



SIP/2004-WP6  
Business case

# Special Implementation Project

## CNS/ATM Systems – Economics and Organization

(Presented by H.V.SUDARSHAN)

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Workshop on the development of business case  
for the implementation of CNS/ATM systems  
Cairo, 6–9 September 2004



# Presentation outline

- Approach to establishment
- Organizational format
- Economic issues
- Benefits
- Legal issues



# Approach to establishing CNS/ATM systems infrastructure ...

CNS/ATM Systems Elements	National Systems	Multinational/ Subregional/ Regional Systems	Global Systems
<b>COMMUNICATION</b>			
Ground/ground data and voice communication	X	X	
VHF data/voice	X		
HF data			X
AMSS data/voice			X
ATN	X	X	



# Approach to establishing CNS/ATM systems infrastructure ...

CNS/ATM Systems Elements	National Systems	Multinational/ Subregional/ Regional Systems	Global Systems
<b><i>NAVIGATION</i></b>			
GPS/GLONASS/ GALILEO			X
GPS Overlay			X
GBAS	X		
GRAS	X	X	
SBAS	X	X	

(2/4)



## Approach to establishing CNS/ATM systems infrastructure ...

CNS/ATM Systems Elements	National Systems	Multinational/ Subregional/ Regional Systems	Global Systems
<b><i>SURVEILLANCE</i></b>			
SSR Mode A/C	X		
SSR Mode S	X		
ADS	X		
ADS-B	X		

(3/4)



# Approach to establishing CNS/ATM systems infrastructure

CNS/ATM Systems Elements	National Systems	Multinational/ Subregional/ Regional Systems	Global Systems
<i>Air Traffic Management</i>			
Airspace management	X	X	
Air traffic control	X	X	
Air traffic flow management	X	X	
Decision support systems	X		

(4/4)



# Identification of costs in establishing CNS/ATM systems infrastructure ...

Equipage (Hardware/Software)	Capital Costs	Revenue Costs
<p><b><i>Communication</i></b></p> <p>Ground-ground data and voice communication (such as VSAT network)</p> <p>VHF data/voice digital radio</p> <p>HF data link*</p> <p>AMSS data/voice link*</p> <p>ATN (end-systems, gateways, routers)</p>		



# Identification of costs in establishing CNS/ATM systems infrastructure ...

Equipage (Hardware/Software)	Capital Costs	Revenue Costs
<p><i>Navigation</i></p> <p><b>GNSS*</b> <b>(GPS/GLONASS/GALELEO)</b></p> <p><b>GPS overlay*</b></p> <p><b>GBAS/GRAS(monitored station including data link)</b></p> <p><b>SBAS (master station, monitored station GEO overlay uplink)</b></p>		<p>(2/4)</p>





## Identification of costs in establishing CNS/ATM systems infrastructure ...

Equipage (Hardware/Software)	Capital Costs	Revenue Costs
<b><i>Surveillance</i></b> SSR Mode A/C SSR Mode S ADS situation display ADS-B		
<b><i>Air traffic management</i></b> Decision support systems for ATS		



## **Identification of costs in establishing CNS/ATM systems infrastructure**

### ***Qualifications:***

**In quantifying the above, costs towards the following services should be taken into account:**

- a) building, power supply and ancillary facilities;**
- b) training for technical and operational personnel; and**
- c) administrative services (as a surcharge).**

**\* There may be no requirement for capital investment by States to establish the infrastructure.**



# Organizational format for service providers of air navigation systems

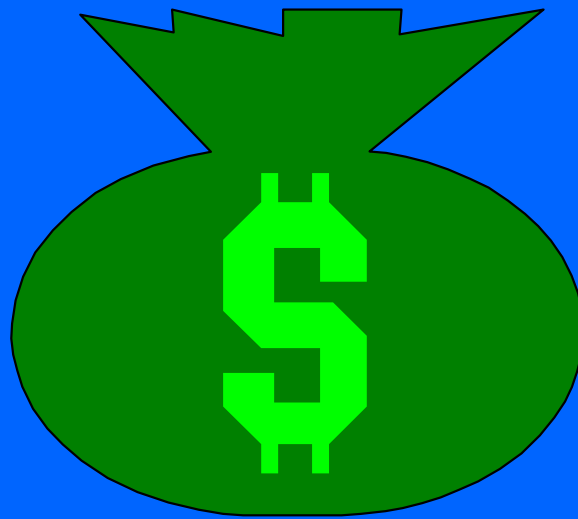
Level	Type of Organization
National	Government department Autonomous public sector undertaking Private organization
Multinational/ Subregional/ Regional	Service provided by one government Service provided by group government Organization with own legal responsibility
Global	Service provided by one government Service provided by group government Organization with own legal responsibility



# Capital investment Who is responsible?

- States
- Service providers
- Airspace users

Again, how much?



*Depends on the  
implementation options!*



## **Global economics – CNS/ATM systems**

**Capital cost — US \$ 6.5 billion**

**Operating cost — US \$ 1.0 billion  
per annum**

**Benefit/Cost ratio ranging  
from 5.2 to 6.6**



# Who should perform cost/benefit analysis?

- **Global evaluation**
- **States**
- **Service providers**
- **Users (aircraft operators)**



# Allocation of costs and benefits ...

Cost/ Benefit Item	CAA	Aircraft Operators	Passengers	Totals
<b>Costs of CNS/ATM Systems</b>				
Equipment costs				
Ground				
Aircraft	X	—	—	
Training	—	X	—	
Purchases from intermediate service providers	X	X	—	
TOTAL	C1	C2		C





# Allocation of costs and benefits

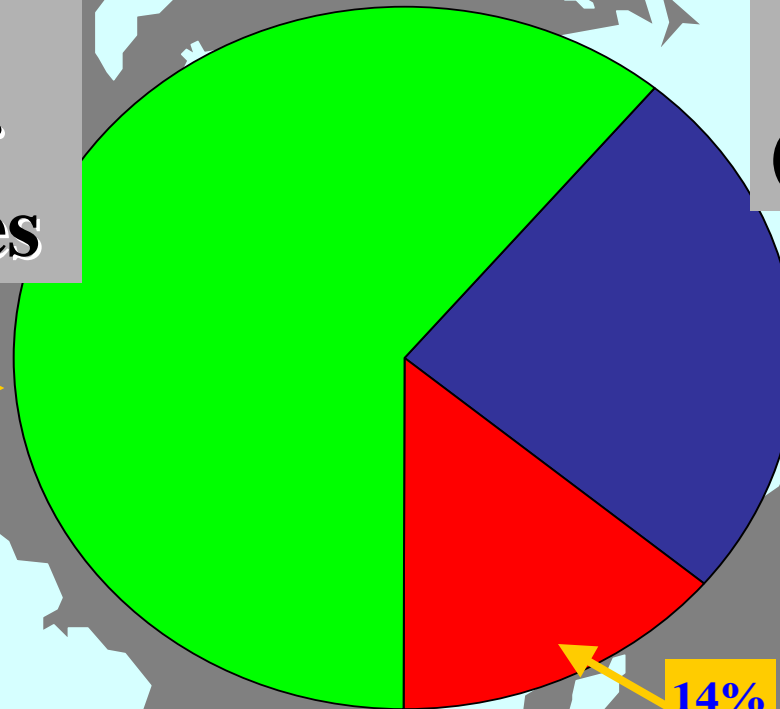
Cost/Benefit Item	CAA	Aircraft Operators	Passengers	Totals
<b>Benefits of CNS/ATM</b>				
<b>Avoided equipment costs (Present technology)</b>				
<b>Ground</b>	<b>X</b>	—	—	
<b>Aircraft</b>	—	<b>X</b>	—	
<b>Efficiency improvements</b>	<b>X</b>	<b>X</b>	—	
<b>Passenger time savings</b>	—	—	<b>X</b>	
<b>TOTAL</b>	<b>B1</b>	<b>B2</b>	<b>B3</b>	<b>B</b>



# Benefit shares

**Aircraft  
Operator  
Efficiencies**

61%

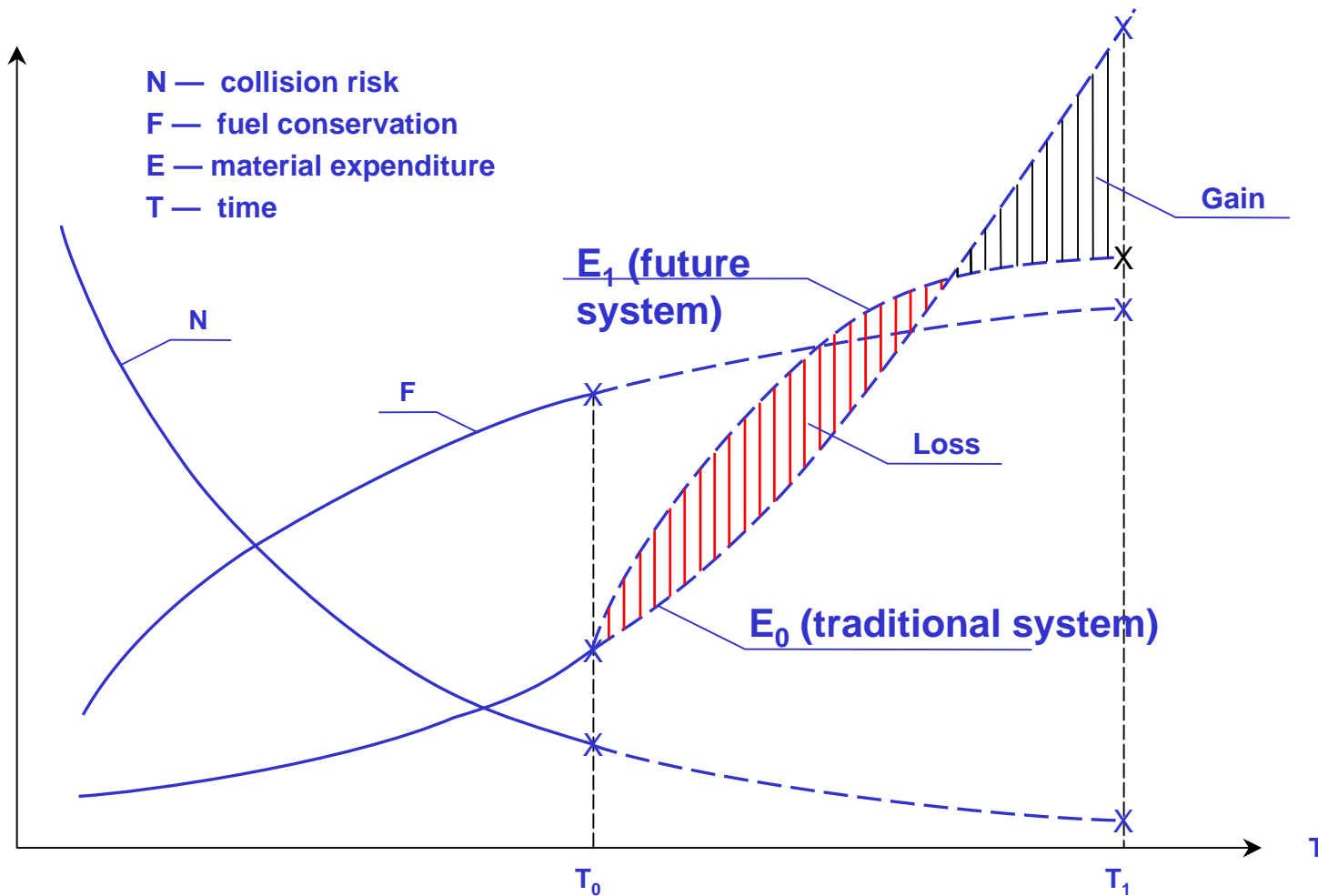


**CAA  
Present  
technology  
Equipment  
(avoided cost)**

25%

**Airlines  
Present  
technology  
Avionics  
(avoided cost)**

14%



## General trend in the variation of the main factors of the ATM system



## **Cost/Benefit studies**

- **The study to address the following:**
  - **financial viability**
  - **implementation options  
(operational/technical/organizational)**
  - **business case: the guidance material for preparation of a business case for implementation of CNS/ATM systems has been developed; workshop for MID Region in September 2004**



# Cost/Benefit Analysis

- **Measure of economic viability**
    - Net present value (preferred option)
    - Cost-effective
    - Least cost
    - Snapshot
    - Utility value
    - Pay-off period
  - **Sensitivity analysis**
    - Analysis to ensure wide fluctuations in changing data conditions are taken into account
    - Validate the model using the best judgment
- (Refer to ICAO Circular 257 and Circular 278 for more information)



# Costs of Service

- **Cost determination**
  - **Identification of facilities and services**
- **Scope of cost basis**
  - **Cost basis for charges to include all costs incurred in addition to facilities and services**



# Costs & cost allocations

- Resolution A32-19 provides guidelines.
- Cost allocation issues
  - multi-modal services
  - allocation options
- Allocation of costs
  - Aeronautical and non-aeronautical
  - Airport and en-route operations
  - Commercial and non-commercial users
- ICAO to continue its efforts in this area with a more comprehensive study



# Cost Recovery

- **Cost allocation and cost recovery principles are set forth in ICAO Document 9082**
- **Methods of cost recovery**
  - **Direct collection from users**
  - **Joint charges collection agency**
  - **Delegation to external agency**





# Cash Flow Analysis

- **Cash flow analysis is required to determine working capital needs**
- **The exercise includes:**
  - **Cash in-flows**
  - **Cash out-flows**
  - **Payback period**
  - **Internal rate of return**



# Financing

- **Sources of financing include:**
  - **Contribution from governments (national or foreign)**
  - **Commercial sources (debt financing)**
  - **Accumulated excess of revenues over costs (profits)**
  - **Bonds**
  - **Equity financing (share capital)**
  - **Leasing**



## Funding ...

- Investment recovery through the medium of user charges
- Revenues from airport and air navigation charges to be applied solely towards defraying the airport and air navigation facilities
- Financial institutions are encouraged to extend preferential funding through:
  - bilateral programmes
  - development banks

(1/2)



# Funding

- **Regional cooperation among service providers**
- **To consider funding options such as:**
  - **ICAO implementation mechanism**
  - **bilateral and multilateral cooperation programmes**
  - **international organizations**
  - **development banks**

(2/2)



# **Airline benefits**

- **Route optimization (time, fuel)**
- **Optimum altitudes**
- **Dynamic aircraft route planning**
- **More alternate airports**
- **Reduced contingency fuel**
- **Possible reduced crewing**
- **Increased aircraft utilization**
- **Greater payload capability**
- **Greater revenue generation**



# State benefits

- **Improved level of service**
- **Consolidation of facilities**
- **Reduced maintenance costs**
- **Avoided capital costs**



# Airports benefits

- **Increased airports capacity**
- **Improved airside management**
- **Decrease in diversions in instrument meteorological conditions**
- **Enhanced revenues**
- **Happy passengers**



# GNSS – organizational issues ...

## ➤ Satellite constellations

- one government (GPS by US and GLONASS by Russia)
- a group of governments (GALILEO by European States)
- an international operating agency with its own legal entity (INMARSAT)

(1/3)





# **GNSS – organizational issues ...**

- **Augmentation systems: SBAS**
  - **one government (WAAS By US and MSAS by Japan)**
  - **a group of governments (EGNOS by European States)**
  - **an international operating agency with its own legal entity**



# **GNSS – organizational issues**

- **Augmentation systems: GBAS**
  - **does not require international environment**
  - **service provider could be a government department or an autonomous entity or private organization**
  
- **Augmentation systems: ABAS**
  - **part of avionics**
  - **aircraft operator's responsibility**



## Legal issues ...

- It has been generally agreed that there is no legal obstacle to the implementation of CNS/ATM systems and that there is nothing inherent in CNS/ATM systems that is inconsistent with the Chicago Convention

(1/2)



# Legal issues

- It is generally concluded that:
  - GNSS shall be compatible with international law, including the Chicago Convention, its Annexes and the relevant rules applicable to outer space activities
  - the integrity of any legal framework for the implementation and operation of GNSS requires observance of fundamental principles, which should be established in a charter

(2/2)



# **An update on legal aspects of CNS/ATM systems ...**

- **The ICAO Secretariat study group on legal aspects of CNS/ATM systems was established in 1999**
- **This group has:**
  - **finalized the concept of a contractual framework for implementation of CNS/ATM systems**
  - **considered for an international convention**
  - **addressed security aspects concerning prevention of unlawful interference to CNS/ATM systems**

*(1/3)*



## **An update on legal aspects of CNS/ATM systems...**

- **Submitted the final report in January 2004. Examined by the Council in March and June 2004. The review report will be considered by the 35th Session of ICAO Assembly (Montreal, 28 September – 8 October 2004)**

(2/3)



# An update on legal aspects of CNS/ATM systems

## ➤ The final report contains:

- Part I – described current legal framework
- Part II – identified inadequacies of current legal framework
- Part III – developed a draft contractual framework relating to the provision of GNSS services and addresses the issue of liability
- Part IV – relates to the consideration of an international convention
- Part V – discussed legal implications of communications & surveillance elements

(3/3)

