has been taken, it is extremely difficult to reverse the decision.

In the case of competitive tendering, an invitation to bid for the market is issued at regular intervals (for example, every ten years) and the market is awarded to the bidder who makes the best offer. Regulation is carried out by means of a franchise agreement and compliance with the agreement is monitored by the public authorities. The basic differences between external regulation and competitive tendering are shown in the table on the next page.

If the natural monopoly of a supplier results from his power of disposal over an infrastructure, then he will be very interested in withholding his infrastructure from his competitors, even in the case of a competitive tendering procedure.

	External regulation	Competitive tendering
Award of the service	Permanently	For a specific period
Legal basis	Regulation law	Tender law (and other legal principles)
Regulation instrument	Rule-based directives and orders; contestable in court	Fulfilment of the franchise agreement
Regulator	Regulation authority	The awarding authority (= the authority which invited tenders)

If it is desired that several bidders should have the opportunity of entering the market, then it is necessary to grant them right of access to the infrastructure. For this, there are two basic alternatives:

1. The *essential facility doctrine* guarantees every company access, without discrimination, to essential facilities which it needs in order to provide its services. This is already firmly established in the European and German competition laws. Compliance with these laws is monitored by the antitrust commissions, such as the Federal Cartel Office in Germany.
2. An obligation to clearly separate infrastructure and services (also called *unbundling* or *vertical disintegration*) can be achieved only by the way of politics. *Unbundling* is intended to limit the monopolistic power of companies to the area from which it arises, namely the infrastructure area, and thus to avoid disturbance of the competition in the upstream or downstream markets.¹⁵

Box 1: Essential facility doctrine

The *essential facility doctrine* comes from the competition law of the USA and was integrated into the German competition law in 1999.¹⁶ *Essential facilities* are facilities or infrastructures in the hand of a market-dominant company without whose use a competitor cannot offer services to his customers. The *essential facility doctrine* states that the market-dominant company must permit its competitors to use the essential facilities at conditions comparable with those for its own use of these facilities. The market-dominant company may not force its competitors into a disadvantageous competition situation.¹⁷ For assessment of whether a facility is to be regarded as an *essential facility*, it is important to determine whether the market offers reasonable alternatives to the use of the facility in question or whether the – timely – entry to the market is possible only by use of the essential facility. Typical examples of essential facilities are ferry ports owned by shipping lines or pipelines for the transport of gas.

¹⁵ See the comments on Section 11.

¹⁶ See § 19, paragraph 4 of the German law against trade restrictions (GWB): "Abuse exists in particular when a market-dominant company refuses to allow another company access, for suitable compensation, to its network or other infrastructural facilities if the other company cannot, for legal or actual reasons, act as a competitor to the market-dominant company in the upstream or downstream market without access to these facilities."

¹⁷ See Markert, K. (1995), Die Verweigerung des Zugangs zu „wesentlichen Einrichtungen“ als Problem der kartellrechtlichen Missbrauchsaufsicht (The denial of access to „essential facilities“ as a problem of the cartell law? misuse supervision?), in: *Wirtschaft und Wettbewerb* Vol. 45 (1995), pp. 560-571.

3. The Service "Air Traffic Management"

Air traffic management manages the airspace to the benefit of air traffic. It coordinates the air traffic and thus offers its customers (the airlines, military aviation and other participants in air traffic) both safety (freedom from collisions) and reliability (relative freedom from disturbances). The ability to plan operations, or the relative freedom from disturbances, has two advantages for the airlines:

- it permits compliance with flight schedules, thus ensuring that passengers can catch their connecting flights (advantages for the customers),
- it permits reduced consumption of kerosene and the use of fewer personnel and less equipment (cost reductions).

It is clear that airlines with complex networks of flights value the first aspect more highly than, for example, regional airlines and that they are thus prepared to pay more for the performance feature "reliability". However, the existing organisation of the air traffic management in Europe pays little attention to this since it does not provide for a differentiation of process and qualities (such as on the basis of reliability features).

In some respects, air traffic management is similar to the rules of the road which apply in road traffic. Of course, the participants in road traffic coordinate their own actions to a great degree with the aid of rules and traffic signs. They accept the risk of collisions resulting from violations of the rules and the risk of disturbances (traffic jams), partly because the consequences of collisions are far less severe than in air traffic.

In contrast to road traffic, air traffic management not only uses traffic rules, but also directly orders the behaviour (in particular their speed and height) of the participants. These instructions have the character of *critical information* – they must be received in good time and must be comprehensible, reliable and free of conflicts, because the pilot of an aircraft does not have sufficient time to check the incoming information for plausibility. The collision between two aircraft in the airspace over Lake Constance on 1 July 2002, which was caused by conflicting instructions issued to one of the pilots, demonstrated the necessity for clear instructions in a tragic manner.

In order to carry out its tasks, air traffic management has to be able to rely on various production factors:

- the exclusive right of disposal, at all times, over a specifically defined airspace,
- the radar-based location technology, ground- or satellite-assisted navigation aids and the communication channels between the ground control and the aircraft (the so-called CNS services),
- the technical ATM systems (processing of location data and of flight-plan data, human-machine interface) which support the air traffic controllers in their work,
- the operation of the ATM systems by the air traffic controllers (ATM services in the more literal sense).

3.1 The Right of Disposal over the Airspace

An *exclusive right of disposal over a specific segment of the airspace* enables an air traffic management organisation to protect the airspace against overfilling, which would endanger the safety there.¹⁸ The activity of air traffic management services is thus often referred to as a *natural monopoly*. This is imprecise from the economic viewpoint, because almost every production activity requires exclusive rights of disposal. Alone, this exclusive right cannot be the reason for a natural monopoly.

A natural monopoly is formed only when the minimum optimal airspace assigned to an ATM service must, for economic-technical reasons, be so large that the airlines cannot fly around it and thus have no realistic alternatives to using this airspace. There are various indications for this:

- With an increasing number of handover points between different ATM operators, the costs for transaction and coordination increase.
- The geographical bundling of control centres which are responsible for ATM in certain airspaces also permits cost reductions.¹⁹
- The optimum flight route between two airports depends greatly on physical conditions and on the existing weather conditions, which means that it can change daily. If one wants to implement optimum flight routes, then these will, if the ATM areas are very small, continually pass through new areas of responsibility. For the airlines, who want to use the optimum flight route, this would involve additional transaction costs and, on the other hand, the ATM operators would not be able to plan their activities as reliably.

It thus seems that economically optimal air traffic management areas must have such a great physical extent that they can, with the current state of the art, be called natural monopolies. However, due to the absence of empirical knowledge, it is not possible to say, at the moment, whether the division of Europe into 6, 10 or 12 air traffic management areas is the best answer.

¹⁸ One could theoretically ask whether it is actually necessary for each ATM service provider to have its own exclusive airspace or whether, instead, several ATM service providers could coordinate their operations in one and the same airspace. From the practical viewpoint, the latter option seems questionable, for two reasons. Firstly, if the existing and potential ATM service providers were allowed to divide up the European airspace into exclusive areas, this would possibly not result in a balance of negotiation if there is no "regulating body". Secondly, if exclusive airspaces are done away with, which means that two or more ATM service providers could offer their services in the same ATM area, then these would not only have to coordinate the flight movements, but would have to coordinate their coordination activities with each other. From the practical viewpoint, this seems impossible at the present, and would also use additional airspace capacity.

¹⁹ One could also consider the possibility of several ATM service providers working together in a single control centre, but this would again result in additional transaction costs.

3.2 Surveillance Technology/CNS Services

The surveillance *technology* generally demands certain technical minimum sizes and, in particular, the use of radar technology. For this reason, it would hardly be feasible for a new supplier of ATM services to set up a competitive system alongside the existing radar system.²⁰ This, in turn, means that the provision of radar systems could be a source of natural monopolistic power, which would require specific regulation. Of course, the type of regulation would have to take into account that the conventional surveillance technology is increasingly susceptible to attack as the result of technological alternatives, such as satellite surveillance systems. At the moment, radar technology is still regarded as an indispensable part of surveillance technology.

Due to this indispensability of radar technology, CNS services currently have the character of a natural monopoly. This does not apply to some parts of CNS, such as communications, which means that they could be opened for competition.²¹ Nevertheless, the monopolistic sector of the CNS services will be referred to in the following as the CNS infrastructure in order to take its special character into account.

3.3 ATM System

ATM systems process the flight data received from the CNS services surveillance data processing) and present them in a working environment (human-machine interface) to the air traffic controllers. Although flight (plan) data are also available in the aircraft and are processed there, there is at present no systematic networking of these data. The development and set up of an ATM system involves very high investments, even compared with those for the CNS infrastructure. One can thus ask whether there is also a possibility of market failure in the provision of ATM systems and whether intervention by the state is necessary.

Since the investments in the development and set up of ATM systems pay for themselves more quickly if there is a large number of users, due to the *decreasing unit costs*, at least one of the conditions for a natural monopoly exists.²² However, the market for ATM systems seems to be contestable. A newcomer who concentrates exclusively on the development of systems, without actually operating ATM services, could hope to win new customers (= ATM service providers) with a newly developed system with superior quality, either from the sale, leasing or operation of his system. Since data-processing capacities, in contrast to radar systems, are not limited to specific locations, their market may well be contestable. It is perfectly possible, for example, for an ATM system provider in Glasgow to process CNS data (surveillance data) from Germany and to send the results to its air traffic controllers in Luxemburg, and for these to transmit their instructions to the pilots of aircraft in the German airspace.

Even if only three or four ATM systems become established in Europe, or even in the entire world, this is no indication of market failure. It thus seems advisable to leave the market entry

²⁰ See G. Knieps (1990), Überlastung des Luftraums – Potentiale der Marktsteuerung (Over-excessive use of air space – potential of market regulation), in: *Ordo* Vol. 41 (1990), S. 195-205, c.f. p. 196.

²¹ However, this is difficult since there is only a restricted number of frequencies available for air traffic management.

²² In a natural monopoly, this reduction in the unit costs expresses itself as a gradual reduction in the average costs.

for ATM systems open. This also ensures that new technologies can be developed with little hindrance in the form of state intervention. However, it may be necessary, in individual cases, to regard ATM systems as *essential facilities*.

3.4 ATM Service

Operation of the ATM service is ensured by the air traffic controllers and their working environment. Intensive training of the controllers with certain ATM systems will result in considerable productivity advantages. Of course, such training, just like the training of the air traffic controllers, can be provided by specialised companies. Furthermore, the fact that several Irish air traffic controllers worked for Deutsche Flugsicherung GmbH in 2002 shows that air traffic controllers can be used in a fairly mobile manner.

In principle, the market for ATM services could thus function like a normal market. The service providers with the best price-performance ratios would succeed. Of course, ATM service providers without access to a CNS infrastructure and without an exclusive right of disposal over part of the general airspace currently have little chance of gaining entry to the market. This has a negative effect on the service quality and the costs of ATM services.

Result: intensive competition between ATM service providers promises considerable increases in the allocative, productive and qualitative efficiencies. The decisive competition parameters (success factors) are the training and the availability of the air traffic controllers.

3.5 Summary

In a greatly liberalised market for air traffic management, there would probably be a differentiated structure of service providers. In addition to the existing, completely integrated ATM service providers, which possess an exclusive airspace, a CNS infrastructure, ATM systems and air traffic controllers, there could be new actors, such as

- pure service providers who offer ATM without possessing an ATM system or a CNS infrastructure,
- technology providers who develop and provide new ATM systems,
- providers of CNS services,
- technology providers who offer both CNS infrastructure and ATM systems and deliver flight progress data (ATM data) to the pure service providers,
- providers of both technology and services equipped with ATM systems and with air traffic controllers trained specifically on these systems, but without their own CNS infrastructure.

However, a certain amount of economic policy assistance is necessary if such a market is to be able to emerge. In particular, it is necessary to ensure that the exclusive rights of disposal over airspace does not remain the property of one and the same provider for ever and ever and that providers without their own CNS and/or ATM infrastructure receive fair and undiscriminating access to the ATM data. This can be done, for example, by *unbundling* of

the CNS infrastructure, the ATM systems and the ATM service.²³ Section 11, above all, of this study deals with this in more detail.

²³ See also AEA (2000), How to inject the element of competition into Air Traffic Control (INCAS), Part 1, p. 8.

4. The Current Organisation of Air Traffic Management

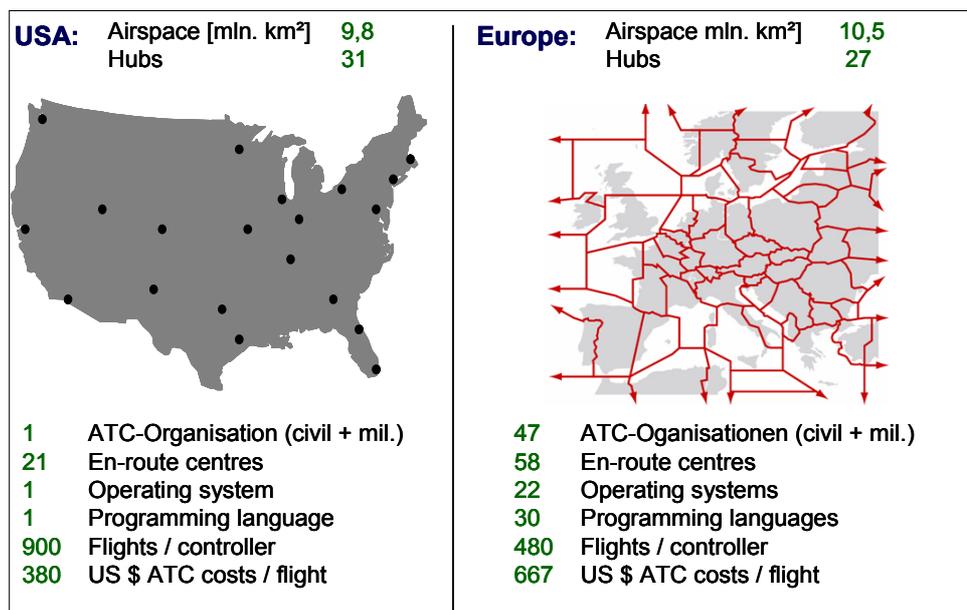
Today, air traffic management is provided primarily by national area monopolists in all countries. However, the organisational shapes of these monopolies differ greatly. In addition, there are some elements of competition in individual segments of air traffic management, such as approach control.

4.1 Air Traffic Management in Europe

Eurocontrol is regarded as a possible switching point for a uniform European airspace. Eurocontrol was founded in order to promote the harmonisation of the Europeans' ATM systems. Today, 31 states (plus the EU) are members of Eurocontrol (the organisation).

Eurocontrol (the agency) currently handles ATM only for the upper airspace of the BENELUX countries and the North of Germany. It also operates the *Central Flow Management Unit* (CMFU) and handles the collection of the *en route ATM* charges in accordance with uniform rules.

The hopes for better harmonisation of the European ATM systems have not yet been fulfilled. In Europe, there are 58 control centres which use software written in 30 different programming languages (status: 2000). The USA has 21 ATM centres which use a relatively standardised system. The following figure shows a (simplified) comparison between the USA and Europe.



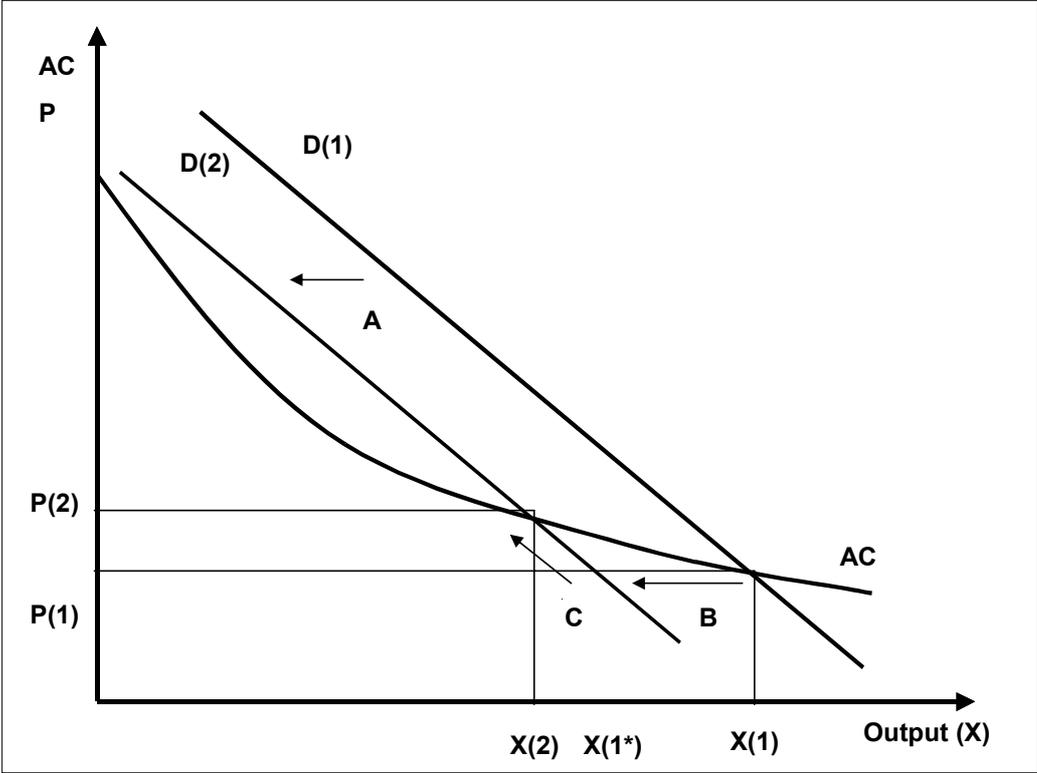
Source: Eurocontrol (2001)²⁴

²⁴ See Eurocontrol, Performance Review Commission (2001), Performance Review Report, An Assessment of Air Traffic Management in Europe During the Calendar Year 2000, Brussels. Presentation according to C. Klingenberg (2002), Die Zukunft der europäischen Flugsicherung – aus Sicht der Fluggesellschaften (the future of European air navigation - viewed from an airline perspective), Lecture at the Berliner Forum Zukunft der Deutschen Gesellschaft für Auswärtige Politik – DGAP, (Berlin „forum for the future“ of the German Association for foreign policy), „Mehr Sicherheit und Effizienz bei der Flugsicherung durch Single European Sky – Welche Konsequenzen ergeben sich aus dem Flugzeugunglück am Bodensee“ (More security and efficiency in air navigation provided by Single European Sky – What consequences will result from the airplane accident at the Lake Constance) September 3rd, 2002, Berlin.

The policy of the EU Commission is aimed at the creation of a uniform "upper" European airspace. The objective of the EU is to create this uniform European airspace by the year 2004. For this, the EU Commission has presented drafts of a general regulation for the creation of a uniform European airspace and of three specific regulations dealing with the design of the airspace, the licensing and regulation of ATM services and the interoperability of these services. Further draft regulations, for example for the economic regulation and for the implementation of Eurocontrol regulations, are currently being prepared.

Amongst other things, the objectives of these draft regulations are to define a transparent calculation of charges for ATM services, to open peripheral services to competition, to promote cooperation between civil and military aviation, and to define a harmonised standardisation process for the equipment. The peripheral services communications, navigation and monitoring²⁵ will be opened to competition, while the core services (en-route control, approach control and aerodrome control) will remain free of competition for the moment. The draft makes no statements about the assignment of ATM systems.

At the moment, ATM charges throughout Europe are calculated and invoiced on the basis of the Eurocontrol recommendations, in other words on the *principle of cost-based charges* (cost mark-up rule).²⁶ The drawback of such a cost mark-up rule is, on the one hand, that it provides little incentive for cost discipline and, on the other hand, makes the funding of larger investments more difficult. Furthermore, price determination based fully on the costs²⁷ results in dysfunctional price increases in the case of reductions in demand. The following figure show this relationship.



²⁵ The draft refers to "monitoring", but it really means surveillance.
²⁶ Eurocontrol, Central route charges office (1999), Principles for Establishing the Cost-Base for Route Facility Charges and the Calculation of the Unit Rates, Doc. No. 99.60.01/1, Brussels
²⁷ In the case of fully cost-oriented price determination, the total costs are simply applied to the produced quantities. In the demand drops, this will paradoxically result in price increases.

If the demand for air traffic, and thus for ATM services, drops as the result of a worldwide recession from D(1) to D(2) (see arrow A), a hypothetical demand quantity X(1*) results if the charges remain unchanged at P(1) – this is indicated by arrow B. However, with the number of flight movements X(1*), the charge P(1) no longer covers the average costs AC. Instead, the ATM service provider must increase the charge to P(2), as shown by arrow C, and this results in a further reduction in the demand for flight movements to X(2). The restrictive quantity effects of the recession are thus amplified by the procyclical price determination process. This effect does not manifest itself as long as air traffic is expanding – here, there is a regular refund of charges from the ATM service provider to the airlines. For this reason, the full-cost principle can also be regarded as a *good-weather model* which functions more or less effectively only while the market is growing.

This is one of the reasons why the permanent Eurocontrol commission, in its decision No. 52 dated 20 July 1999, basically recognised that price-cap regulation is permissible as an alternative to the cost-based calculation of ATM charges. (For details of price-cap regulation, see the comments in Section 4.3.) However, only Great Britain has made use of this opportunity at the present.

The draft regulations of the EU Commission also still stick to the principle of full cost coverage, although – in conflict with this– they demand performance-oriented payment by means of *service level agreements*. They do, however, demand some organisational provisions such as the separate billing for each of the services defined in Appendix I (*unbundling of accounts*, p. 21). This is admittedly a necessary exercise for monopolies which require regulation, but one should not place too much confidence in it - something which is shown clearly by the still incomplete implementation of the comparable directive 91/440 for the railway sector.

4.2 Germany: DFS

In Germany, almost all ATM services are provided by DFS.²⁸ The interface to the airport is on the ground and relatively close to the terminal. DFS is the exclusive provider of air traffic control services, technical ATM services, air navigation services, aeronautical telecommunication services, flight information services, aeronautical information services and the air traffic flow management service. Viewed against the international background and the background of the coming EU regulation, it is thus clear that the level of competition in this area in Germany is behind the times.

DFS GmbH was founded in 1993 as a formally privatised successor to the Federal Administration of Air Navigation Services. The sole shareholder is the Federal Republic of Germany. By introducing measures to improve performance, DFS was able to cope with the 25% increase in air traffic between 1993 and 1997 without external help to regularly refund charges to the airlines (see the comments in Section 4.1). Since 1998, however, the delays and the resulting consequential costs have been increasing again. The shock of 11 September 2001, combined with the weak state of the world economy, first caused a dramatic reduction in the demand for air traffic and also had negative effects on the planning at DFS.

²⁸ This applies to all airports except a few regional airports where representatives of the public owners or of the local province are responsible for this function.

Nevertheless, all forecasts assume that the long-term trend towards further growth will continue.

DFS monitors the German flight information regions (FIR), which coincide approximately with the state territory. For the lower airspace (up to 24,500 feet), Germany currently has five Area Control Centres: East (in Berlin), North (in Bremen), West (in Düsseldorf), Central (in Langen near Frankfurt) and South (in Munich). These control centres monitor the lower airspace with the aid of radar. The control centres Berlin and Rhine (in Karlsruhe/Munich) are responsible for the upper airspace, while the upper information region (UIR) Hanover is controlled by the Eurocontrol centre in Maastricht.

For control purposes, the control centres are sub-divided into radar sectors, with one control unit responsible for each such sector. In the lower airspace, each control area has between 6 and 17 radar sectors.²⁹ With the formation of the divisions Tower (aerodrome control), Center (en-route control), Aviation Data Management (Air Information Service AIS and Advanced AIS), Consulting, CNS (Communications, Navigation and Surveillance Systems) and the Academy on 1 January 2001, the various activities of DFS have become more independent.

4.3 Great Britain: NATS

The transformation of the British National Air Traffic Services (NATS) into a public private partnership (PPP) is an interesting example which differs clearly from the models used elsewhere in the world.

In the year 2001, NATS was taken out of the hands of the civil aviation authority CAA and transformed into an operative company. As part of a partial privatisation, 46% of the company was transferred to private investors and a further 5% to the employees of NATS, which meant that only 49% of the company remains in the public hand. Three syndicates have bid for the private portion:

- NIMBUS, a consortium of the service provider Serco and the company PPM Ventures, with technical support from ARINC and the University of Cranfield,
- NOVARES, a consortium of Lockheed Martin, Apax Partners and Airways International, with technical support from AEA Technology and DERA,
- the AIRLINE GROUP, consisting of seven British airlines, to which the contract was finally awarded. Technical support for this group is provided by British Telecom and some European air navigation service providers, including DFS.

The main reason for the partial privatisation of NATS was the shortage of capital of the previously public provider of ATM services, which had prevented expansion to keep up with the growth of air traffic. In the discussions which preceded the partial privatisation, which began in 1998, the following main options were considered:

1. a separation of the infrastructure and the service (network and operations),
2. a separation of airport ATC and en route-ATC,
3. a separation of the core business and the other peripheral business areas.

²⁹ The DFS is currently working on combining its six control centers into three: R. Riedle (2002), „Strategische Ausrichtung einer nationalen Flugsicherung auf Single European Sky“ (strategic orientation of national air navigation towards Single European Sky), Lecture for the DGAP, a.a.O.

Finally, the options 2 and 3 were implemented. NATS now carries out airport ATC only at the 13 larger airports in the country. In 2000, NATS won the related contracts at Southampton and Luton. Smaller airports provide these services either on their own or with the assistance of third-party providers (such as Serco). The separation of network and services was rejected due to the negative effects experienced in the comparable separation of network and operations at British Rail. NATS is subject– just like all British utility providers – to price-cap regulation.

Box 2: Price-Cap Regulation

In the case of a price-cap regulation, all services of the provider are placed in a shopping basket and an upper limit for the "price" of the goods in the shopping basket is defined for a period of at least five years with the aid of the price-cap formula RPI-X. RPI stands for the Retail Price Index, an indicator for the general rate of inflation, while X stands for the expected productivity increase which the company can probably achieve after privatisation. X generally lies between 3 and 5 and remains constant for about five years.³⁰ After this, a new value for X is defined in a process of consultation between the regulator and the regulated company. Price-cap regulation has two main drawbacks:

- If competitive sectors and monopolistic sectors are placed in the same shopping basket (the so-called single-till approach), then increases in the revenues, due to increased demand, of the monopolistic sector will mean that the prices in the competitive sector have to be reduced. The disturbance of the market is thus propagated into the competitive sector. One possible solution to this is that regulation be carried out only in the monopolistic sector (dual-till approach).
- Price-cap regulation can rapidly lead to a reduction in long-term investments. In some sectors, the regulated company is thus permitted to earn a rate of return for investments. During the partial privatisation negotiations, NATS demanded a rate of return of 25%.

In addition to airport services, en-route services and infrastructural services, NATS also provides the so-called *oceanic services* and some peripheral services (training of air traffic controllers, etc.). The oceanic business contributes only 3.5% to the total revenues of NATS. On the other hand, considerable investments in a new flight-data processing system (FDPS2) will soon be necessary. For this reason, the regulator (CAA) proposed a low value for X for the first five years in order to permit the funding of the investments. After this five-year period, the value for X is to be increased to between 5.3 and 8.6%, the reason for this being the productivity increases which will result from FDPS2.

NATS has promised to invest 1 billion GBP and has offered its users a service-level agreement and regular reductions in the charges in the period until 2006.

The unforeseeable shock of 11 September 2001 also had negative effects on the plans of NATS and almost drove the company into bankruptcy. With hindsight, it can be said that the privatisation of NATS was carried out at the wrong time.

³⁰ The regulator CAA has proposed a value of 5 for X for the en-route services of NATS.

4.4 USA, Canada and New Zealand

The air traffic management system of the USA is regarded as far superior to the European system. Indeed, the USA seems to profit from uniform technical standards in a uniform airspace. However, a closer look shows that the relatively higher productivity of the American air traffic controllers is achieved at the cost of motivation problems, overload effects and critical air situations. In the USA, regulation and operations are both in the hands of the FAA. An attempt to formally privatise air traffic management, carried out in 1995 by the Clinton administration, foundered on the opposition of the groups who make use of the ATM services but are unwilling to pay charges for this. The adoption of the Canadian model is the subject of intensive discussions in the USA.

In Canada, ATM is provided by Nav Canada, a private company which, however, is not a limited liability company and which is intended to operate on a non-profit basis. Nav Canada is funded entirely on the basis of outside capital. The providers of this outside capital have demanded that Nav Canada earn and maintain cash reserves. The fees charged by Nav Canada (en-route and landing fees) should cover, in addition to the operating costs, only interest and repayments for the loans. Since this situation presents no incentives for making a profit, the responsible persons are of the opinion that no regulation is necessary. At the same time, the company has no incentive to increase its capacity. This is one of the reasons why a regulatory body in the form of a committee of stakeholders was created in order to monitor investments and the quality of the services. In Canada, peripheral services are again open to third parties. The monopoly of Nav Canada applies only to the air navigation services in Canada and over the North Atlantic as far as 30° West.

The Airways Corporation in New Zealand is regarded as the most commercial provider of ATM services in the world. It was founded in 1987 by the Ministry of Finance and the Ministry for Public Companies. The regulatory authority CAA is responsible only for the technical regulation and for the regulation of safety. Economic regulation is the responsibility of the New Zealand Commerce Commission; at present, however, no regulation is actually carried out. One of the reasons stated for this is that there is so little traffic in the airspace that each additional user contributes to the payment of the costs. This, in turn, means that the service provider can have no interest in charging excessive prices. Nevertheless, the airlines have frequently complained in the past about what they regard as a poor price-performance ratio of the corporation, and this forced the government to start a process of public consultation.

4.5 Summary and Evaluation

All over the world, there is a trend towards the greater unbundling of ATM services. This simultaneously makes it possible to open the peripheral services to competition. Specialised external service providers thus have the opportunity of entering the market without having to invest too much capital and of starting effective competition on the basis of prices and quality. A few smaller countries and some emerging and transformation countries are already making use of this.³¹

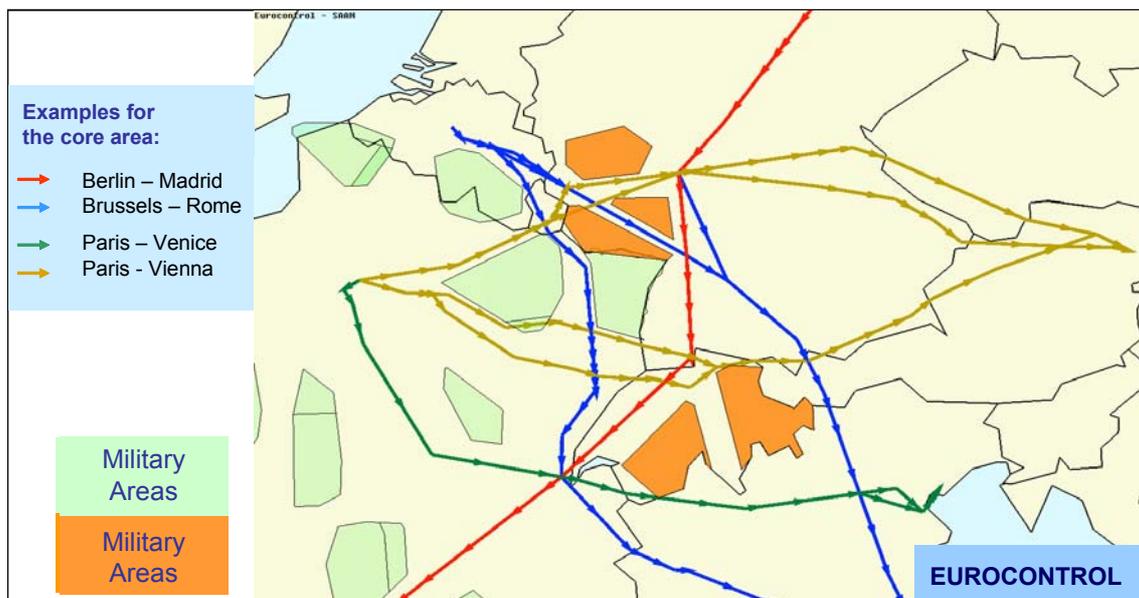
³¹ Two examples: The Czech Republic has its air traffic controllers trained by external service providers and the United Arab Emirates invite new tenders for their ATM services at regular intervals.

5. Air Traffic Management between the Market, Military, Public Service Obligations and Safety

Many national ATM services are currently subject to special burdens which can be grouped together under the heading of *public service obligation*.³² In addition, the armed forces demand use of the airspace and all relevant interest groups express a serious need for safety of the airspace.

Provision of services for peripheral airports: airports and/or province governments can demand of the federal government that DFS should provide ATM services for peripheral airports, even if the provision of these services would not cover the resulting costs. A more satisfactory solution, from the economic viewpoint, would result if the airports or the peripheral regions were made responsible for the provision of the necessary tower and approach services. The region would then have to invite tenders for these services and, possibly, award the services to the bidder who requires the lowest subsidies. Since 1994, this solution is common in local rail services and has resulted in noticeable service improvements and cost reductions.

Military requirements: military aviation also demands airspace capacity for its *training flights*. Some countries, such as France, have exclusively reserved certain airspaces for this purpose, but this means that important main routes have to be routed around these areas, as can be seen from the following figure.



In contrast to the concept of reserved training areas which are out of bounds for civil aviation, Germany practices the *flexible use of airspace*, where airspace is allocated to civil and military users as required by the current situation. At the same time, the concept of civil-military integration states that the civil and military air traffic controllers shall cooperate with each other.

If the *airspace* is *threatened* from the outside or – as in the case of the terrorist attack on 11 September 2001 in the USA – from the inside, the only important thing is that the information

³² To be precise, "public service obligation" is the wrong term for describing the infrastructural responsibility of the state; see G. Hermes (1998), Staatliche Infrastrukturverantwortung (National infrastructure responsibility), Tübingen, pp. 323 ff.

about the threat is passed on immediately to the military air defence. This applies to both state-owned and private ATM service providers.

In the case of a *military crisis*, the armed forces must make use of the services of DFS. In extreme cases, the civil services will be discontinued – just as in most other sectors. For private providers of ATM services, such interventions are accompanied by considerable losses of revenue. For this reason, they need clear definitions of the situations in which the armed forces may intervene in ATM operations, how they may do this and who is to pay the consequential costs.

Safety of the airspace: occasionally, there is a fear that private ATM service providers are unable or unwilling to ensure sufficient safety in air traffic. One argument against this is that all participants in air traffic – airports, airlines, ATM services and regulatory authorities – are responsible for the safety of air traffic. The decisive factor is not the legal form of the companies concerned, but a clear definition of the responsibilities and independent safety supervision by the state. Furthermore, private companies are liable for possible damages with their own capital, which means that they will take due care in their daily business, since this is in their own interest. Over and above this, suitable regulations must ensure that private ATM service providers can provide proof that they have taken actions to provide sufficient coverage for any eventuality, for example by means of insurance policies. If such policies are not currently available on the market, the insurance branch is perfectly capable of developing suitable offers.³³

³³ See, on the subject of tanker liability, C. Hassel (1998), *Haftungsrechtliche Strategien, Instrument der Risikoreduktion bei Tankerunfällen in der Seeschifffahrt, Eine ökonomische Analyse (Liability strategies, Instrument of risk reduction in case of tank accidents in naval traffic, An economic analysis)*, Göttingen.

6. Recent Proposals for Improvement

In addition to the practically implemented solutions, the results of several studies dealing with the options for improved management of the European (and worldwide) airspace have recently been published. Of these, the studies by Wilmer Cutler&Pickering on a European "Airspace Management and Design", by Booz Allen & Hamilton and DFS on ATM Market Organisation and by Logica on the economic regulation of ATM services (all published in 2001). Furthermore, the INCAS Report published in 2000, which was written under the overall control of the AEA, provides an interesting contribution to the possible further development of the European ATM system.

6.1 Wilmer Cutler&Pickering: Regulation of Airspace Management and Design

This study defines the main objectives of a Single European Sky as:

- the creation of a functional airspace design,
- the uniform classification of airspaces,
- the definition of uniform sectorisation standards,
- the definition of criteria for a European route network,
- the application of the FUA (Flexible Use of Airspace) concept, which proposes more civil use of the military airspace.

Above all, it recommends the uniform upper airspace over Europe which should be divided into airspace blocks without regard for national borders. These blocks could then be controlled by different ATM service providers. The study regards the award of licenses for the operation of these airspace blocks (joint franchising) to different service providers as a suitable regulation method.

A functional airspace design, which is no longer based on national boundaries, should then make it possible to transform the existing navigation methods, which are subject to diversions, into a more direct routing method. The study calls the elements of this functional airspace design *functional blocks of airspace*. Initially, these should be defined for the upper airspace and should not end at the national boundaries. The study also states that it is necessary to classify the airspace within the EU in a uniform manner and to define the sectors in accordance with uniform standards.

The study does not say how the award of licenses for blocks of airspace and the economic regulation of the service providers could actually be carried out. It also makes no mention of the management of the lower airspace.

6.2 Booz Allen&Hamilton/DFS: Air Traffic Management (ATM) Market Organisation

This study states that the main drawbacks of the conventional ATM model are the fragmentation of the airspace, the redundant and excessively complex infrastructure of air traffic centres, radar, communications and navigation (with overfilled frequencies) and the inefficiencies which result from differing national standards.

The study comes to the conclusion that the coordination in a given airspace can be provided only by a single service provider. Since short routes are more important to the airlines than the ATC costs they could save (fuel costs 12-21% of the total costs, ATC costs 7-9%), there is no room for competition between different service providers. In other words, there can only be competition for the market.

The study proposes the introduction of standard European licensing procedures for ATM service providers, beginning in 2003/2004. In addition, economic regulation and performance regulation of the service providers should be introduced. Alliances between service providers should be permitted. The study thus contains important elements which have been introduced into the EU initiatives for the formation of a Single European Sky. However, it underestimates the fact that the formation of large organisational units (such as alliances) endanger the competition between the providers and could thus have a negative effect on the performance willingness of the ATM service providers. It is doubtful whether the proposed regulation mechanisms are suitable to compensate for this disadvantage.

6.3 Logica: Economic Regulation of Air Traffic Management Services

Logica first examines the current organisation of air traffic management and comes to the conclusion that its economic efficiency is poor. An effective method of regulation should ensure that the productive efficiency of the service providers increases and provides incentives for better performance. This regulation should comply with four principles:

- no negative effects on safety,
- ATM charges based on actual costs,
- freedom from discrimination with respect to charges and services,
- transparency of costs and performance.

The study also examines the alternatives of regulating ATM services at the European level and regulating these services by the member countries. As a major drawback of regulation at the national level, it fears that the regulation would be aimed more at the protection of the existing national ATM service providers and that this method could not ensure that necessary investment activities are carried out.

For this reason, the study favours regulation at the European level, with the emphasis on cooperation. It proposes the creation of zones of coordination (ZOC), without regard for national borders. These correspond to the *functional blocks of airspace* and the existing ATM service providers would be able to operate cooperatively within them. The service providers should be able to select any desired form of coordination. The states which participate in a ZOC should define how the revenues are to be divided. The argumentation in the study, which often criticises competition, is not always comprehensible from the economic viewpoint and is, by and large, incomplete.

6.4 AEA: INCAS - How to inject the element of competition into Air Traffic Control

The strength of the Incas study (published in 2000) is that it considers more possible model options than other studies:

- It presents the possibility of main routes and of competition between agents who can purchase the rights for marketing of routes and could then sell or lease these to the airlines.
- It presents the possibility of dividing routes or sectors between ATM providers on the time basis (*time sharing*).
- It emphasises the possibility of price differentiation.
- It emphasises the possibility of separating the infrastructure from operations.

It was not possible to deal more intensively with the models, or to assess them and adapt them to the existing or future legal situation within the framework of the INCAS study.

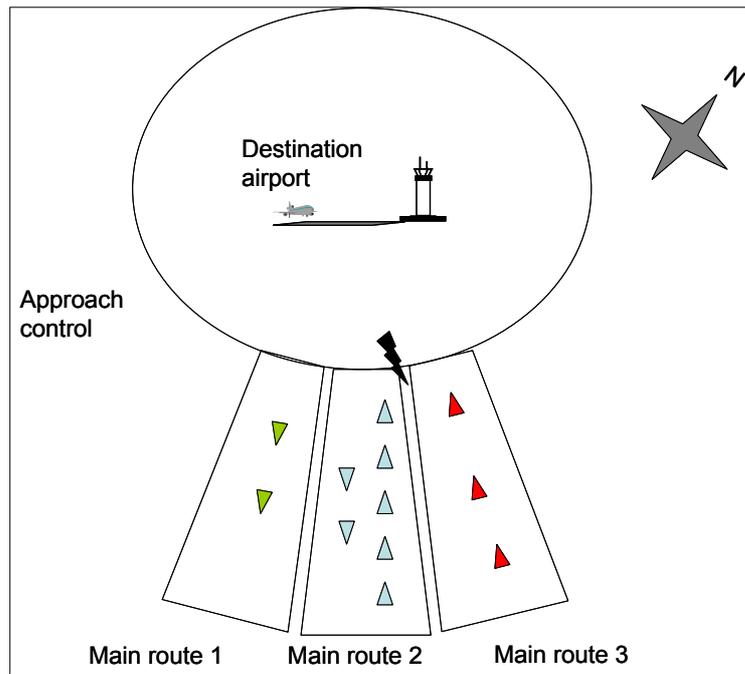
With the proposal, amongst other things, that agents and brokers be included in the process of distributing ATM service capacities, this study opens up a far-reaching perspective on the competition which is doubtlessly worth being examined more closely. In the context of this study, however, the INCAS Report primarily raises the question of whether the competition could be increased and, above all, improved by setting up competing main routes between major airports. At the moment, it is immaterial whether a main route can be set up in addition to the existing national regional monopolists, so that the users would be able to choose between at least two providers, or whether a national airspace can be divided up into several main routes.

At this point, we can anticipate the results of the discussions on the main-route concept.³⁴ The basic drawbacks of the main-route concept are that it uses a considerable amount of the available capacity, particularly at the points where the main routes cross each other, and that it does consider the fact that the physically optimal route may change from day to day. However, once main routes have been defined, they can no longer be adapted flexibly to the changing physical and meteorological conditions.³⁵

Furthermore, the creation of several parallel main routes will cause the approach control of an airport to become a monopolistic *bottleneck*, as shown in the following figure.

³⁴ This is done on the basis of the contributions to the discussion at the symposium "Marktorientierung im Air Traffic Management: Meilen- oder Stolperstein auf dem Weg zum Single European Sky" (Market orientation in) ATManagement - help or hurdle on the way to the S.E.S., documentation on 24 June 2002 in Berlin. These can be downloaded from http://wip.tu-berlin.de/de/veranstaltungen/2002_06_24-symposium_atm/tu-berlin_wip-pspc-symposium_airtraffic_management_2002_06_24-dokumentation.pdf.

³⁵ Admittedly, the providers of the main routes could react to this by means of a compensatory price policy, but the practical implementation of this would involve many difficulties.



If several main routes depart from or arrive at one airport, then the capacity of this airport's approach control service will limit the number of aircraft which can be accepted from these main routes. The approach-control service provider will therefore have to agree with the providers of the main routes on some method for assigning priorities to flight movements. Since the approach-control service provider is in a monopolistic situation with respect to the route providers, he could be tempted to auction off his available capacity. Effective regulation of the approach-control service provider is thus necessary in order to prevent a permanent loss of efficiency. All in all, the main route concept will cause a considerable requirement for regulation.

7. Summary and Recommendations

Competition is regarded as a method of coordinating economic activities which, as a rule, produces macroeconomically efficient results. One could therefore ask why *air traffic management*, which can be designed to a high degree as an economic activity, has until now been protected from competition.

ATM is a service which is intended to ensure safe air traffic, free of collisions, at favourable operating costs. For this, it must possess certain production factors:

- an airspace which, for reasons of cost and complexity, should be defined exclusively,
- CNS systems which, amongst other things, produce surveillance data (CNS data) based on radar observation,
- an ATM system which transforms the CNS data into ATM data and passes these on to the air traffic controllers via a human-machine interface,
- the air traffic controllers, each of whom controls a sector in their working environment (strictly speaking, the actual ATM service).

As practical examples show, the actual ATM service can very well be provided in competition with other providers. Admittedly, the service provider must be able to obtain the rights of disposal over an exclusively defined airspace. At the moment, this is not possible, since the service is already divided between the national regional monopolists. For efficiency reasons, it thus seems advisable to occasionally allocate these rights of disposal to new, more efficient service providers. The proven instrument for selection of the best bidder is by inviting tenders.

The entry of new service providers to the ATM market is also hindered by the fact that they generally do not have their own CNS systems. On the other hand, service providers which have such CNS systems are generally not interested in making them freely available, without discrimination, to their competitors. The option of setting up a second, or even a third, series of CNS systems would be a duplication of costs and thus a waste of resources. For the economist, this is a situation which he calls a *natural monopoly* which requires regulation. In such cases, it is important that newcomers receive access, free of discrimination, to the CNS data. This is confirmed by the *essential-facility doctrine* which is part of the European and German competition laws.

Admittedly, the application of the *essential-facility doctrine* is generally accompanied by costly and time-consuming litigation. Particularly in competitive tendering, where the bidders are under considerable pressure, it will not always be possible to carry out such litigation exhaustively. In the medium term, it is thus essential that the CNS sector be separated organisationally from the pure ATM service operations, so that the CNS services are available without discrimination to all providers of ATM services.

Last but not least, the ATM systems themselves, which require large capital investments, are also a possible barrier to market entry. For this reason, it may be necessary, in individual cases, to also apply the *essential-facility doctrine* to ATM systems. In a later market phase, this should no longer be necessary.

Part II
Approaches to the Solution

8. Introduction

In Part I of this study, air traffic management was characterised as a service which is intended to ensure safe air traffic, free of collisions, at favourable operating costs. In order to provide this service, the ATM providers must possess, amongst other things, an exclusively defined airspace and access to CNS data.

Today, airspace is already divided up between the national monopolists who are tasked with providing ATM services. For efficiency reasons, however, it would be better if the rights of disposal to airspace were redefined from time to time so that efficient newcomers have an opportunity of entering the market. With the aid of competitive tendering (competition for the market), it is possible to find the best service provider, who then receives the exclusive right to manage a block of airspace.

The entry of new service providers to the ATM market is also hindered by the fact that they generally do not have their own CNS systems. From the economic viewpoint, CNS systems are a *natural monopoly* whose output can be produced most cheaply by only a single provider. In such cases, it is important that newcomers receive access, without discrimination, to this output, namely the CNS data. The *essential-facility doctrine*, which is part of the European and German competition laws, ensures that newcomers can access CNS data without discrimination.

On this foundation, it is necessary to examine how the airspace can be managed on a market-oriented basis. In accordance with the Single Sky Initiative of the European Union, this examination will initially be carried separately for the upper and lower airspaces, although the technical processes for both of these are comparable and although the ATM service providers make use of the same ATM infrastructure in both cases. Politically, however, the member states still claim the lower airspace, which is used primarily for approaching and departing flights, as their own property, while it is generally accepted that the upper airspace requires supranational coordination.

The examination thus begins with the upper airspace. After this, possible solutions for the lower airspace are examined. Even if the latter remains the responsibility of the member states in the near future, we are of the opinion that there are no reasons for not managing it in a market-oriented manner.

Finally, it is necessary to examine the problem of how the ATM infrastructure will have to be handled in order to ensure that it does not prove to be an obstacle to competition. For this purpose, this study also examines solutions which extend over and above the application of the *essential-facility doctrine*, with the aim of *unbundling* the ATM infrastructure and the ATM service. This is done in Section 11.

Section 12 provides some final recommendations for more market-orientation in the European and German *air traffic management*.

9. Solutions for the Upper Airspace

For the upper airspace, the concept of the Single European Sky recommends the creation of so-called *functional blocks of airspace*. These should permit efficient air traffic management and should therefore not be restricted to the existing national borders. The member states over which a block of airspace is located should together select the ATM provider for this block. Although no standardised definition of functional blocks of airspace exists at the moment, these blocks must comply with the following criteria:

- From the viewpoint of the users, each block must be large enough to meet the actual functional demands of the traffic streams. Such a block must, for example, extend from Frankfurt to Paris or from London to Frankfurt.
- From the viewpoint of potential ATM providers, it must be possible to manage each block technically and organisationally, which means that it may not be too large.
- From the viewpoint of competition policy, there must be a sufficient number of blocks in Europe to ensure that effective competition for these blocks can be established. This criterion would, for example, be violated if there were only three or four such blocks.

Very probably, however, the future functional blocks of airspace will be larger than today's blocks of airspace, which are based exclusively on national borders. Furthermore, it is quite possible that the airspace over the larger member states will be broken down into separate functional blocks of airspace and that these will then not end at the national borders of these countries.

Little will be gained for the users if the existing ATM service providers form alliances to share the ATM services in a functional block of airspace, and potential newcomers who wish to offer ATM services will have little chance of establishing themselves in the market if they have no discrimination-free access to the data output of the ATM infrastructure. On the other hand, the existing service providers in a block of airspace will have little interest in providing such discrimination-free access to their ATM data if this means that they must therefore fear the entry of a competitor to the market. For this reason, special political precautions must be taken.³⁶

A further question is how a possible competition for ATM services in a *functional block of airspace* can be organised. We examine two alternatives for this:

- the direct award of a contract (Section 9.1),
- the invitation to tender for a contract (Section 9.2).

³⁶ Cf. Section 2.5.

9.1 Direct Award of a Contract

If a contract for the provision of ATM services in a *functional block of airspace* is awarded directly to a service provider, the national governments must agree on a procedure for the award of such contracts.

Box 3: Regulation of ATM service providers in a functional block of airspace

If contracts are awarded directly to ATM service providers for functional blocks of airspace, these would have to be restricted to a certain period of time in order to ensure that no "grandfather rights" can be established. The regulator must ensure that the service provider to whom the contract is awarded provides the services reliably and with an acceptable quality. Qualitative shortcomings should result directly in malus payments to the affected users. Furthermore, the service provider to whom the contract is awarded must feel a constant incentive to optimise his cost situation and to pass on savings to the users. A suitable regulation instrument for this purpose is the so-called price cap regulation, which places an upper limit on the prices for ATM services in the course of time (see Box 2 in Section 4.3). Rules must also be set up for the case where major investments in expansion of the capacity become necessary. Amongst other things, the regulator must judge whether the investments are necessary and are made to the advantage of the users, that no better alternatives exist, which investment amounts are justified and how the additional costs are to be divided between the users. In other words, the tasks of the regulator demand comprehensive competence which extends into the operational aspects of ATM. Even if the regulatory body possesses this competence, it must still be remembered that the service provider will, of course, always have a superior knowledge and will, wherever possible, employ this to his best advantage.

In order to avoid demanding too much of the regulator, an economic regulator should be responsible for only one functional block of airspace. The task of the EU is then to take care that the regulators carry out their activities as planned in the concept of the Single European Sky.

It is not easy to predict the market results of the direct award of contracts. The results of this procedure become particularly difficult to predict if the award of the contracts is not tied to specific selection and performance criteria. Since the ATM service providers who are owned completely or partially by the state and who provide their services in the form of a national regional monopoly generally have good "connections" to the government departments which make the decisions, it must be feared that they will work intensively towards having the contract awarded to them again. This could quite possibly lead to the horror scenario, with respect to competition policy, that the functional blocks of airspace are simply divided up between the state-owned ATM providers in the countries over which these blocks are located. This would be no better than today's conditions; it would, in fact, be a major setback.

If, in contrast, the governments do not wish to succumb to the pressure from the existing ATM providers, they will have to define clear and transparent criteria for the award of the contracts. This would then be the first step towards inviting tenders. Once these criteria have been formulated, it will then be possible to examine the market systematically in order to determine which of the existing providers are prepared to meet, or even exceed, the required criteria. This is then no longer a simple market survey, but an invitation to tender for the contracts.

9.2 Invitation to Tender for Functional Blocks of Airspace

In contrast to the direct award of contracts, the invitation to tender for the contracts makes it possible to relate the selection of providers directly to operative criteria. In particular, these criteria are:

- the so-called "subjective criteria", with the aid of which the bidders prove their ability to provide the required services and
- the bidding criteria, namely the monitorable performance promises of the bidders, which correspond to the conditions in "normal markets". The essence of inviting tenders is the fact that compliance with these promises is intensively monitored during the concession period and non-compliance results in sanctions.

In contrast to the direct award of contracts, the performance specifications are not simply dictated to the selected ATM providers, but are systematically determined in the market. In most cases, the contract will be awarded to the bidder who promises, with sufficient credibility, the best price-performance ratio. The invitation to tender is thus not only more transparent, but also leads to the selection of the most able bidder.

If tenders are invited, the state does not act as the regulator, but as the customer and, as such, monitors the compliance with the promised conditions. The examination and regulation of investments is also unnecessary in this case. The differences between the simple award of contracts and the invitation to tender are shown in the following table:

	Direct award	Tendering
Performance parameters	Specified or negotiated	Determined by competition
Contract awarded to ...	the bidder with the best political contacts	the most able bidder
Risk of corruption	High	Low to medium
Main role of the state	Regulator	Customer
Error-friendliness	Low, due to the lack of alternative providers	High, since alternative providers are available
Fairness	Low	High

Experience has shown that well-organised markets based on tendering become increasingly dynamic in the course of time. This is expressed in an improved price-performance ratio and also in the professionalisation of the market participants. It is thus to be expected that competent groups of bidders, who will share the work, will be formed in a competition to bid for *functional blocks of airspace*. This also means that private service providers will also have a chance of entering the market. In order to avoid overloading the bidders, the invitations to tender for blocks of airspace should not be issued simultaneously for all blocks, but should be staggered over a period of time (regular *deal flow*).

Box 4: The organisation of an invitation to tender for a functional block of airspace

Just as in the case of direct award of contracts, the states affected by a *functional block of airspace* must agree by means of a State Treaty on the principles for awarding the contracts and how these are to be incorporated into the organisational rules. In other markets based on tendering, it is common practice to set up an "awarding company" for the professional and flexible preparation, execution and supervision of invitation for tenders. The shares and the voting rights in such a company could be divided up on the basis of the how much of the *functional block of airspace* is owned by each member state. The legal domicile of the company also decides which competition or award laws shall apply in the case of disputes. It would probably be better to set up a chamber of awards at the General Executive for Competition of the European Commission which, in the case of disputes, should examine the legitimacy of the invitation to tender and of the award of the contract, because national chambers of award could possibly be too sympathetic to national bidders. However, the national laws on the award of contracts are already based on principles which apply throughout Europe.

As already mentioned, newcomers have a real chance in competitive tendering only if they have fair access to the data output of the infrastructure.³⁷ This fair chance exists, in the long term, only if the state-owned ATM providers are split up into mutually independent ATM infrastructure companies and ATM service companies (*unbundling*).

In some cases, this splitting of state-owned European ATM providers will be difficult to achieve politically. In the transition phase, it will therefore be absolutely necessary to define rules which ensure that potential newcomers who bid for the ATM services in a functional block of airspace are protected against unfair behaviour of the existing service providers. These rules should state that existing ATM providers may bid for a contract only if

- they keep their infrastructure and service divisions separate in their accounting,
- they offer the services of their infrastructure division (ATM data) to third parties at the same conditions as those applied to their own service division,
- they subject their ATM division to an external regulator who examines the conditions for use by third parties for fairness and freedom from discrimination.

³⁷ The fact that this is technically feasible is demonstrated by the work on the European AIS (=Aeronautical Information System) Database; see Frequentis (2002), EAD Programme Overview, o.O.

9.4 Evaluation and Recommendations for Political Actions

The following overall picture thus results for the evaluation of the options "direct award" and "tendering":

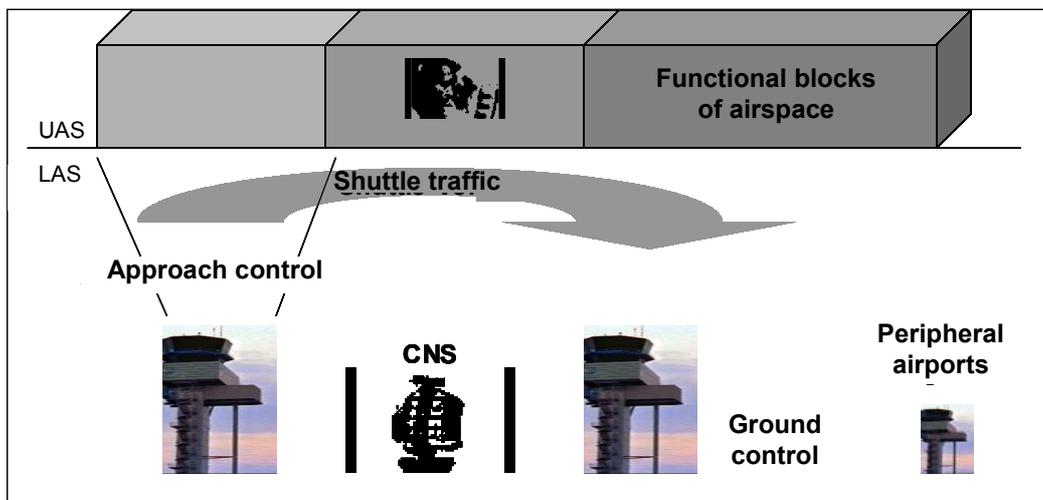
Evaluation criterion	Direct award	Tendering
Productive efficiency (cost effects)	Inefficient	Efficient
Allocative efficiency (user-orientation)	Generally inefficient	Basically efficient
Dynamic efficiency (capacity effects, technical progress)	Inefficient	Efficient (if incentives are defined correctly)
Intensity of competition/ market structure	No competition	Effective competitive tendering
Regulation requirements	Very high	Medium
Time required	>2 years	>3 years
Feasibility	High	Medium to high

This overview of the evaluation thus results in a clear ranking: invitation to tender are the best means of identifying the best ATM providers in *functional blocks of airspace*. Although it appears relatively simple at the first glance, the direct award of contracts results in considerable problems from the regulation viewpoint, quite apart from its possibly fatal consequences for competition and service quality.

The recommendation for political action is thus quite clear: the *functional blocks or airspace* must be awarded on the basis of competitive tendering. A supranational company, in which all states affected by the block of airspace hold proportional numbers of shares, could be set up for the preparation and execution of the invitation to tender. Since this company also monitors compliance of the selected ATM provider with the requirements, it also handles some of the tasks of economic regulation. The EU must ensure that the work of the various companies awarding the functional blocks of airspace is coordinated and is executed in keeping with the spirit of the Single European Sky concept.

10. Solutions for the Lower Airspace

Most flight movements in the lower airspace are approaches to and departures from airports. Admittedly, the present initiatives of the EU are aimed primarily at the upper airspace; nevertheless, it appears advisable, for traffic, economic, legal, political and compatibility reasons, to manage the lower airspace in accordance with the market, in a manner similar to that for the upper airspace. For simplicity, the approach control, the ground control at the airports and the generally deficitary operation of ATM services at peripheral airports, should be included in the lower airspace.³⁸ Furthermore, the use of the lower airspace could in future also serve as an occasional alternative to the use of the upper airspace, such as for the execution of shuttle flights between operationally related hub airports (such as Frankfurt and Munich). Today, some regional airlines already carry out all or a major part of their flights in the lower airspace.



There are two main alternatives as possible solutions for the lower airspace:

- the material privatisation of DFS GmbH with the simultaneous provision of an effective regulatory body or
- the creation of an award company which systematically invites bids for the ATM services in the lower airspace and awards the contracts for restricted periods to the best bidder.

10.1 Award of the Contract to DFS GmbH

At the moment, the sole owner of DFS GmbH is the Federal Republic of Germany. A material (or capital) privatisation would permit DFS to position itself better in the arising European market for ATM services, to become more user-oriented and to act in a more entrepreneurial manner with respect to investments and to price and quality differentiation.

If the privatised DFS is charged with the management of the entire lower airspace, it would be necessary to set up an effective regulatory body in order to control its power of monopoly. This body would have to monitor the prices and services of DFS and to issue sanctions in the case of misconduct. The British ATM provider NATS is subject to such regulation by the

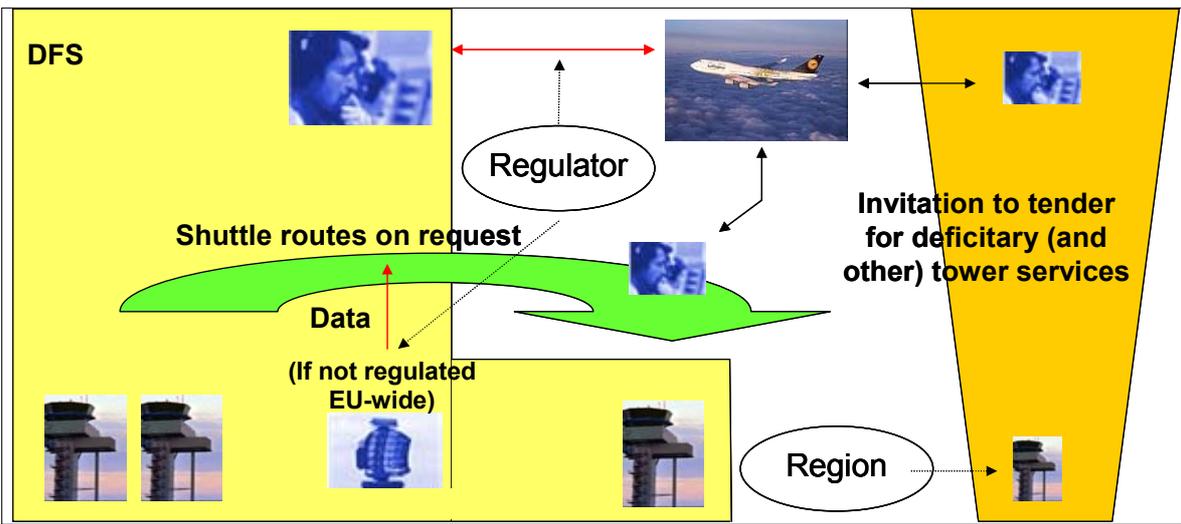
³⁸ On the subject of the problems of deficitary ATM services at regional airports, see the comments in Section 5.1.

Civil Aviation Authority (CAA), a body with a relatively small staff but with an effective set of regulation instruments.³⁹

For effective regulation it is mandatory to set up a powerful, independent regulatory body. If this is not done, there is a permanent danger that the Federal Republic neglects its regulation interests in favour of its interests as the owner of the service. The regulatory body should be set up at the national level. If the lower airspace is subsequently integrated more strongly into the concept of the Single European Sky, the national authorities will have to be combined to form international units, each of which is responsible for a functional block of airspace. Their coordination with respect to the Single European Sky is the responsibility of the EU. A central super-regulatory body for the EU would, in contrast, probably be incapable of taking the national features of ATM into account.

Additional scope for the market would also result from relieving DFS from the obligation to provide services which do not make profits, which are today funded by cross-subsidies from the more profitable services. This also applies to the positions for which the Federal Republic sees a public interest. It would then be the responsibility of the regions or the Federal Republic to invite tenders for such services at peripheral airports and to award the contracts to the bidder who needs the lowest subsidy. In individual cases, this bidder may even be a subsidiary of DFS. Such tendering procedures add a further element of competition to the management of the lower airspace; this could be called "competition at the margins".

This competition at the edges could be extended by permitting third parties to apply for, at their own initiative, and operate new ATM services, for example for shuttle flights. If this is to function correctly, the regulator must ensure that newcomers have fair access to the ATM data of DFS if they need these for the execution of their services. Access to the ATM without discrimination would have to be ensured as long as the ATM infrastructure is not unbundled from DFS.⁴⁰ The following figure shows a schematic representation of the competition at the margins:



In this scenario, the degree of market opening is initially restricted. The effectivity of the regulatory body will decide whether or not it results in noticeable improvements for the users. If the regulation is designed incorrectly, for example if it does provide not sufficient

³⁹ See the comments in Section 4.3 and in Box 4 on the management of the upper airspace (Section 9.1).
⁴⁰ See Section 11.

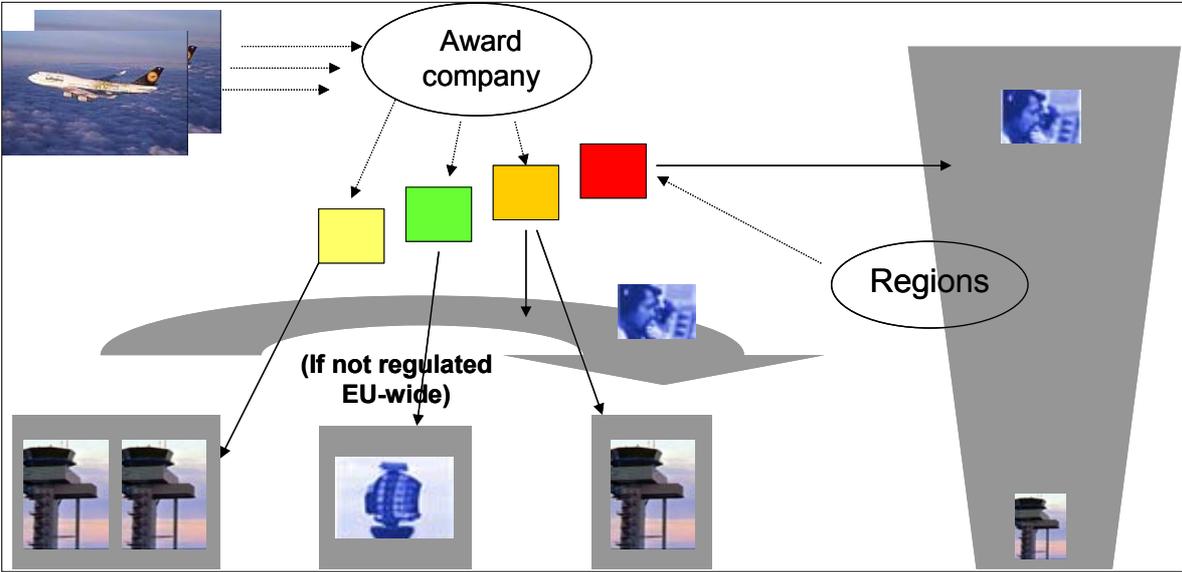
incentives for investments, then worst-case scenarios may result, such as those commonly associated with the British regulation experiments. On the other hand, competition at the margins can become unexpectedly dynamic because potential competitors will search intensively for ways and means of entering the market and penetrating the profitable core business.

10.2 Tendering

In the tendering model, the lower airspace is divided into several lots and these are opened for tendering, either singly or in bundles, and awarded to the best bidder. For reasons of flexibility and professionalism, this task should be handled by a national award company. For reasons of neutrality, this company can initially remain in the public hand. However, it is advisable to control its activities with the aid of a *board of users*. The company may be a private company (such as a limited company).

The task of the award company would be to invite tenders for the operation of the individual ATM services in the lower airspace and to award the contracts for a limited period to the best ATM service provider in each case. It could lump several services, such as the tower services at several regional airports, into one lot. DFS could bid for services in the competition for the market, but is not obliged to do so.

For competitive reasons, DFS would be able to maintain its market position better if it is privatised, sooner or later, by material or capital privatisation. At the same time, care must be taken that an efficient, competitively neutral solution is found for the ATM infrastructure. A materially privatised DFS which possesses the complete ATM infrastructure could not be reconciled with competitive structures.⁴¹



If the award company does not have its own funds, it is difficult to see how the deficitary ATM services could be maintained at peripheral airports in such a scenario. For this reason, it must be the responsibility of the regions (provinces) to invite tenders for such deficitary services or to commission the award company with the execution of such procedures.

⁴¹ See the comments in Section 11.

Experience from other infrastructural sectors (roads, railways) has shown that the award company would need some time to learn the correct methods for inviting tenders for ATM services. On the other hand, the experience from other sectors also shows that such a model is very interesting to the service providers, that the market develops very quickly from the very first day, and that it results in noticeable quality improvements.

10.3 Evaluation and Recommendations for Political Actions

The following table shows the evaluations of the two options "Regulated DFS" and "Award company" (competitive tendering).

Evaluation criterion	Award to DFS	Tendering
Productive efficiency (cost effects)	Critical	Increasingly efficient
Allocative efficiency (user-orientation)	Critical	Trend towards efficiency
Dynamic efficiency (capacity effects, technological progress)	Very critical	Increasingly efficient
Intensity of competition/ market structure	Competition only "at the margins"	Intensive competition for the market
Regulation requirements	Very high	Low to medium
Time required	>2 years	>2 years
Feasibility	High	High

The above overview shows that competitive tendering is the most attractive alternative in the short, medium and long term if it is designed professionally by an award company. A prerequisite for this solution is that the ATM infrastructure is removed from the area of influence of the previous national ATM service provider – in this case DFS. The next section deals with this subject.

11. Solutions for the ATM Infrastructure

It can be seen that the efficiency with which the upper and lower airspaces can be managed depends decisively on whether third parties or newcomers receive fair access to the output of the ATM infrastructure, namely the ATM data. If they do not have access to these data, if the access is of poor quality, or if the conditions under which they receive access are bad, then they will, compared with existing service providers with direct access to the ATM data, have little chance of becoming the best bidder. The current situation, where the ATM infrastructure is in the hands of the national regional monopolists, is therefore not suitable for promoting competition with efficient results.

It is thus necessary to determine how third parties can receive fair access to the ATM infrastructure. Possible solutions would be to transfer the responsibility for the ATM infrastructure to the public hand (Section 11.2), to treat it as a regulated private infrastructure monopoly (Section 11.3), or to regularly invite tenders for its operation (Section 11.4). A prerequisite for all of these solutions is the *unbundling* of the services. First, however, it is necessary to find out under which conditions competition can function, even in the existing situation where the ATM infrastructure and the ATM services are provided by one and the same company (Section 11.1).

The club model, where all users of the CNS infrastructure (the ATM service providers) are simultaneously the owners, with equal rights, of the infrastructure, is not examined separately. The main reason for not analysing this model in more detail is that it is hard to imagine a club of ATM service providers who permanently compete with each other in tendering for the provision of services in the upper and lower airspaces. It will, however, become clear that the competitive tendering model for the CNS infrastructure can be extended to form something like the club model.

11.1 ATM Infrastructure in the Hands of Vertically Integrated Providers (as today)

In a competition to tender for the exclusive ATM services for the upper or lower airspace, the existing service providers would have little interest in making their ATM data available to the other bidders. For this reason, the competitors must have fair access, without discrimination, to the data, as intended by the competition law and its *essential facility doctrine*.

What is actually to be regarded as an *essential facility* can be determined only in a specific case.⁴² Many things speak for regarding the CNS infrastructure as an *essential facility*, because it cannot be duplicated without major efforts and costs. The situation for ATM systems is less clear. Basically, one could imagine a European market in which several providers of ATM systems and their operation compete with each other. At the moment, however, the operation of such systems is exclusively in the hands of the state-owned ATM service providers. In such a situation, a third bidder has no short-term access to his own ATM system. Admittedly, he could set up such a system within a certain period of time, providing the contract for the ATM service in the upper or lower airspace offers sufficient security to make this feasible, but this will probably be accompanied by considerable costs. This could mean that a pure service provider could bid for services in the airspace only in cooperation with other providers who already have their own ATM systems (in other regions).

⁴² See the comments in Box 1.

All in all, therefore, it is not possible to reliably estimate, from today's perspective, the degree to which the *essential facility* doctrine will or will have to be used in order to ensure fair access to the ATM data. It will evince itself in practical use.

In addition, there are considerable doubts about the effectiveness of the *essential facility* doctrine in competitive tendering, because its legal implementation generally takes some time, something which a bidder in competitive tendering normally does not have. For this reason, it will probably be necessary to set up further institutions such as clarifying legislation and an effective regulation authority. The alternative to this would be the *unbundling* of the ATM infrastructure and the ATM service, something which is examined in the following sections.

11.2 ATM Infrastructure in the Public Hand

If DFS were to be privatised, it would be conceivable to leave the company's CNS division in the public hand. This would have the advantage, from the viewpoint of competition policy, that the CNS division would be provider-independent and would be able to offer its data to all service providers, without discrimination.

However, considerable doubts exist with respect to the performance (i.e. the productive efficiency) and the dynamic efficiency of a public infrastructure provider. In particular, it must be feared that the necessary investments in the expansion and modernisation of the capacity will not be made, or will not be made in good time. State-owned regulatory bodies have not yet proved themselves capable of ensuring the efficiency of state-owned infrastructural companies.⁴³ There are therefore considerable doubts as to the usefulness of this solution – and this applies particularly to the area of ATM systems, which require major investments.

11.3 ATM Infrastructure as a Regulated, Private Infrastructure Monopoly

Another possibility would be to privatise the operation of the ATM infrastructure, simultaneously forbidding the infrastructure company from offering its own ATM services. The advantage of this solution is that an independent, private infrastructure provider would have no interest in discriminating against individual providers of ATM services.

However, the private infrastructure company has the character of a private monopoly. As long as CNS operates on the basis of radar systems, this monopoly is difficult to attack. It would therefore be necessary to subject the private infrastructure company to external regulation. Above all, the regulator would have to ensure that the company does not charge excessively high prices and does not generate any unnecessary costs. Once again, there are serious doubts about this model:

- Until now, nobody has convincingly succeeded in regulating private infrastructure companies in such a manner that they have sufficient incentives for economic efficiency

⁴³ This can be seen from the nationalisation of the Swedish rail network, which is today managed without discrimination but not very efficiently.

on the one hand and sufficient incentives for investments in modernisation on the other hand.⁴⁴

- A protected private monopoly is an obstacle to the further development of CNS technologies.
- These reservations apply particularly to the area of ATM systems: making this the responsibility of a private monopoly would hardly be compatible with the objective of developing a functioning market for ATM systems.

11.4 Provider Models for the ATM Infrastructure (tendering)

The fourth possible option would be to have the provision and operation of the ATM infrastructure carried out, for a certain period, by an independent private provider who does not offer ATM services. The provider would be selected by inviting companies to tender for the service. Depending on the necessary investment volume, the duration of the franchise agreement would have to be selected such that the provider can earn back the money he has invested. The company funds itself exclusively from the sale of CNS data or ATM data. The franchise agreement regulates the quality of the ATM data which the infrastructure provider sells to the ATM service providers. ATM service providers who bid for the ATM services in the upper or lower airspace can thus plan their activities on the basis of reliable facts.

In order to ensure that the provider meets his investment responsibilities, the franchise agreement also contains clear functional specifications and effective regulation mechanisms. This ensures that the systems are returned to the state or the authority awarding the contract in a modern condition, complying with the contract, at the end of the franchise period. The adaptation to meet new EU or international standards can also be included in the contract, as can the introduction of new technologies. In order to prevent the national CNS infrastructures from drifting apart, care must be taken that all invitations to tender are agreed upon with the EU or with an expert organisation nominated by the EU, such as Eurocontrol, and that they are harmonised with the objectives of the Single European Sky.

The tasks of the authority which awards the contracts (invitation to tender, selection of the provider, regulation of the provider) could be delegated to award company which is responsible for the lower airspace.⁴⁵ Since this company has a board of users, this construction gives the users a decisive voice in the selection of both the service provider and the CNS provider. In this respect, this model has some similarities to the so-called club model.

If it should later become apparent that the integration of the ATM infrastructure at the supranational or EU level is advisable, the invitations to tender will be issued by an international authority. However, this makes the procedure more complex and difficult to handle. As the technology progresses, it is probable that the "natural monopoly" character of the ATM infrastructure gradually disappears, which means that there will eventually be no need for the tendering procedures.

⁴⁴ This is shown, above all, by the unsuccessful privatisation and regulation of the former British railway network provider Railtrack.

⁴⁵ See Section 10.2.

11.5 Evaluation

The following table provides an overview of the evaluation of the four options for the ATM infrastructure.

Evaluation criterion	Infrastructure in the hand of the ATM provider	Infrastructure in the public hand	Regulated infrastructure company	Tendering
Productive efficiency (cost effects)	Given	Very questionable	Critical	Given
Allocative efficiency (user orientation)	Partially given	Very questionable	Critical	High
Dynamic efficiency (Capacity effects, technological progress)	Partially given	Not given	Very critical	Very high
Intensity of competition/ market structure	Competition gained by legislation	Intensive competition for ATM services	Intensive competition for ATM services	Intensive competition for ATM services and infrastructure
Regulation requirement	High	Medium	Very high	Low to medium
Time needed	Short-term	1-2 years	>2 years	>2 years
Feasibility	High	Medium	Medium	Medium to high

It can thus be seen that tendering also promises the necessary flexibility and efficiency for the ATM infrastructure (in particular, for the CNS sector). It is also a relatively open solution which permits adaptation to new technological developments.

In the transition phase, however, it will be necessary to accept the fact that the infrastructure is primarily in the hands of completely integrated ATM providers. In this constellation, the *essential facility* doctrine provides a certain amount of protection for the competitors. The cost transparency can be improved by separate accounting for the ATM infrastructure and ATM services, as defined by the EU initiatives. However, it is hardly possible to estimate, at the present time, how effective this protection will prove to be in real life.

12. Conclusions and Recommendations for Political Actions

For the upper airspace, *functional blocks of airspace* should be formed, in a manner similar to that recommended by the EU and be awarded to capable service providers for specific periods. For reasons of efficiency, the direct award of contracts to service providers should be avoided.

The lower airspace, including approach control and ground control, should also be divided into lots of sizes which the emerging market can "digest" and companies should be invited to tender for them. This should be the responsibility of an award company owned by the Federal Republic. This company should have a board of users.

In the transition period, one should consider permitting competition in the lower airspace, particularly at the "margins", such as ATM services at peripheral airports. A regulation authority in the area of responsibility of the Federal Ministry of Transport then monitors the prices, quality and market behaviour of the state-owned ATM company during this period. At the changeover to competitive tendering, this regulation authority is converted into a company for award of contracts. The ATM infrastructure is removed from the organisation of the national ATM service provider and, just like all other services, transferred to the area of responsibility of the company awarding the contracts.

The necessary cooperation with the affected neighbouring countries for management of the functional blocks of airspace will have to be based on a State Treaty. Furthermore, the task of the *institution building* is to create a franchise company for each of these functional blocks of airspace which awards the contracts for the services transparently, fairly and without discrimination. A further prerequisite for this is that all bidders have discrimination-free access to the ATM data of the national ATM service provider during the transition phase. This must be monitored initially by the Federal Cartel Office and later – after the transfer of the ATM infrastructure to the award company – by a European competition authority.

In a transition phase, state-owned ATM companies who do not ensure discrimination-free access to their data by third parties, and thus hinder the efficient tendering procedures, should be excluded from the award of ATM services in functional blocks of airspace.

In order to ensure that ATM providers without their own CNS systems have a fair chance of entering the market, CNS systems should be removed from area of influence of the national ATM providers and transferred to a neutral organisation which makes their services available, without discrimination, to all ATM service providers.

In the transition phase, the *essential facility doctrine* ensures that newcomers have the right to discrimination-free access to CNS systems and, possibly, to ATM systems.

The decisive advantage of this concept is that it transfers the marketable parts of ATM to management on the basis of competition, while the creation of rules, the decisions to provide services, the economic regulation of private service providers and the responsibility for safety remain in the hands of the state. The state defines the framework and the private companies can take full advantage of this framework to maximise their profits and thus also to contribute to the common welfare – and that is the principle of social market economy.