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Integrated Passenger Service System for Ideal Process Flow in Airports

***Abstract**. According to Simplifying the Business (StB) program initiated by IATA, an airport can offer passengers all travel-related services such as departure, transit, arrival, interchange, travel planning, etc. As the information system coping with the expansion of airport services, Integrated Passenger Service System (IPSS) focuses on the full integration of various information resources and ensures the smooth communication between passengers and the airport, which is based on SARI (Service, Application, Resource and Infrastructure) architecture.*

***Streszczenie.** Przedstawiono zintegrowany system serwisowy do analizy i kontroli procesu obsługi lotniskowej. \Bazując na zebranym zestawie danych system umożliwia prostą komunikację między pasażerem a lotniskiem. (**Zintegrowany lotniskowy system serwisowy do analizy danych i ich przesyłu**)*

Keywords: SARI; Integrated Passenger Service System (IPSS); Airport; Simplifying the Business (StB); Ideal Process Flow (IPF)
Słowa kluczowe: system lotniskowy, przesyłanie danych.

Introduction

With business expansion and change in management philosophy, airport passenger services evolve from a simple check-in or arrival step to full range of services covering the whole trip such as departure, arrival, transit, interchange, travel planning, etc. so the airport information systems should support a well communication channel between passengers and the airport throughout the travel process, providing more convenience to passengers for more comprehensive services, giving passengers a better travel experience, improving customer satisfaction and loyalty.

For most airports, optimization of passenger service process within the airport is relatively limited, but there is still huge room for improvement in external process. The usual services provided within the airport can be extended with the expansion of IT systems. Such expansion not only strengthens the communications between the airport and the passengers directly, but also enlarges the airport's transport capacity and route network indirectly. It increases the airport's service area, making the airport's virtual boundary extended from the original departure and arrival place, and creating ideal conditions for new business development of the airport. This is in accordance with the objective of Simplifying the Business (StB) and the Ideal Process Flow (IPF) promoted by IATA, ACI and other related organizations in recent years.

Information Silo

The existing information systems of an airport are introduced gradually through the process of continuous development, and are mostly specialized to meet specific needs. Since technology in the early days had considerate limitations in security measures and transfer rate, and with comparatively high cost, systems were introduced and updated based on immediate needs, following the principle of reciprocity for costs and benefits, which objectively caused the limitations of application of technology.

With the development of businesses and the increasing importance of IT in airport management, this isolated state of operation can no longer satisfy the requirement of present passengers. Without the adoption of unification information systems planning, such IT systems were created in a disordered, duplicate and localized manner. In fact, integrated architecture of IT did not exist. All systems operate mostly in isolation, which commonly known as information silo or information island, as illustrated in Fig.1.

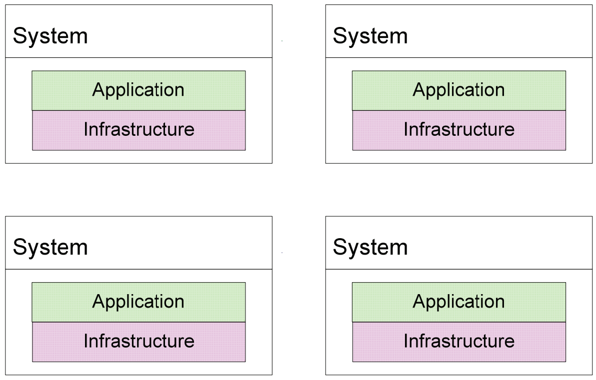

Fig.1. The Stand-Alone Information Silo

The above figure can also be considered as an IT architecture operated in an isolated state. The major problems include the following.

Inconsistency of system objectives: All systems were created based on the needs raised by different organizations or departments at a particular period. The system objectives were based on the interest of individual business units, rather than the overall organizational development goal.

Lack of technology standardization: Since there is a lack of overall integration planning, the network, hardware and software of all systems are proprietary. Each system has its own technical standards, operating procedures and maintenance team. System interoperability is poor.

Poor access to information exchange: Information exchange among different business units or systems cannot be done in real time. Many areas rely on manual operation. Duplicate data entry will not only lead to increased operational costs but also increased risk of error occurred.

Difficult to eliminate potential risks: Uniform network management and monitoring measures do not exist in stand-alone systems. Potential risks are thus greater. Specialized networks can only achieve equipment level security management and low level of fault tolerance mechanisms. Security is entirely determined by equipment. If hardware failure occurs, it may lead to paralysis of their network, and may affect the operation of other systems.

Potential security problems: The lack of a centralized security management means it is unable to uniformly manage the network, data, business and incapable of identifying network and user activities. As the network edge security facilities are inadequate and terminal technologies are of different standards, security incidents are invisible, uncontrollable and cannot be prevented.

Data storage problems: Storage methods and standards of all business systems are inconsistent. There is a lack of data reliability and resource sharing is insufficient. The lack of high availability storage system is not conducive to the establishment of a uniform backup and disaster recovery system.

Definitely, these problems hinder the achievement of full Informatization in airports. Following the rapid change of business environment and vast increase of IT technology, IT architecture must transfer to the model with uniform system application, centralized data storage, unified IP-based network and comprehensive security control mechanism for effective and intelligent decision support.

4-Layer Architecture (SARI)

The daily operation of an airport involves in many different business systems. Since the various applications are developed at different times, the technical standards are inconsistent and come from different vendors. It thus adds more difficulties and cost to system integration. Besides, the integration of two systems from different platforms will cause decreased flexibility to the system. For some outsource systems, integration plan may need to be changed because of the software update from the supplier. Moreover, data exchange among different business processes is sometimes temporary and implementing specific integration plans for them may be inefficient.

Aiming to attain an IT architecture which allows facilities sharing, data sharing, applications integration and services unification is a great challenge for planners.

1. General description

Therefore, system integration while maintaining existing applications through the establishment of a common platform is a more reasonable alternative. Resource Layer and Service Layer can be added to traditional architecture. The Resource Layer implements centralized data transfer, backup, storage and disaster recovery mechanism. The Service Layer implements message interchange and transmission, forming unified communication with external parties and remote applications, as shown in Fig.2.

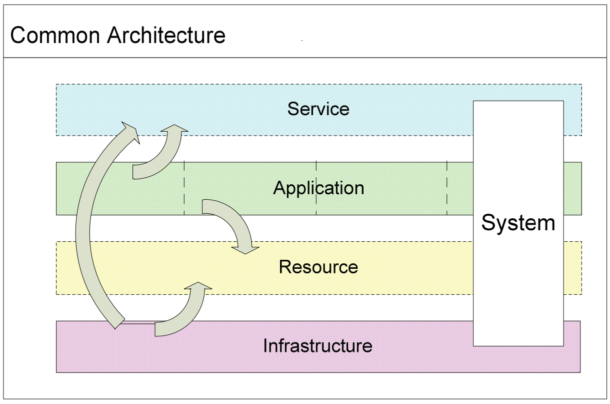

Fig.2. 4-Layer Architecture (SARI)

This 4-Layer architecture includes: Service, Application, Resource and Infrastructure. Taking the first letter of each layer, it is known as "SARI".

2. Advantages of SARI architecture

SARI is the architecture that adapts to the requirement of reengineering strategies. This architecture adds the two layers Resource and Service based on the traditional architecture and enhances its integrity, flexibility, scalability and operability.

Integration and sharing are the core principles of SARI. SARI is for the establishment of a true share-based technology platform, providing full support to various business processes and achieving a comprehensive information resources sharing. Compared with traditional architecture, SARI has the following advantages:

Facility sharing: In the Infrastructure Layer, through the unification planning of infrastructure, the transition from simple interconnection to the integrated network based on IP standard reduces network complexity, enhancing benefits of traditional architecture.

Data sharing: Physically integrating the database hardware and network resources in the Infrastructure Layer and logically centralizing the data resources of application systems form a separate Resource Layer. Unified data storage, backup and disaster recovery mechanisms are built on this.

Applications integration: Various application systems are integrated in accordance with business process optimization purposes. Data is consolidated through the Resource Layer. Messages are integrated through the Service Layer. On the one hand, effective interaction among systems is achieved while system flexibility and independence are maintained.

Services unification: Various applications are unified into browser-based user interfaces, improving the ability to interact with the outside. Communication channels with the outside are integrated, forming a unified communication channel and reducing the confusion and disorder that may arise during the interaction with external parties.

3. Applying SARI to enable IT process re-engineering

When applying SARI to airport’s IT architecture, it is necessary to conduct great changes to the existing IT operations. The original fully-decentralized mode of operation has to be altered to a combination of centralized and decentralized mode. In business processes, the implementation of SARI requires all issues related to application of IT to be integrated as a single business process, providing uniform support and services to other business processes.

Through the establishment of overall IT planning, development, upgrade, management and maintenance of IT facilities of each business unit can be improved. Lack of interoperability is eliminated. Clearly identifying the responsibilities of all businesses helps in upgrading the management abilities of IT service providers and enhancing communications among IT personnel.

Technical standards, specifications and daily maintenance mechanism for an organization are important elements for setting up IT architecture. An airport has various types of information systems. To ensure smooth and effective communications among systems, an integration standard must be established. Two aspects have to be considered. First, assure self-standards for hardware, software, data storage and network protocol. Second, adopt common standards such as international standards, regional standards, national standards, industry standards and organizational standards. The combination of the two aspects forms a single standard system.

Unified maintenance mechanism is an important part of IT architecture. It includes the development of technology maintenance system and support team. Technology maintenance system includes maintenance and updates on all hardware, software, networking and related extra low voltage systems, as well regular training to system users. Support team building includes all aspects of IT human resources, creating an atmosphere for harmonious communications, resource sharing and collaboration.

Integrated Passenger Service System (IPSS)

As the information system to support the passenger service process, Integrated Passenger Service System (IPSS) focuses to fully integrate the various information resources, and broadcast information to passengers through various channels timely and effectively.

At the same time, since this business model involves many areas of the airport's e-business, some platforms should be established or integrated to ensure smooth realization of specific businesses and efficient operations. Based on the IT architecture - SARI, IPSS's system framework is shown in Fig.3.

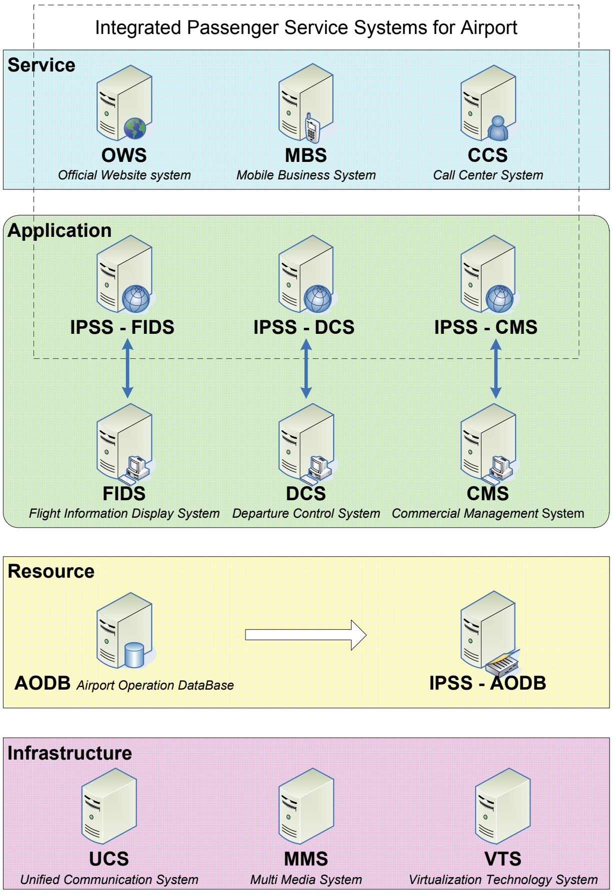

Fig.3. IPSS based on SARI Architecture

IPSS is not an independent system, but the portfolio of applications. IPSS-AODB, IPSS-FIDS, IPSS-DCS and IPSS-CMS are a collection of systems established based on the original system at the airport. These systems can utilize similar application architectures such as Airport Operations DataBase (AODB), Fight Information Display System (FIDS) Commercial Management System (CMS), Departure Control System (DCS), etc.

With adoption of SARI architecture, all of the sub-systems can share resources like public facilities, networks, data storage, disaster recovery, maintenance mechanism and team unification. Other systems include Unified Communication System (UCS), Multi Media System (MMS), Virtualization Technology System (VTS) and etc., shown in the fugue may need to be redeveloped and upgraded from existing ones. These modules can support not only IPSS but also other supporting services within the airport.

Based on gradual improvement, IPSS-FIDS can be developed into comprehensive information dissemination and passenger query system. IPSS-DCS can be developed into a consolidated passenger business processing system. IPSS-CMS can be developed into a comprehensive passenger e-commerce system, and IPSS-AODB can be developed into a comprehensive database or data warehouse to support operation and management of the airport. The overall IPSS will eventually become the airport's integrated passenger service system.

Due to the openness of IPSS, the system can be applied not only to the existing airport service, in which some or all of the features can also be used for off-site traffic sites, hotels, exhibition and other partners' workplace.

Infrastructure Layer

The Infrastructure Layer provides uniform support to all other layers. It exists as a physical platform for sharing among numerous processes and systems, mainly including network and sharing equipment.

The network part of infrastructure is a campus network made up of wired, wireless and specific networks, involving various types of cabling and related software and hardware. With the integration of campus network with external networks, adopting VPN and VLAN technologies form virtual networks that support the operations of various systems.

Based on the concept of interoperability and through the establishment of a single technology standard and specifications, integrate related networks gradually according to unification planning. Apply uniform management on all external connection and centralize them physically, forming a genuine infrastructure sharing platform.

As technology advances, normal airport facilities can be reformed based on IP technology, such as automatic identification equipment, camera, cable TV, broadcasting system, transmission media, communication device and etc.. With IP technology, such equipment is able to operate on airport's public network. Data transmission does not rely on specialized networks. Meanwhile, it also means that such equipment will no longer be monopolized by a particular system, but can provide support to multiple information systems and business processes.

The continuous advancement of related technologies merges computer network, telecommunication network and cable TV network into a single IP-based computer network. The application of facilities transforms to a new model based on IP-based network and its coverage will also extend along with the expansion of this single public network.

Due to versatility and broad applicability, these facilities can support multiple information systems and business processes. With virtual network and virtualization technologies, infrastructure can be flexibly and dynamically segmented into different zones for undertaking different tasks and supporting information access, transmission, distribution and control of different information systems and business processes. The overall operation efficiency and cost effectiveness of an airport are thus enhanced.

To share common hardware platform by multiple systems can not only improve the utilization of resources but also increase the flexibility of system upgrade and migration. Unified deployment of resources reduces management complexity and system maintenance cost. It also indirectly brings environmental benefits.

Resource Layer

The Resource Layer represents essential asset and core competence of an airport, including the central database, various data warehouses and associated storage, backup and disaster recovery mechanism. It is the virtual infrastructure shared by multiple business processes and application systems. In practical implementation, it consists of the software, hardware and specific network (for storage, backup and disaster recovery), data format and data interface standard of AODB that supports daily operations and Airport Management Data Warehouse (AMDW) that supports management tasks.

AODB is the main information resource to support airport operation and act as the core system of the airport's daily operations. Other related data and information can be added into AODB, so as to allow the IPSS-AODB to play as the role of integrated information resource to support passenger service.

IPSS-AODB may include: Local airport flight information (from AODB) and transport information; Local transport, business and tourism information; Flight information and transport information of destination airport; Flight information and transport information of neighbour airport; Transport, business and tourism information of the periphery area and other cities; Immigration and customs information; Information on weather and exchange rates.

In technical implementation, IPSS-AODB may physically separate from the existing AODB, but both can still use the same technology, data storage and disaster recovery mode. A corresponding connection mechanism can be established between the two databases and AODB can be regarded as one of the data sources of IPSS-AODB.

From the view of information flow, the amount for various traffic and business travel information is much greater than that of flight information, and the source is complicated with numerous formats. Therefore, beyond technical issues, IPSS-AODB establishment need to settle mechanism of information gathering, validation, standardization and update by a dedicated team to response for the relevant operation.

With the information content of IPSS-AODB enriched and improved constantly, IPSS-AODB can be developed into a comprehensive database or data warehouse for the airport and partners to support their operations. In addition, the great amount of information content can enable the new business of the airport like database marketing, developing the data products, as the new profit growth point of the airport non-aviation business.

AODB and AMDW have strong relation. The former is the major source of data for the latter. Both databases, based on the same database technology, require physical centralization on storage, transmission and backup. Both of their data come from many different information systems and need to be logically centralized for effective sharing. Either physically or logically, AODB and AMDW is not a single database, but a database system constituted from a series of subject databases.

The difference between AODB and AMDW is that once the subject database of AODB is confirmed, it will exist on a long-term basis and will not be easily modified. On the other hand, the subject database of AMDW can be dynamically modified according to various needs. AODB stores only internal data related to business operations. AMDB includes not only internal data, but also collated external data. From the data backup and disaster recovery point of view, AODB is of higher significance.

Application Layer

The difference with the other three layers as a common platform is that the Application Layer can be regarded as a collection of applications. The Application Layer is a distributed structure. Each system can be flexibly configured, allocated or upgraded according to business needs, preserving the flexibility, changeability and scalability of system formation.

Systems in the Application Layer can be grouped according to business processes. In general, System amendments can be done in this layer due to adjustment or recombination of business processes and will have no influences on other layers or the overall IT architecture and.

Classification of application systems correlates closely with business processes. Within business processes, various related systems should be gradually integrated into a single system. Data exchange and message transmission between business processes are achieved through the Resource Layer and Service Layer.

Applications can be classified into stand-alone systems and shared systems. Stand-alone systems complete tasks within departments or an organization, and can be allocated according to the actual situation, as long as it conforms to the standard of the Infrastructure Layer.

For shared systems, as they involve multiple departments and business processes, it is necessary to conform to the standards of the Infrastructure Layer, Resource Layer and Service Layer. Such systems have to be planned and managed at the level of organizational strategy.

1. Improvement of Information Dissemination Channels

Airport Flight Information Display System (FIDS) is often used to release the taking off and landing airport flight information, which is the major communication channel between airport and passengers. IPSS-FIDS implementation can be extended based on the existing FIDS platform, sharing of proven technology, campus network equipment resources and maintenance mechanisms of the FIDS on the one hand, and providing more comprehensive and detailed information services to more people through add-on channels on the other hand.

In terms of technical architecture, IPSS-FIDS mainly originates from AODB or IPSS-AODB, with FIDS network expansion and technology updates, making the function of IPSS-FIDS continuously enriched and improved; and information dissemination methods can be the traditional way of screen display, through the airport's official website and partner's sites. Together with the functions of network information inquiry and multimedia terminals, IPSS-FIDS may be developed to be an integrated passenger information system.

IPSS-FIDS and FIDS can share with all of the display terminals, according to the location difference to display different contents, change and update dynamically. For content of information display, not only flight information, but also various types of transit traffic information of the local or destination airport, such as city's ships, trains, buses and weather, foreign exchange premium, local news and business, tourism and other comprehensive information.

IPSS-FIDS can also combine with the mobile service platform, integrate customize information and push functions for visitors to provide personalized information services.

Furthermore, the airport's advertising system can be combined with the IPSS-FIDS, sharing the network and facilities which coverage includes the airport and other areas of traffic and tourist facilities, making IPSS-FIDS an ideal platform for advertising. Extensive and targeted channels of information dissemination can expand the airport advertising business to explore ways to bring more advertisers to the airport.

In addition, through the cooperation with relevant government departments, the potential of the system may be fully exerted, making more people understand and familiarize with the airport and the city, and creating a publicity image of the airport and the city. This way also creates the platform to raise the airport's popularity.

2. Optimization of Service Processes

Passenger check-in is the major focus of passenger service. The ultimate aim of passenger service optimization is to provide better integrated services. So the airport DCS must accommodate with it, extend the original value of the local services, and establish IPSS-DCS to match with the new business model.

In function realization, IPSS-DCS not only supports the local airport check-in service, but also supports other check-in methods，like self-service or remote service. The system not only provides single step passenger services, but also provides comprehensive services covering the overall trip of the passengers, like remote hotel check-in and check-out services.

Local check-in support: Local check-in support includes counter check-in, mobile check-in, self check-in, web check-in and off-site check-in, providing a variety of services for visitors. All of the new check-in methods can be supported by DCS or IPSS-DCS. Through IPSS-DCS, there may be even more flexibility, and it may have less influence to the daily operations of the airport.

Remote check-in support: Remote check-in can be carried out by cooperating with the airlines and other partners. IPSS-DCS should have open interfaces to connect with partners' systems. It includes supporting remote check-in in local airport and transit services in departure airport.

Other business support: Other support includes various services like tickets, reservations, baggage for aviation, ships, trains, coach, etc. Furthermore, IPSS-DCS may support similar services in hotels, attractions, exhibitions and performances. All of these service supports can be achieved in the airport or partners' sites.

In technical realization, IPSS-DCS is no longer confined to traditional departure control functions, and in fact it has expanded to an integrated travel business processing system, and with DCS, IPSS-AODB, IPSS-FIDS formed an integrated passenger service system. Moreover, in response to the needs of passengers, the system may connect to reservation system, security system, baggage system, and other relevant systems.

3. Integration with Commercial Management System(CMS)

IPSS-CMS may update from the existing CMS to support more businesses including traditional business and e-commerce. Most of the services in passenger service process are reservations, ticketing and payment services. The service implementation depends on the existing facilities of the airport and partners, in which the payment and cash flow need IPSS-CMS's support.

Passenger service is the main income of the airport. Based on the rich information resources of IPSS, the functions of travel plan management for passengers can be incorporated into IPSS-CMS to expand the airport's non-aviation business income. Business travel planning service is to help individual or group passengers to arrange their business trip, including ticket booking, car rental, hotel accommodation, venue arrangements, travel document applications and other related services. This service can save customers' time and offer them more reasonable prices. Through the service, customers can receive the appropriate travel itinerary, save their travel cost, bring new revenue for the airport, and obtain better arrangement on airport services.

IPSS-CMS can act as the common platform to integrate the systems of airport and partners, to expand the airport original value chain to cover the entire process of passenger travel, transit, staying and return. The whole process should cover airlines, travel agencies, hotels, attractions, convention, exhibition and other various related industries. Through travel plan management services, airport and its partners can get the passenger travel information earlier, resulting in a more rational allocation of resources arrangement and more effective operational plans.

Service Layer

The Service Layer plays an important role in the architecture. It is the platform for integration of application interface and information, as well the communication channel between an organization and its business partners. Remote application of business operation system, call centers, office automation and knowledge management can be implemented based on this platform.

The Service Layer consists of two main parts: the Enterprise Service Bus (ESB) and public service platform. The former completes the integration of messages and interfaces of the Application Layer, and acts as the latter's technical support platform.

Public service platform combines all remote services and information broadcast function of the Application Layer. By associating e-commerce and remote collaboration technologies, it acts as an application platform to business partners and customers, providing online services, information sharing, remote applications, collaborative office and e-commerce facilities.

The realization of the above-mentioned functions is an important measure to expand an airport's business. In addition to providing physical facilities, an airport and its partners can offer corresponding virtual services thru websites, etc. The implementation of most systems has to integrate with the airport's website, mobile service platform, unified communications platform and electronic payment platform for supporting comprehensive e-commerce services.

An airport's website, mobile service platform and call center can be integrated into a common communication platform for the airport and passengers throughout their whole journey.

To achieve instant access, consistent provision and integral content of information and so on, an airport should integrate its own resources with partners' to establish a unified call center. Meanwhile, the modern call center which is a combination of telephone, computer network and other related technologies is a communication platform for passengers. The airport can also share the call center with its partners by interfacing with their information systems.

The establishment of a unified call center enables passengers to easily obtain the right information on the right time and strengthens the communication effectiveness between partners. The call center requires an IP-based communication platform which supports its operation and is also the core component of the airport common infrastructure.

Integrating passenger communication platforms is an important way to extend airport services. If online and mobile services are available, many passenger services such as ticketing, check-in, shopping, communication, etc. can be completed through these virtual resources. Since the service location and time are no longer limited in the virtual space, costs of airport operation and passenger journey will be reduced and service satisfaction will be improved as well.

Conclusions

From the perspective of airport operations, the optimization of passenger service process is a result of an airport's own strengths integrating with its partners' resources. IPSS can be implemented with little change of current business processes and without large amount of investment. All application systems in IPSS are not actually brand-new but extension and integration of current systems. New systems extended from current systems can be developed by referring to present application architecture, data storage, disaster recovery and maintenance mechanisms and sharing of existing facilities and support team, which will not cause technical bottlenecks and difficulties during implementation.

The core principle of SARI architecture is integration and sharing. SARI architecture is not of great concern to the pursuit of the most advanced technologies, but the selection of the right one, the decision on the most appropriate combination of technologies, and the effective use of relevant technologies. More importantly, SARI architecture should be concerned with the series of problems brought by changes in optimization of business processes.

The key point of IPSS implementation is to effectively integrate passenger service processes and the associated information resources, and hence forming an information sharing platform for an airport, partners and passengers. With sufficient information, passengers are able to plan their journey in advance. During the whole journey, they can obtain the latest relevant information for next stop, such as choice of services and its provider, time, location, etc.

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