Business Models and charging for mobile services in the air travel value chain

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***Abstract*—The explosion of mobile services and the availability of wireless coverage in airports and aircrafts during flight alike will make possible to introduce to business and leisure travelers, airline and airport personnel several new services. Service creation platforms for these environments will have to work with the continuous context change that people experience in the different phases of the travel experience, from a travel preparation at home or in the office, to pre travel, travel and post travel phases.**

In this paper the scenarios, use cases, business actors, charging aware system architecture and possible business models are analyzed.

***Index Terms*—Aeronautics, Billing, Business Models, Charging, Location Based Services, Service Creation Platforms, Travels.**

I. Introduction

THIS paper illustrates a business model which applies in a business travel scenario where service creation platforms can be used to introduce Location Based Services (LBS) to traveling passengers. Service Creation Platforms (SCP) have so far concentrated on automating the task of quickly creating services in a "cut and paste" fashion to avoid long time to market experienced here. The SMS (Simple Mobile Services) project aims at providing a framework that enables simple and quick service creation.

II. A FLIGHT TRAVEL SCENARIO

We consider here a complete travel scenario, which illustrates the use case of an end user through the different phases of travel, from the planning to the execution and post flight activities. In the following we will use the word scenario also to describe this use case. The detailed description is needed to identify all activities and actors involved in the business model.

The proposed scenario is to follow an end user for a travel experience during the different temporal phases of pre travel, travel, post travel in the different space location contexts (home, office, airport approaching, departing airport, airplane, destination airport, hotel transportation, travel location stay and back).

Professor (User) U from European University EU has to travel abroad to visit his colleagues in a Chinese University CU where there will be a conference on SMS and he will give some lectures there. He prepares the travel by using the SMS Travel Planner Service SM. While booking, the contextual bookmarks are loaded to the devices he will carry along during his travel. SMS will assist him throughout all the travel experience as a travel assistant, LBS support, and to compile travel reports and bill and tax refunds in the post travel phase. He first selects a flight and since he uses Airline AL for the first time, when connecting to the airline web site he indicates user preferences on seat, meal, drinks and on board entertainment (movies, games) and luggage requirements.

The SMS Travel Planner service looks up in databases of U's Mobile Operator MO and Wireless ISP supplier WI, which subscribed telecom services will be available in the different space locations (roaming information at destination, wireless coverage in the aircraft and in the likely visited destination places). It then suggests which devices to carry with, which operators to choose when at destination, and assists in finding the cheapest and most effective ways of communication when at destination. U selects the devices to carry with him during the travel.

On-board cellular telephony and Internet access are provided by an AirCom provider (AC).

U also informs the airline of his communication requirements during the travel, and informs them about the carried on devices on board during the flight. This information need not be all reentered, but just imported using SM from a User central repository to the Airline AL.

Upon receiving the booking, the Airline AL sends information on luggage requirements to departure airport DA and arrival airport AA (globally referred to as airports AP), to catering company CA and to in-flight entertainment services IF. The airline also knows that the laptop and headphones Professor U will carry on board can be used to get access to on board movies, games and music and therefore informs the airline logistics not to board a wireless IFE terminal for him, thus saving cost.

Professor U has booked a hotel (SM found U's preferred hotel chain at the destination and it was easy) but not a taxi.

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Considering the difficulty in finding the way to the hotel, and knowing from the profile that Professor U does not speak Chinese, SM sends the information to the destination city Taxi driver companies TX. These companies advertise the taxi service and Professor U selects the cheapest. Company TX will send a taxi to the destination airport taking into account the actual arrival time of flight, which they will get from the Airport Flight Operating Company (ARINC or SITA). The taxi will use the people discovery service at the airport, which matches U position relative to Taxi driver position using RFID to get in touch with Professor U when he arrives.

Collecting SMS travel planning information, the destination city multimedia museum MM recognizes the large number of admirers of Painter X whose paintings will be exhibited in town next week. MM advertises the special event and upon receiving sufficient bookings from the addressed community,, an optimized Museum Guide Service is prepared accordingly. Peoples' agendas are marked with the event and information on how to get to the museum and other advance info is sent.

On the day of flight U arrives at DA. First he gets guidance to the airline special parking place PA, which has special rates for Airline AL passengers and business agreements with some airport shops SH. First he checks in, being guided to the right desk receiving an RFID identifiable boarding pass for him (U) and similar for his luggage L. Since the baggage information was communicated early, the overall procedure may be faster than in current operations. He drops the boarding luggage. RFID identification is used for U and his Luggage L to track back U's belongings. From now on U/L RFID tags are used to pass all check-points, security, passport control, boarding, luggage routing and boarding and finally checking that U picks up his luggage at destination airport.

Advertising messages from shop SH and Advertisers AD lead him to some shops according to personal preferences as specified in the user profile, where he buys something. Since he is in an airport, shops purchases entail him to get a discount on parking at PA. Furthermore he gains AL frequent flyer miles for the purchases just made. Finally he can pay using any combination of credit cards, debit cards, credit bonus left from previous flights and frequent flyer miles programs. In these paying transactions connection to a Credit Card Validation institute (CC) is required as well as to the Airline AL CRM Database and to the banks (BA). Of course when he approaches the cashier with his RFID boarding card, automatically gets the tax-free rates applicable to the international nature of his travel and he does not have to pay local taxes (TA).

He also needs to have lunch before departing. Triggered by the statistics about the proposal/responses, the airport Restaurant R decides quickly to set up a new menu for tonight. Another shop also updates its service. Some airport services are not working and notification is sent automatically to the airport personnel that will send maintenance people around the airport DA.

Some specific needs arise and a service is designed on the spot at the ice cream restaurant at the airport. As soon as he enters into the DA domain, information on available wireless networks is sent to all his devices, with instructions on where the Access Points are and the applicable rates.

Then he moves into "flight mode" and a new context appears. Depending where he is going, the aircraft type, the satellite coverage en route, and his flight class, different services may be available to him. U can use his laptop to watch his ordered preferred movie on the plane.

Upon landing at the arrival airport AA, he gets support services in his own language for direction guidance, immigration, baggage collection, shopping, booking what is missing in his travel and guidance to the waiting driver.

Next day he moves (using the same taxi company's TX special taxi package) to the University campus final destination CU. As the professor moves into the campus he is guided accordingly, and at the visitor gate receives an RFID pass used to pass RFID gates and track U's position in the campus. Furthermore the scheduled lectures and course time is updated according to his agenda and availability schedule.

The University Campus students then get the updated schedule on an easy to access portal.

During his stay he finds nice Chinese restaurants and ice cream shops, and updates his contextual bookmark accordingly on his PDA/Smart phone. Taking advantage of the Infotainment Services, he is alerted that his favorite jazz band is playing tomorrow only 30 km from his location. He books a ticket for the concert.

Having half a day left he tries to contact his friends from the social network which happens to be in the same place where he is now (all palm collectors in the area). He manages to get in touch with few of them, who recommend the visit to some private gardens in the area he would not have otherwise discovered in such a short time.

Upon the day of return, the former AA, which now becomes the DA for the return trip, can take advantage of knowing the luggage information of U and his history to further optimize operations.

In the post travel phase the bookmarks saved on the PDA are uploaded and made available to the desktop environment. He decides to share his experiences made with the MM and his palm friend's community.

All payments marked so are traced and, at the end of a trip, a cost claim containing eligible travel costs is issued to the business trip accounting unit and to the European Commission Project Officer.

III. ACTORS, STAKEHOLDERS AND BUSINESS MODEL

The following table lists the major actors in this scenario/use case and the most important relations.

Actor Name	Abb.	Role	Relationship with
User	U	End user of SMS Services	AL, MO,WI,CC, BA
SMS Travel Planner Service	SM	A service which assist U through all phases of the travel	
European University	EU	The U organization	
Chinese University	CU	The Organization U is visiting on this Flight	
Airline	AL	The Airline used for U flight	DA,AA,CA,
Mobile Operator	MO	U Mobile Operator	U, DA, WI
Wireless Internet Service Provider	WI	U Mobile Access Operator for WLAN	
Airport	AP, DA, AA	Departing, Arrival or Transit Airport	AL
AirCom Provider	AC	For example OnAir and AeroMobile	
Catering Company	CA		AL,DA
In Flight Entertainment	IF		AL, CP
Taxi Company	TX		
Multimedia Museum	MM	A Content Provider	
Airport Parking	PA		SH, DA,AL
Airport Shop	SH		DA
Advertiser	AD		DA,
Credit Card Validation	CC		
Bank	BA		U, SH, AL
Tax Authority	TA	Includes Duty Free Handling	
Content Provider	CP	Generic Content Provider	

Several business model for the airport domain [4] and for the in flight domain [5-7] have already been analyzed.

Fig 1. depicts the actors involved in this scenario, and therefore possibly involved into the related business model.

It is remarkable to note the large number of actors and the probable complex relationships between them.

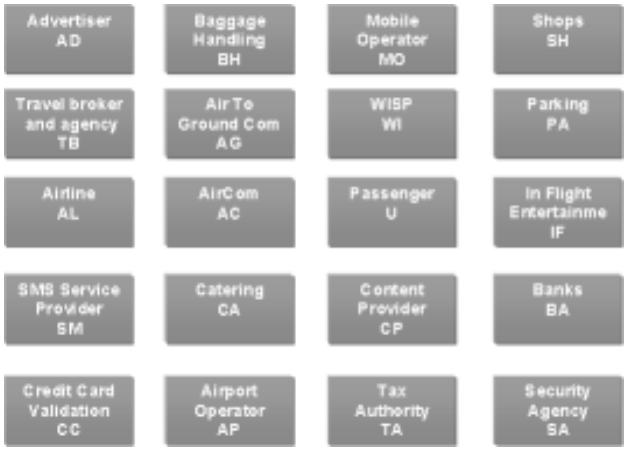
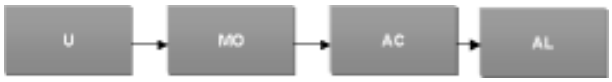


Fig 1 : Actors in Business Model

In the booking and ticketing process the business model is

In the airport shopping process, there is a direct transaction between the user and the shop, which then has agreement in places with the Airport. In this case we assume that there is no connection with the passenger flight information, therefore the shops require the user to show his boarding card to apply correctly taxation and tariffs.

The last two pictures show the relationships in the case of airport or during flight communication services respectively.



On-board cellular telephony involves several actors. The example above is the current used model by OnAir and AeroMobile. The passenger pays his Home Mobile Network Operator MO while roaming on the on board aircraft cellular network. Further transactions are between the MO and the AirCom Operator (OnAir, or AeroMobile) and between the AirCom operator and the Airline.

Internet Access as in the Connexion by Boeing Model was slightly different. Since there was no requirement to roam into an existing ISP User Network, the business model applied was as above.

In general the business model can be quite complex. The picture below shows a generalized relationship.

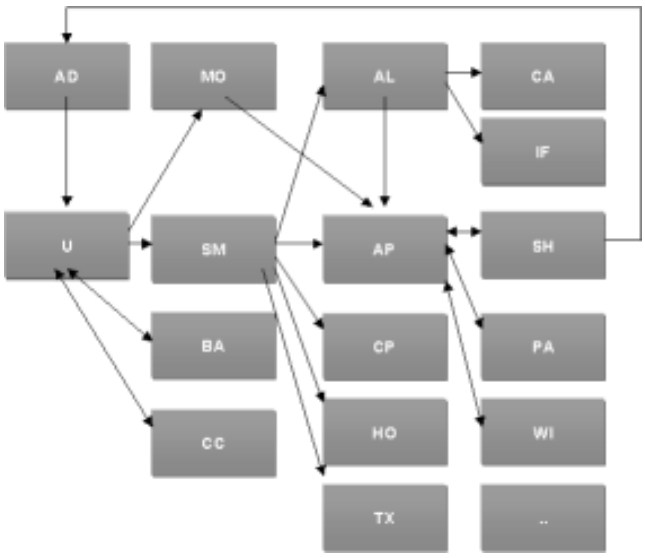


Fig 2: Business Relationships

The actors are divided into two categories: those who pay and those who receive money. In this model U and AD will only pay for services and all other actors will receive/pay.

Since the model involves business, it will be quite controversial. This is just an initial model and it is left for further study. The important thing is to identify requirements in terms of billing and payment that allow the implementation of such a model.

IV. CONTEXTS AND SERVICE CREATION PLATFORM REQUIREMENTS

During the travel experience the user changes a number of contexts. First of all, a context may have many dimensions. When the passenger travels he moves from an Office/Desktop/Fully Connected Context to a mobile with Laptop or PDA Wi-Fi or 3G Coverage environments, with likely GPS coverage. Spatial Triggering have been used to alert mobile networks when a user (or better a SIM) enters a certain area, and are used to trigger LBS activation.

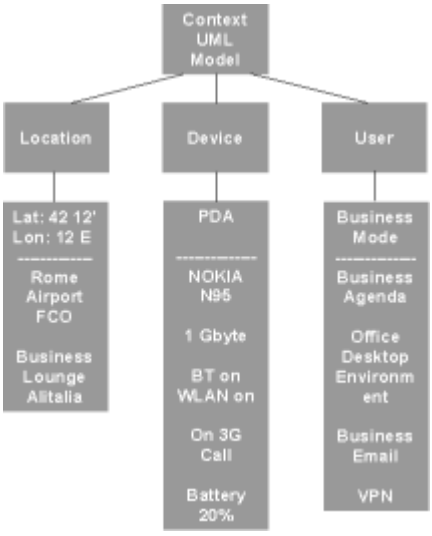


Fig 3.: SMS Context model

ContextUML is a UML based modeling framework to assist in the development of Context Aware Services [1]. Context information can be atomic as directly produced by a sensor (e.g. latitude, longitude) or composite, which contains high-level information (Athens Airport). The following sub-categories of context information and their attributes have been considered in the SMS project so far:

User
- context information about single persons/users; attributes could be collected in a user profile
- name, age, sex, job, demographic, payment details, preferences, activities, hobbies, languages, …

Device
- context information about (mobile) computing devices; attributes could be collected in a device profile
- type, input, output, display size and resolution, memory, processor, software, operating system, wireless interfaces, connectivity protocols, service, service type

Location
- absolute, relative, semantic, virtual, orientation, …

Network
- type of connection, data rate,

Security/Privacy
- authorization, passwords, accepted protocols, connection ports, sensitive info

Date/Time
- virtual, time zone, summertime, evening

Social Context
- Describes the social environment of service users.
- Business, leisure, with friends, active group

Physical Context
- Describes physical phenomena
- Weather, temperature, traffic, …

Service
- Describes (formal) properties of services
- Input, output, parameter types, …

Quality of Service
- Describes constraints of services and their provision
- Minimum bandwidth required, minimal computation capacity, end-user perceived response time, image quality, streaming quality, freshness, relevance, timeliness, history

Payment
- Credit Card, Credit Bonus, prepaid accounts, postpaid accounts, loyalty points

Context Change Triggers are a way to react to context state transition for the purpose of creating, deploying or activating a service.

V. CHARGING ARCHITECTURE FOR SMS

Fig 4 depicts the elements required to support real time charging in an SMS Service environment during the flight phase of the travel.

The architecture below is simplified and just depicts the functional nodes involved when the passenger uses the

airport or on board WLAN access services for Internet access. Actors Contract Management and SMS Creation node are defined as Front Office Applications, since they are performed before the actual service delivery to the passenger. Similarly, Postpaid Billing and CRM including statistical data analysis and settlement and revenue sharing are considered Back Office Applications. [7-11]

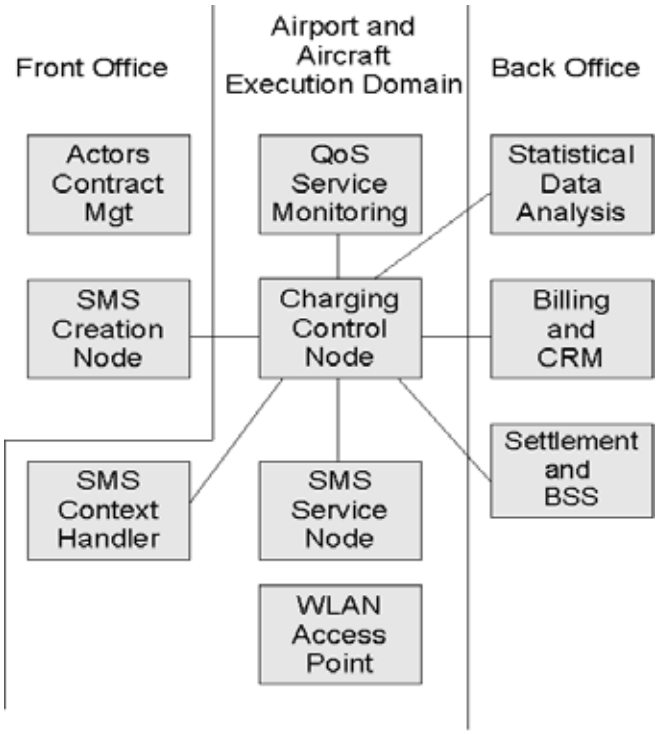


Fig. 4: SMS Charging Architecture

Finally in the airport and aircraft domain, we have SMS service nodes, i.e., those that provide SMS Services. They are interconnected to a real time Charging Control Node (CCN) using the charging application on top of the Diameter protocol [2-3], an IETF standard adopted by 3GPP for charging, being an evolution of the RADIUS protocol, which is widespread also for charging in ISP environments. Charging control information as well as SMS contexts and QoS data are sent from the SMS node to the CCN. CCN performs rating based on service and context data and returns service parameters or authorization to the SMS Service Node. CCN also is connected to a BSS node (Billing System) for postpaid processing, to a CRM or customer Data warehouse node for statistical analysis, loyalty and marketing purposes and to a Settlement engine to bill and settle with all the value chain partners according to the contracts in place.
CCN also sends warning of low account value to the SMS service node, should the user accounts become insufficient to provide the on going services.

VI. Conclusion

We have discussed business models and charging architecture for advanced services in a commercial flight scenario for passengers. The charging related nodes, context handler and QoS nodes are critical for a real time implementation of the business model in a multi actor environment.

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