

Institutional Aspects of a Global Navigation Satellite System

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Galileo is being developed as the European contribution to the next generation of navigation satellites to replace GNSS1. Sponsored by the European Union, Galileo will be a civil, internationally controlled and operated system that will secure the long-term availability of satellite-based navigation services for multi-modal purposes throughout the European region and beyond. Galileo will be designed to support a wide variety of applications. These include professional navigation, position reference, safety, emergency, tracking, sport/leisure and governmental. Such services may be open to all, for safety-of-life applications, or for commercial users. In the case of safety and commercial applications in particular, it is imperative that the appropriate institutional control and regulatory framework is in place for purposes of safety and economic regulation. To ensure that the various parties understand their obligations and liabilities, clear legal instruments must be put in place to support the organisational framework. It is planned to attract private investment to fund elements of system development and operation through Private/Public Partnership arrangements. At present there is no institutional, regulatory or legal framework that will enable the early impetus to Galileo development to be maintained. This presents a challenge that Europe must address without delay. It has been the subject of several European Commission studies in the past twelve months. In a complementary activity under contract to the European Space Agency (ESA), a European industry consortium comprising Alcatel, Alenia, DASA and Matra Marconi Space was tasked to complete the preliminary design of the space and ground segments by the Autumn of 1999. One task of this study, led by Matra Marconi Space, relates to a study of the impact of institutional, regulatory and legal issues on the organisation and development of Galileo. This paper describes the studies undertaken into these issues within the overall Galileo development programme.

KEY WORDS

1. GNSS. 2. Law. 3. Organisations. 4. Policy and Planning.

1. INTRODUCTION. Last year, the European Commission issued its first communication on developing a European strategy for global satellite navigation (EC, January 1998). It identified three key issues associated with a continued reliance on GPS or GLONASS:

- (a) The sovereignty and security of Europe's safety-critical navigation systems were outside European control,

- (b) There was a need to ensure that European users were not at risk from changes in the service or the introduction of future charges in a dominant, virtual monopoly situation,
- (c) There was a need for EU industry to compete effectively in this lucrative global market.

To address these issues, the Commission embarked on extensive discussions with potential international GNSS partners and launched a number of related studies. The Commission also sought advice from leading experts drawn from industry, governments, service users, providers and academia in the satellite navigation field (GNSS Forum, 1998). The conclusion of these activities indicated that co-operation with the US would only be possible if the GPS standard and signal structure were retained as the basis for all civil applications of a future system. In addition, there seemed to be no prospect that the US would relinquish or share future control of GPS.

Taking these findings into account, the Commission concluded that the best option for Europe was a system that would be independent of the US GPS but complementary to and interoperable with it. Early this year, the Commission issued its second communication (EC, February 1999), which proposed that the European concept for a future GNSS should be a stand-alone, multi-modal system and, at the same time, be complementary to GPS. It is called Galileo.

It is currently expected that the Galileo signal structure will permit a number of compatible services to be provided including open (free) access, controlled access (value-added), safety-critical and restricted-access governmental services. The optimum arrangements for financing Galileo are still being studied, but it is acknowledged that initial development will require public sector funding. However, a Public/Private Partnership (PPP) offers scope for private investment and is now under detailed investigation. It is hoped that the prospect of a greater involvement of European industry in the applications market will increase the willingness of private investors to participate in PPP.

In commercial terms, the challenge for Galileo will be to deliver service levels that are attractive to both service providers and users in circumstances where GPS is free of user charges. Galileo must achieve equivalent or better performance to that being considered by the US for its next generation GPS. In addition, if revenue is to be generated it must provide value-added services that are unique and enhance user applications. Furthermore, in order to satisfy the demanding requirements of certain safety-related applications, the system will have to be designed to satisfy the requirements of the transport safety regulators and operate within an appropriate safety management regime.

The achievement of the political objective of a civil, internationally controlled system in an efficient and cost-effective manner is also dependent upon the establishment of an institutional and management framework that has the right mix of private and public sector involvement and the appropriate interfaces to other relevant institutions both national and international.

2. INSTITUTIONAL CONSIDERATIONS. Galileo is expected to make a vital contribution to the social and economic future of transportation and other services in Europe. This suggests the need for a high level, inter-government entity,

or agency, at the outset. Such an agency should have overall responsibility to arrange for the provision, operation, regulation and use of the Galileo infrastructure. The value of a 'Galileo Agency' lies in its ability to oversee the development of the overall infrastructure, policy direction, standards, security, economic and safety regulation and control of the entity that will be responsible for commercial operations, i.e. a Special Purpose Vehicle (SPV) if PPP arrangements are followed. Participating States would formalise, through agreements, the policy and the terms under which an agency would be established. The agreements would cover organisational aspects such as the functions and responsibilities of the agency, operator, regulator and service guarantor. They would also need to define the objectives of the organisation, obligations of States, legal responsibilities, liabilities, management accountabilities, auditing, financing, cost recovery, types of service and security.

A meeting of the European Union Council of Transport Minister's (EC Transport Ministers, June 1999) passed a resolution that *inter alia* invited the Commission to establish a provisional Galileo Steering Committee to oversee the initial development phase of Galileo. This committee would be composed of representatives of Member States. A decision was also taken to establish a Programme Management Board (PMB) to assist the committee and begin work on determining the legal and institutional arrangements for the effective operation of those bodies established to manage the operations of Galileo. This Steering Committee could be the embryo Galileo Agency that is believed to be necessary in the longer term. The potential user market for a European GNSS is significantly larger than that currently embraced by the European Community. It is important at the outset to ensure any actions taken within the EU are perceived by the regional and worldwide community as a precursor to an eventual global system under international civil control.

In institutional terms it is important to distinguish between the *operational* and *regulatory* frameworks that are required. At the same time, it will be necessary to define the legal and contractual frameworks within which Galileo activities are managed, i.e. which Galileo services are provided by whom, under what legal and regulatory regimes and through what mechanisms. Linked to the issue of regulation are the requirements for *safety approval* and the question of *liability*. The framework for approval will be largely dependent upon the outcome of the development of the regulatory components of the institutional structure, and it must be independent of service providers and operators. Thus in institutional terms it is important that there are defined and understood procedures for dealing with liability. These could be based in part upon existing agreements (such as the Chicago Convention for civil aviation), contractual arrangements, commercial liability insurance and mutual insurance, i.e. 'superfunds' as for oil spills.

Navigation has traditionally been the responsibility of sovereign States' and satellite navigation will be no exception. The *security* of the system from outside interference must be guaranteed to the users. Because of the inherent high accuracy of the proposed system, national security considerations dictate that Galileo needs protection against misuse. This is apart from any governmental use of the system for legitimate purposes.

In order to attract investment, the implementation and operation of Galileo should be in accordance with common commercial practice. This will require suitable and transparent accounting procedures, and a decision-making structure that is isolated from political influences, to the best practical extent.

One key constituent of an institutional structure including the *private sector investor* under a PPP arrangement is the promoter. The promoter's role in the early stages would be to prepare for financial support and arrange commercial operations. The promoter should also have the authority to procure services and equipment and co-ordinate overall development through to deployment and operation. It is envisaged that the promoter role would evolve into a Special Vehicle Company within a Public/Private Partnership scheme.

The functions of the Agency strongly indicate that it should possess an *international legal personality*. The Agency would thus be a subject of international law, distinct from its Member States, and capable of bearing international rights and duties. Without such a status the Agency would not be able to function independently. It could not, for example, determine and enforce policy, conclude agreements, acquire and dispose of property or go to law.

3. ORGANISATIONAL FRAMEWORK. The criterion for the Galileo organisational structure is that it must ensure that government/institutional interests are preserved, while not inhibiting effective governance, management and commercial investment and that it should be legally robust. The key elements of a suitable organisational structure are:

- (a) Defined institutional framework,
- (b) Unified, coherent management,
- (c) Clear public sector policy objectives,
- (d) Defined private/public sector roles,
- (e) Evolutionary structure linked to system development phases,
- (f) Accountable framework.

Taking account of the resolution of the EU Council of Ministers, a possible organisational structure for the System Definition Phase is shown at Figure 1. European Policy will be set by the Steering Committee composed of representatives of Member States supported by the European Commission and the European Space Agency. The PMB will implement these policies. This will establish a framework that ensures that public sector funds are spent and accounted for in accordance with the agreed arrangements.

The technical definition of the main components of the system has been entrusted to ESA who have put in place a Satellite Navigation Programme Board to oversee this work. The private sector must be involved as early as possible in the definition and management of the development phase. The Council of Ministers also determined that potential users, service providers and others should also be integrated into the organisational arrangements being made for the definition phase. This also includes measures to support the concept of the proposed PPP via a Promoter Task Force.

One objective sought by European governments is to utilise to the maximum extent possible, private and public finance in the various phases of system development. The achievement of this aim requires an organisational framework that covers development, implementation, operation and regulation. The organisation must be under a unified and coherent management that allows commercial and business organisations to evolve over time. It should allow differentiation of the policy roles of the public sector and the business roles of the private sector. Thus the

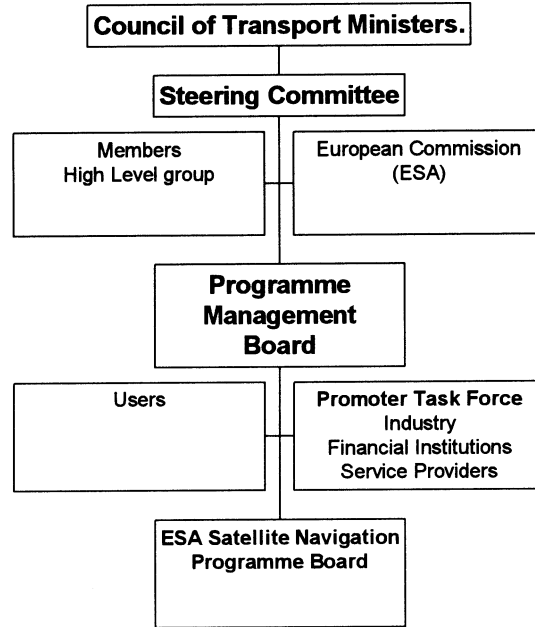


Figure 1. Initial framework for the definition phase.

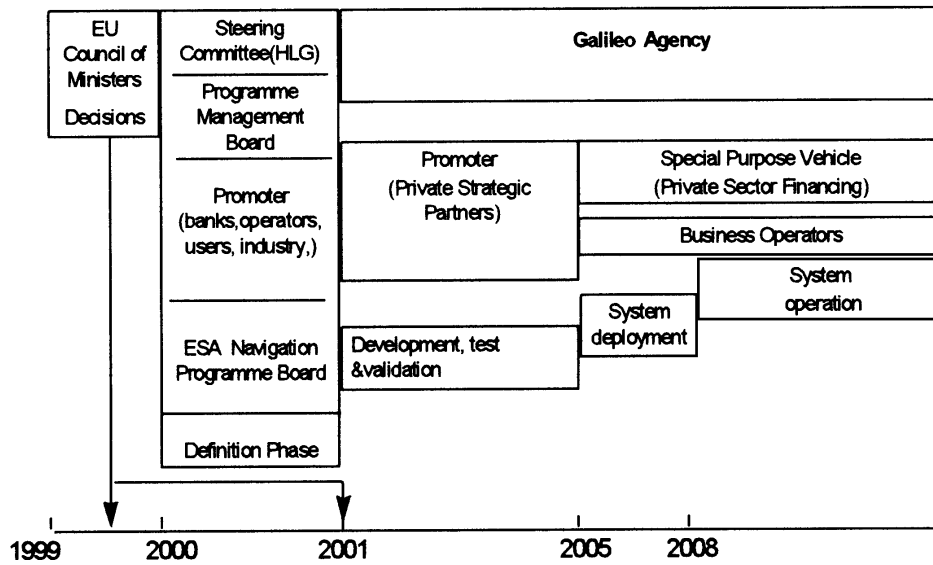


Figure 2. Evolution of the institutional framework.

organisational structure would evolve as development progresses towards a final operational structure as shown at Figure 2.

The government bodies, both national and European, set up for the definition phase, can be expected to evolve into the Galileo Agency before full operations

commence. The promoter, established early in the programme, would evolve into the SPV who would subsequently manage system infrastructure. ESA work on the technical definition and development of the infrastructure will proceed as a normal ESA programme with the aim of making the assets built up available to the SPV for operations. The actual definition of the requirements for the ESA development will be the responsibility of the PMB. Eventually it is envisaged that the complete institutional framework might be as shown in Figure 3. This illustrates a proposed

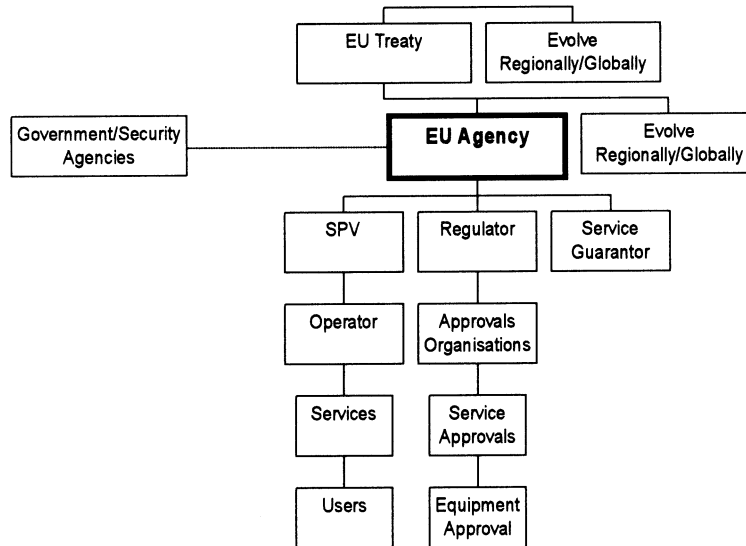


Figure 3. Final institutional framework.

overall institutional framework with the Galileo Agency as the key element. Also shown are the subordinate bodies discussed later in this paper, the roles of which need to be encapsulated in the appropriate legal instruments.

4. ROLE OF THE AGENCY. The setting up of a European Galileo Agency is the key enabler that would allow the rest of the organisation to be put in place. It is expected that this could take some time because of the complexity of the issues, particularly those relating to national sovereignty, which will require co-operation of States to permit the agency to take over some responsibilities that are, at present, solely within the competence of a State. There are also a myriad of other entities, both national and international, that already cover areas for which the new agency would be responsible, so co-ordination with existing entities would be complex and not make the task any easier. The European Union Member States will obviously form the core of the agency and they could use the Galileo Steering Committee and the PMB to draw up the required legal instruments and form the initial executive. In order to cover the whole of Europe, other States, who are not members of the EU, will also need to be incorporated into this work. In summary, the functions to be undertaken by a Galileo Agency would include:

- (a) oversight of new European Galileo organisation,
- (b) ensuring that the system meets the needs of the users,

- (c) definition of overall policy including transition from existing systems and organisational arrangements,
- (d) ensuring that appropriate mechanisms are established for the operation and use of Galileo; this could include EGNOS,
- (e) guarantor of signals-in-space (SIS), including RF spectrum protection,
- (f) ensuring that service quality is guaranteed to users,
- (g) ensuring that arrangements for safety regulation are in place,
- (h) ensuring that arrangements for economic regulation are in place,
- (i) liaising with system infrastructure organisations in other regions,
- (j) interfacing with national security entities,
- (k) promotion of standards for the signal in space and equipment.

5. PROVISION OF SERVICES. The principal services to be provided are:

- (a) Open Access Service – an open access global service for general public use with no safety or commercial implications. It provides a basic service, equivalent or superior to GPS IIF.
- (b) Safety Access Service – a controlled access local/regional/global service with implications for the safety-of-life. Loss or erroneous navigational data poses a high risk to the end user. Safety-related services will always require some form of approval that raises issues of liability and are often the subject of international standards.
- (c) Commercial Access Service – A local/regional/global service with impact on business efficiency and commercial operations. Commercial applications may require guarantees of availability and raise issues of liability and consequential loss.
- (d) Secure Access Service – a restricted, secure service, under the control of government and/or military agencies, having no civil application.

The EC assumes that public funds will be applied to the system deployment and operation will be met from user charges. However, much work remains to be done to identify the most practical means of recovering the costs of service provision. Any arrangement should comply with the following principles:

- (a) all user groups should pay,
- (b) no user group should be levied for more than its fair share of the cost,
- (c) system financing should be transparent,
- (d) service providers would be responsible for their own cost recovery.

In the expectation that the GPS Block IIF signals will be provided free of charge, assuming the present situation remains unchanged, traditional arrangements for the collection of user revenues will be difficult. Agreement on the levels of Galileo service and application segments to which they will be provided will be crucial to the definition of appropriate methods of cost recovery. Options for the fee-paying services will depend on the overall system architecture and the signal data/format. The chosen system design must provide scope for value-added services to be provided, whilst at the same time preserving the principle of open, universal access. Competition policy/price control with regard to service provision must also be considered since the

Galileo infrastructure operator will hold a virtual monopoly. The infrastructure service provider will be a private or public/private enterprise responsible for provision of the basic signals in space. Making use of these signals and providing value-added services to users, will be a number of service providers all with their own modal infrastructures. The services provided will be principally market driven and by such regulations as may be put in place. For these services a light regulatory regime should be applied in order to encourage a healthy commercial environment. The same can be said for the provision of end-user equipment.

6. **SAFETY REGULATION.** An important feature of the organisation of Galileo is the need for appropriate arrangements for its regulation and use, particularly for safety critical and other sensitive applications. Such arrangements will need to reflect the multi-modal nature of Galileo and to be compatible with and support current and future national and international arrangements for regulation. A major issue is that each user has a unique set of safety requirements (if indeed they are defined at all). Furthermore, each user domain shall require different approval requirements for the various applications. A further complication is that currently no single European regulatory body for all modes of transport exists. For example, the civil aviation and maritime services are regulated by separate bodies and the minimal regulation of road transport services is a matter for national administrations.

One EC study (EC CLAIM, April 1999) concluded that consideration should be given to establishing a harmonised multi-modal approach for a set of common requirements relating to the SIS. Regulatory approval of user equipment and its operation would be dealt with by individual authorities within each country. As shown in Figure 3, it will be essential for the regulation of Galileo to be separated (in organisational terms) from the functions of operations and service provision. From an industry viewpoint, it will be helpful to avoid, as far as practicable, multiple requirements and approvals. One of the principal roles of the new organisation, with regard to approval, should be to co-ordinate requirements from the various relevant authorities, promote the development of appropriate standards and arrange for the approval of relevant aspects, particularly the Galileo SIS.

The process of certification, or approval, has the principal aim of ensuring that a certification body gives legal recognition that a product, system, process or service is fit for purpose. It is the formal demonstration that a system or service has been assessed to be *safe*. Only in such a way, will the necessary confidence in the reliability and use of the system be established.

In circumstances where a unified regulatory entity does not yet exist in Europe and common multi-modal standards are not defined, it is believed that the practices of civil aviation relating to aircraft and airborne system certification offers the best and probably only basis from which to proceed. In order to agree the certification process, it will be necessary to establish the safety / certification framework within which the system will be designed and built.

7. **SECURITY.** One the key issues that led to the decision to develop Galileo was the concern of the civil community in Europe over the military interest in GPS. These concerns can be summarised as:

- (a) Maintenance of Safety-of-Life services,
- (b) Civil aviation requirement – open, non-discriminatory,
- (c) Requirement for civil international control,
- (d) Risks associated with denial, jamming, degradation,
- (e) Users seek guarantees on availability of services,

Conversely, the military also have concerns over the implications of a highly accurate, and globally available, civil Galileo, namely:

- (f) Misuse by hostile third parties,
- (g) Issue of controlling access when/where required,
- (h) Implications of any Russian co-operation.

In peacetime, there is little conflict between the requirements of civil and military users, but the EU military community may require a military presence in a peacetime co-ordination and advisory role for Galileo. In times of crisis, the role would include directing the controlling agency with respect to any required degradation or denial of service. An appropriate forum for discussion of Galileo civil-military concerns needs to be established.

8. **LEGAL ISSUES.** It will be necessary to define the legal and contractual frameworks within which Galileo activities take place and the manner in which they are undertaken. The European Commission has carried out several studies into the legal implications of operating a global service such as Galileo. One EC study (EC CLAIM, April 1999) produced an initial report earlier this year. The study considered liability in terms of the supply chain beginning with those who provide the basic GNSS1 SIS today, i.e. US and Russia. Potential claimants were categorised as primary (for example, aircraft operators), secondary (for example, passengers) and tertiary (third party) as well as defendants. In the case of EGNOS or Galileo, defendants might include the EU, ESA, Eurocontrol, national governments and their various instrumentalities and other related international/regional organisations. Equipment designers and manufacturers could also be liable for defects shown to cause or contribute to an accident.

A number of gaps were identified in present EU and Member State law and suggestions offered on actions that might be taken to remedy these shortcomings. The introduction of EGNOS puts Europe in the role of Galileo service provider for the first time. Liabilities will arise, and it is by no means clear that liability can be limited only to those components over which there is European control. If a State has authorised use of Galileo for a safety-critical application, it has also accepted responsibility to ensure – within reason – that the system is capable of satisfying that application. This would extend for example to ensuring that GPS itself and Galileo were protected within the area of a State's jurisdiction.

Whereas the open access service may carry no quality-of-service guarantees, this may not exclude the service provider from liability. The other services will carry a quality-of-service guarantee in some form. Whoever will be the provider of the operational service has an unavoidable liability for the reliability and integrity of that service and all necessary arrangements that bring the service to an internationally accepted operational standard.

The report considered there was merit in the findings of ICAO (ICAO, May and June 1998), and the proposal that was made to establish some form of international convention on liability. Historical precedent suggests that a consensus to agree a homogeneous certification and liability framework for Galileo would require an international convention.

The lack of a regulatory framework is clearly unsatisfactory from a legal liability standpoint. Existing conventions are too rigid and unsuitable which is why it has been proposed that a new international convention should be arranged, but this will take time. Some transport modes may find a temporary solution, such as in aviation where states have absolute sovereignty over the services provided in their airspace but jurisdiction could be – and in some cases it is – delegated to a single international body such as Eurocontrol. However, the broader issues of liability will have to be assumed by the EU and a legal framework established to ensure that the responsibilities are appropriately placed.

9. CONCLUSIONS. A number of key, non-technical issues have to be resolved in order to support and maintain the present impetus in Galileo development. These issues can be broadly categorised under the headings international co-operation, finance and legal liability.

International co-operation at both the political and technical level is essential for the successful implementation of a global satellite-based navigation and positioning service. At the political level, it is important to secure international agreement on critical aspects such as service characteristics, SIS standards, liability, regulation and the radio spectrum. Resolution of these issues will enable co-operation at the technical level and ensure compatibility and inter-operability between the different Galileo systems developed in the US, Europe and possibly elsewhere.

An important by-product of this co-operation relates to safety regulation, where harmonised SIS standards are essential to provide a satisfactory legal basis for the certification and approval processes governing the various safety-related transportation services. One possible approach to achieving a common set of system standards would be for EU member states to agree a co-ordinated approach to ICAO to extend existing GNSS1 specifications for civil aviation to include appropriate Galileo standards. The availability of such standards would enable the certification of user equipment and operational approval to remain the responsibility of the regulatory bodies in individual states. This two-step process would avoid the risk associated with any attempt to develop a single safety regulatory regime within Europe.

A definitive formula covering the future evolution of a Galileo institutional framework is also very important in pursuit of the objectives of the EU Council of Transport Ministers. Perhaps the most significant role of the Galileo Agency will be in the implementation of Public/Private Partnership (PPP) arrangements to support and fund system development. This will be dependent upon the agency's satisfactory resolution of key aspects such as institutional control, safety and economic regulation, protection of the public interest and the establishment of an efficient business management framework in which public sector objectives are well defined.

It is recognised that PPP can bring significant benefits to a major public sector project such as Galileo. It provides a positive and flexible contribution in efficient management, overall project cost-effectiveness, quality of service and risk sharing,

and can complement scarce public sector finances. Nevertheless there must exist an appropriate balance between risk and reward for each partner and this requires the availability of a credible business plan, an appropriate organisational structure and clearly defined roles and responsibilities for the public and private sectors at each stage of system development.

As illustrated in this paper, the provisional management structure set up by the EU Council of Transport Ministers must evolve as system development progresses. Thus for example, the present constitutional, financing and industry work-sharing arrangements of ESA may be quite satisfactory for the system definition phase through to test and validation, but the development of the end product must be undertaken in accordance with normal commercial practice. It is for this reason that the introduction of PPP concepts would suggest the need for a promoter to assume the responsibility for system development and deployment.

Whilst it is evident that the lack of an established institutional and regulatory framework is unsatisfactory from a legal standpoint, similarly the lack of any clear legal liability framework is unsatisfactory from the standpoint of a commercial or public enterprise. The ideal legal framework may therefore be an international GNSS convention. But even if that were possible, it will be a long process. Meanwhile, it is imperative to address this issue and put in place at least some form of interim framework that might be based on international contract law. This is a matter for urgent international consideration and action.

Finally, the organisational framework within which these issues can be resolved is probably of more immediate importance than the issues themselves. The setting up of an interim organisation by the EU Transport Ministers will enable these issues to be pursued, but they cannot be fully resolved until the Galileo Agency is set up. Only then can the rest of the organisation be fully implemented and Europe can move forward on the broad front required to establish Galileo as a global satellite navigation system.

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