BUSINESS MODELS AND BILLING FOR INTEGRATED SATELLITE AND TERRESTRIAL AIR TRAFFIC MANAGEMENT SYSTEMS

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Abstract

The industry of commercial flight services is undergoing major transformations driven by the sector liberalization, technology advances and the trend to make passenger's travel time more valuable enjoyable and basically to offer them the same services and comfort they can enjoy on the ground.

The introduction of on board telecommunications services for cellular telephony and internet access are just now emerging based on advances in wireless technologies and the enormous diffusion of cellular phones and of wireless terrestrial and satellite based networks.

At the same time the large diffusion of GPS receivers and the coming Galileo and GLONASS systems as well as location positioning based on terrestrial network technologies, will have an impact on the air transport industry.

Air Traffic Management is today based on proven but relatively old technology. While today's technologies provide basic voice and limited data communications, in the future higher bandwidth will be required, and new functionality for the operational modes and additional security and privacy functions will be mandatory.

In order to accommodate for the increased number of flights and in order to transmit higher bandwidth for voice and data between air and ground several new alternatives are proposed. Some of such candidate technologies exist today for wireless 3G communications, and in order to reduce costs and to speed up the introduction of these systems several existing and future wireless technologies are being investigated. Dedicated as well as a mix of dedicated and commercial public networks can be used for this purpose.

In the future a large number of terrestrial wireless systems will be available as well as several candidate satellite based systems. It is foreseen that a mix of systems with different characteristics will be used for ATM depending upon their availability, coverage and cost.

In a scenario where several terrestrial and satellite alternatives will co-exist and where the number of potential service providers is large, a new business model needs to be introduced to correctly share revenues between all involved parties. Supporting all the corresponding new business relationships, a tailored billing and settlement system needs to be established, too.

This paper presents a business model in such a scenario and introduces basic requirements for the involved business support billing and settlement system.

Introduction

The scenario for commercial flight services is just undergoing a major change. After the liberalization the more visible effect was the introduction of low cost airlines and the steady increase in flights, which at the current annual rate will double the number of flights in 10-20 years. At the same time the airlines begins to differentiate services, from just having a geographical focus on the country of registration

caused by the national ownerships of them, differentiating themselves to cope with the increasing competitiveness. Several aggregations take places, firstly at the group level but further consolidation and specialization is foreseen. Similarly airport operators are also looking outside their main national territory. To cope with high costs of large airports and to satisfy the low cost airlines the number of airports is also due to increase, especially smaller ones that guarantee lower costs and shorter service times. Some large airports now look more like large specialized shopping centers, and a lot of service providers and business entities compete for the ever increasing number of passengers transiting there. Airline differentiation is likely to be dictated by positioning along four major axes:

1. The PRICE dimension: Low cost no frills airlines versus expensive ones
2. The SERVICE dimension: Airlines offering a rich set of services to passengers versus *Spartan* ones
3. The GEOGRAPHIC dimension: Short haul versus long haul flights
4. The PASSENGER dimension: Business versus leisure passengers/travels

The other major trend going on is the richer service offering that will be given to the passengers when during their travel experience. Internet access, instant messaging, cellular 2G and 3G telephony are just now being introduced to allow passengers maintain connectivity even during flight times. Live TV radio and other in flight entertainment based on pay per view and direct connection to movie servers will further increase passenger satisfaction and make their travel time more enjoyable. The basic trend is to offer passengers the same services they are used to get on the ground when they are moving into an airport on board and at the destination in a seamless way and whenever possible at the same (national/international/roaming) price.

The third major trend connected with the flight increase is a change that the Air traffic Management (ATM) and Air Traffic Control (ATC) systems will undergo. The current increase in flights will lead soon to congestion in certain crowded areas (Europe and parts of North America) and the currently used VHF network for Air to ground communication needs to be improved. New technologies should be used as much as possible considering the relatively long lifetime of ATM/ATC systems. It is not only a matter of modernization of the current services, but it is a natural increase of the capacity required between aircrafts and ground and between aircrafts themselves and a natural change of mix from voice to data services as experienced in the terrestrial network to allow more and more services for the airlines their crew and the passengers. The adoption of existing terrestrial wireless technology is being advocated as one way to reduce the overall system costs, and to benefit from the advances of the technology used on the ground and concentrate purely on the unique requirements given by the application in terms of reliability, security, propagation issues at high quote high speed, etc. Current air traffic operators will thus have a role in the overall Business Model. It is interesting to note that ATM can be seen as a location based service.

The introduction of Galileo and the partial shift from ground based to satellite based systems for assisting navigation. Two of the five defined Galileo services are the so-called Safety of life (SoL) and Commercial Services (CS). It is too early to foresee to which extent Galileo and the future GPS and GLONASS will be used in the ATM/ATC environment. However for sure they will be used and the Galileo business model foresees charging for these types of services, so the Galileo Concessionaire will be part of the business model.

How will all these changes affect the future the Commercial Flights Scenario? What will be the more likely business models applied? What requirements will this "new" business model pose on the system themselves? What impact will these have on value chain Business Support Systems (BSS)?

These are the major points addressed by this paper.

Business Models in the Aeronautical Commercial Flight Industry

So far three different complementary scenarios have been considered. The one related to passenger in flight services [1] , [3] [6], [7] is the most advanced, as the introduction of services for passengers has already started or is about to start mainly depending on the different airlines. The introduction of new actors in the business model as well as the factors facilitating and blocking the service roll-out

have been addressed but is still debated. Business models for the airport environment have also been considered [2]

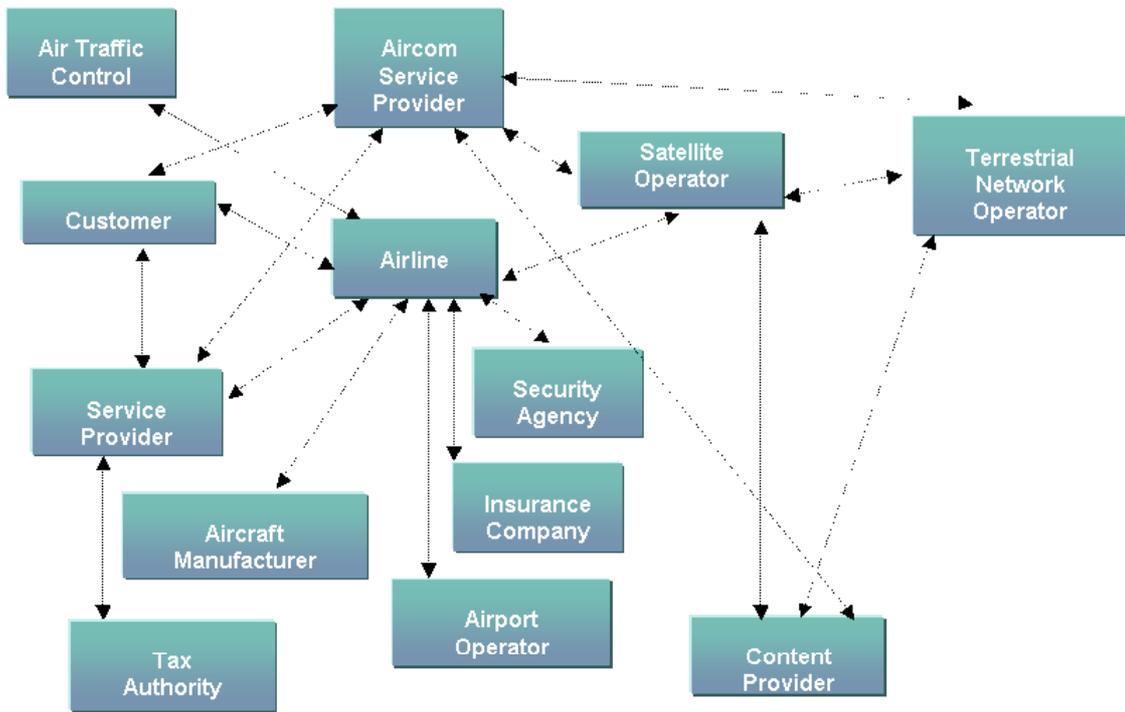Figure 1 below depicts the actors involved in the passenger in flight services.

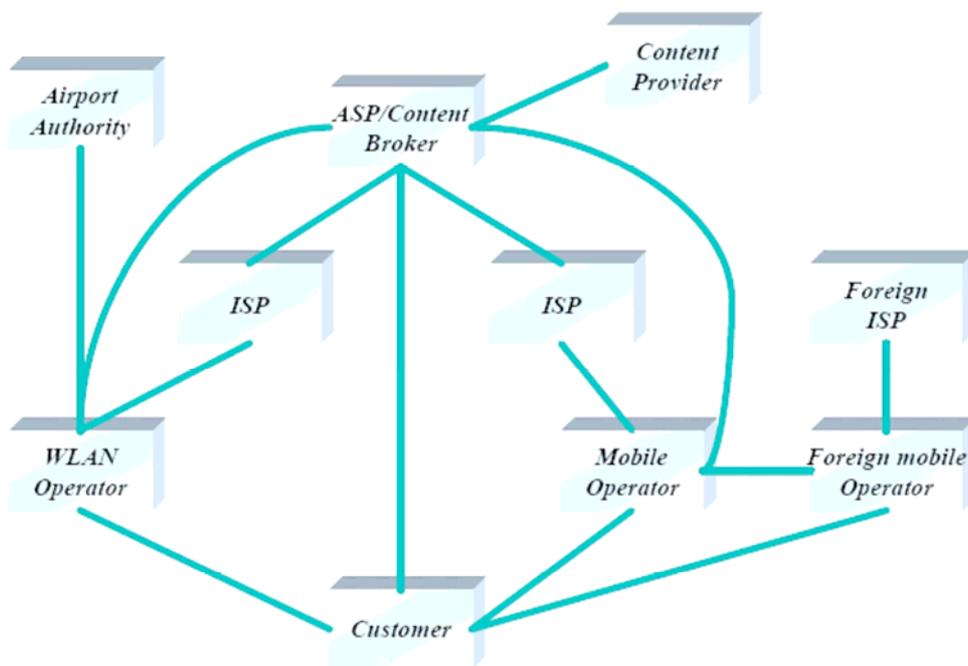*Fig. 1 Actors in the passenger in flight services business model*

Fig.2 Actors in the airport perspective business model

The complementary views of the two models are reflected into the different proposed billing systems [4], [5].

As can be noticed the two models in the enlarged scenario are both incomplete, as they are mainly seen from an on-board or an airport operator perspective. Furthermore, there is a need to consider the more generalized scenario, where alternatives exists for example for air to ground communication and navigation/ATM, systems that may be terrestrial or satellite based, and considering the possibility for the airline to choose services dynamically at flight time, provided the aircraft equipment and context will support it.

The business model concerning the GNSS scenario have been analysed in the context of the Galileo concession bid by the two, now united, consortia namely iNavSat and Eurely, however details have not been publicly disclosed. The Galileo concessionaire as well as similar organization for GPS (if any) and GLONASS will be part of the business model.

The last scenario of ATM so far has not been investigated in the perspective of the future scenario with a mix of terrestrial and satellite based systems both dedicated and general purpose. ATC authorities will be involved as well as eventually new organization to which may be demanded the ATC service. When considering ATM in *non-mission critical* type of applications, the use of commercial terrestrial wireless networks such as 3G UMTS or Tetra, supporting at least guaranteed Quality of Service (QoS) and availability requirements, can increase the available palette of options for airlines. Therefore mobile operators, provided their networks satisfy the stringent requirements posed in the aeronautical environment, may also enter into this area of business. From an ATC service provider point of view several questions arise: Will this market see the same scenario change as the airlines? Will the national operators become more global? Will they specialize? Segmentation? What about national security and public safety? Will it be one or more concessionaire for ATC? What is the role of satellite?

The main paying actor in this business model is the passenger. However passengers tend to consider (or wishes to) one single entity responsible for their travel experience, namely the airline, that has therefore the most important role in the overall business model.

The revenue streams in the business model will arrive mainly from the passengers and but also from other entities, for example advertisers, local municipalities, governments, shops which will pay to have an indirect return as an example for tourism development.

From an airline perspective, a unified complete business model where all parties participating are considered is desirable, since it will avoid implementing different systems for accounting and billing and in general business support systems.

Current business models in the *Passenger In Flight Services* scenarios are mainly dictated by marketing and are not satisfactory yet. As an example, the recent rumours about Connexion by Boeing profitability may be due to the inadequate business model and underlying billing. Connexion offers flat tariffs between 10 and 30 $ per flight regardless of the transferred volume for Internet access. Some passengers download movies on the plane, and the current high costs of satellite transponder lease are not consistent with the selected tariffs. Furthermore, the airlines have to sacrifice some seats and the compensation they get from the operator may not be adequate.

Passenger Price Decomposition

Passengers used to pay per flight a price that was all-inclusive. The total price was hiding the single components, yet was satisfying the general requirements of "one stop shopping". With the advent of the deregulation, passengers are offered more transparency. Today is not uncommon to have the price decomposed between the price for the flight and the so-called airport taxes. Other examples of further decomposition are the charges per piece of luggage, in flight meals and drinks, fuel surcharge, and so on.

In the future scenario, a further decomposition of passenger price will take place. This has to be reflected into the actor's BSS.
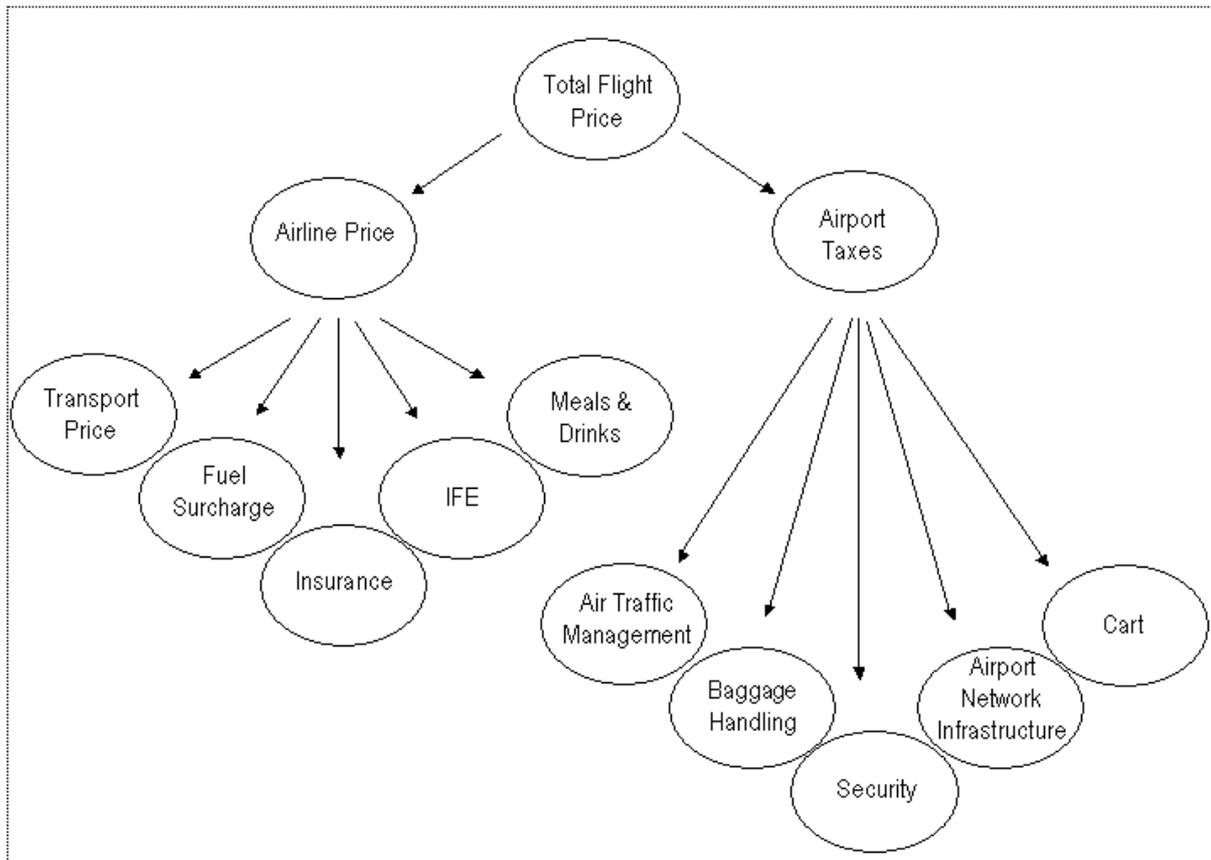

Fig.3 Passenger Price Decomposition

Figure 3 above is an example of passenger total flight price decomposition as it may happen in the future and is useful to define the relationships between the actors in the business model.

A Generalized Business Model for Commercial Flight Services

This section will try to complete the number of actors involved in the business model and define their Business relationships.

As already reported, the model includes many actors and gives rise to complex value chains. Finding the correct balance between them and supporting changing business relationships as well as billing and settlement in an effective way are keys to the smooth and fast introduction of services in this environment.

Based on the above considerations, the business model in the future commercial flight services scenario is likely to have the following players shown in figure.
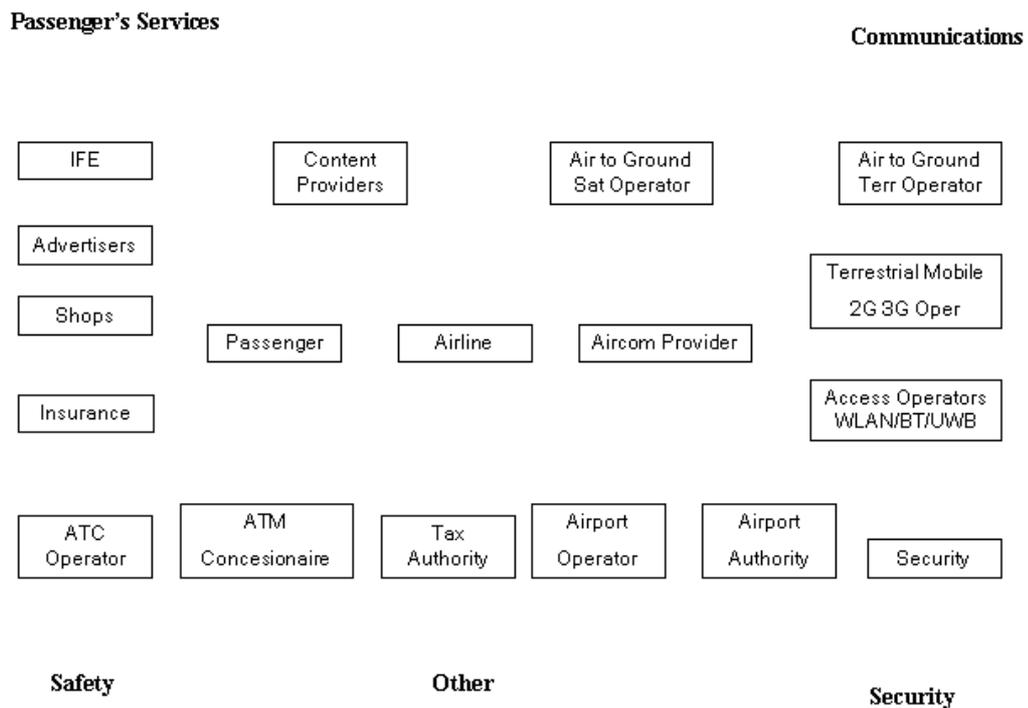
Passenger's Services

Communications

IFE	Content Providers	Air to Ground Sat Operator	Air to Ground Terr Operator

Advertisers

Shops

Terrestrial Mobile 2G 3G Oper

Passenger	Airline	Aircom Provider

Insurance

Access Operators WLAN/BT/UWB

ATC Operator	ATM Concesionaire	Tax Authority	Airport Operator	Airport Authority	Security

Safety   **Other**

Security

Fig.4 Generalized commercial flight services business model

The actors are grouped according to four different main categories, safety, security, communication and passenger services. There is no distinction if a service is offered at the airport on the ground or on board. The passenger is likely to consider the whole flight from when he arrives at the airport as one single "experience". Just like the price decomposition is offered to the passenger in an attempt to reduce overall costs and to go in the "pay per use" direction, the same will apply to airlines. Instead of all-inclusive Service Level Agreements (SLA) with other business partners, decomposition and accounting will charge only the effective usage of the partner's systems and services. Therefore the involved network and systems MUST collect accounting data used for reconciliation between the parties BSS and for billing and settlement purposes.

Impact on Business Support Systems

A business model is only good as long as it is accepted by the involved parties, and is deployable in their business support systems. Therefore, this section outlines the requirements posed by the billing and Customer Relationship Management (CRM) systems on the accounting data and operational information, which need to be generated by the underlying networks.

Requirements are:
- Make life easier for the Passengers: One bill, single authentication/authorization procedure for access to all services, diversity of payment methods chosen by the passenger themselves

- Provide a flexible billing and settlement system for the airline and the involved parties

SLAs will be in place between the actors. For example associated with each SLA there will be some QoS clauses for billing adjustment and or penalties. For example an SLA with a satellite operator may be based with the coverage in certain areas during flight time. If for some reasons the coverage cannot be given, a bill adjustment or penalty will be automatically applied. In the value chain this

penalty will flow towards the passengers to reimburse them, for example, for bad reception of movie services during the flight.

A Sample futuristic Scenario

This section deals with few use cases to show the involved parties and business/revenue flows.

> During one flight, the airline selected satellite network does not offer sufficient bandwidth to guarantee to passengers scheduled *movie on demand* services. The on board system connects to a second satellite provider or to a terrestrial provider in the area and send QoS reports and accounting data to the billing system on the ground.
>
> Unexpected excessive turbulence during flight is registered. In order to improve the airline service on flights in this area, a lot of data has to be transmitted to the ground. The scheduled air to ground channel for this flight is not sufficient to cover the request. Using the WCDMA system on board the pilot makes a regular broadband air to ground connection to transmit the excess data. The Airline has a special subscription with the local wireless terrestrial broadband operator, which that gives them guaranteed bandwidth. Accounting data is transmitted to the airline ground billing system and used for bill checking later on form the operator.
>
> A flight using a polar route must use localization and navigational services from all three existing GNSS systems in the area according to the aircraft position. Accounting data are used to provide for a report to the ATC Service Providers.

Many more examples can be imagined. The common denominator is the need to dynamically adjust for the best possible available network/service and the need to keep track of accounting and QoS data for billing and CRM purposes.

Conclusions

This paper has examined the business model in the perspective of the future commercial flight services scenario. Attempt has been made to consider all the involved parties in the value chain. Requirements for the business support systems from the accounting, billing and CRM point of view have also been addressed.

Acknowledgement

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