The Shanghai Pudong International Airport project

An Airport & System Summary by ADT Security China
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Background

The Pudong International Airport is located on the east side of Shanghai, covering an area of 40 km$^2$. It is about 30 km away from the city center and about 40 km away from the Hongqiao International Airport, located on the west side of Shanghai. The airport is located around 30 km south-east of the bustling Shanghai city centre.

Shanghai Pudong International Airport is a major hub for cargo traffic in the world. With 2,989,795 metric tonnes handled in 2008, the airport is the 3rd busiest airport in the world in terms of freight traffic. A total of 28.24 million passengers passed through the airport in 2008, making the airport the 3rd busiest in the People's Republic of China. However, it handles more international passengers than Beijing Capital International Airport. It is currently the busiest Chinese airport in terms of international passengers handled, with 17,518,790 international passengers handled in 2007, a 9.0% increase over the previous year.

The airport is the main hub for China Eastern Airlines and Shanghai Airlines, and a major international hub for Air China. Pudong airport is organised around two main passenger terminals, flanked on both sides by three parallel runways.

A station for the Shanghai Maglev Train is sited between the passenger terminals, providing the world's first commercial high-speed maglev service to downtown Pudong in 7 minutes and 20 seconds. The airport is open 24 hours per day, one of only a few Chinese airports to do so.

Currently, Pudong International Airport has accommodated average aircraft movements over 400 times per day, already accounting for approx. 60% of the total aircraft movements of Shanghai. And it is serving for about 50 domestic and foreign airlines, connecting with over 90 international and regional destinations and 60
domestic destinations.

**The Decision To Build**

Prior to the establishment of the Pudong International Airport, Hongqiao International Airport was the primary airport of Shanghai.

During the 1990s, the authorities looked into expanding the Hongqiao Airport in an attempt to meet the ever-growing demand for air travel. As the urban area surrounding Hongqiao was developing significantly, expansion of the Hongqiao airport could not be carried out without major disruption to the area.

As a result, the government had to seek an alternative for Hongqiao International Airport to take the load of all of its international flights. A suitable site was along the coast of the Pudong development zone to the east of Shanghai.

The airport opened on October 1, 1999, officially replacing Shanghai Hongqiao International Airport as Shanghai’s international airport. As originally planned, it took over all of its international flights, including regional flights to Hong Kong and Macau.

Phase I of the airport began construction in October 1997. It took about two years to build at a cost of RMB 12 billion (1.67 billion USD). It covers a total area of 40 kilometers square. Phase I of the airport has one 4E category runway (4000 m x 60 m) along with two parallel taxiways, an 800,000 m$^2$ apron, seventy-six aircraft positions
and 50,000 m² cargo warehouse. It is also equipped with navigation, communications
and surveillance systems.

**The Need To Expand**

In 2004, the airport handled nearly 500 flights per day, carrying more than 21 million
passengers per year in and out of China's most populated city. Shanghai Pudong
International Airport was ranked sixth-busiest in terms of cargo traffic, and 28th in
terms of in international passenger traffic at that time. It was also ranked 40th in
Passenger traffic, carrying 26,790,826 passengers in and out of the airport. It was the
eighth-busiest airport in Asia in passenger traffic.

The second and third runways were opened on March 17, 2005 and March 26, 2008
respectively, and a fourth runway is being tested for use at the moment.

Shanghai Pudong International Airport had recently experienced massive increases,
thus never falling below a 10% growth rate of cargo. From 2002–2003, it had seen
near double growth of cargo traffic; 87.3% in that period. From 2002–2006, it has
risen from 26th place to 6th place in cargo traffic, with cargo traffic tripling since 2002.
In 2006, it had a growth rate of 16.8% while Narita (Tokyo) experienced a -0.5%
decrease and Incheon with an 8.7% increase. It may surpass Narita International
Airport within a few years and Incheon International Airport to become fourth place in
terms of cargo traffic. The possibility of overtaking Hong Kong International Airport,
currently the busiest cargo hub in Asia and second-largest in the world, is likely in the
near future. Complementing that, UPS and DHL will be adding hubs in the next few
years and therefore, Pudong will become the first airport to have two international
cargo express hubs.
Pudong International Airport Terminal 2 - View from afar

Terminal 2

Pudong sees many aircraft movements during rush hour times, resulting in most planes having to park on the apron. To alleviate this, construction of Phase II (including a 2nd terminal, a third runway and a cargo terminal) started during December 2005 and was fully complete in time for the Beijing 2008 Summer Olympics. The architects of Terminal 2 chose to use many world-renowned interior finishes such as Bentley Prince Street and Brinton carpets for this new terminal.

Terminal 2, located behind Terminal 1, opened on March 26, 2008 (same day as the official opening of Terminal 3 at Beijing Capital International Airport), adding an additional capacity of 40 million passengers a year. Once Phase II is fully completed, it will give Pudong a capacity of 60 million passengers and 4.2 million tonnes of cargo annually. A transportation center will be added to connect passengers between Terminal 1 and 2 in the near future. A total of 33 airlines now operates in Terminal 2.
**Scale & Vital Statistics**

The airport had 28 boarding bridges along with 127 parking positions and with a tarmac of 1.49 million square meters prior to the opening of Terminal 2. It also has two runways; the 4000-meter runway on category 4E and the 3800-meter runway with a category 4F rating, able to handle the Airbus A380. It is also predicted that the third runway will be on a 4F rating.

**Inside Terminal 2**

Terminal 1 is shaped like Kansai International Airport's terminal, but it is shorter and with 28 gates, 13 of which are double decker gates. The exterior of the terminal is shaped like waves. The capacity of Terminal 1 is 20 million passengers. It currently
The Shanghai Pudong International Airport Project has 204 check-in counters, thirteen luggage conveying belts and covering an area of 280,000 square meters.

Terminal 2 gives a capacity of 60 million passengers and 4.2 million tonnes of cargo annually. Terminal 2 is shaped like the 1st terminal but it has more of a seagull shaping, rather than a wave shape and is slightly larger than Terminal 1. Terminal 2 will be used for Air China, Shanghai Airlines and other Star Alliance members but it is known that some SkyTeam and Oneworld members will relocate their operations to the terminal.
The Grand Scheme of Things

Current airport masterplans call for the building of a third passenger terminal, a satellite terminal and two additional runways by 2015, raising its capacity from the current 60 million passengers annually to 80 million, along with the ability to handle six million tonnes of air freight.

The master plan calls for a total of three terminals, two satellite halls, and five parallel runways, ultimately for a capacity of 100 million passengers per year.

The next ambitious expansion, includes the addition of the fourth and fifth runways, a Satellite concourse, larger than the size of both of the current terminals combined, and additional cargo terminals will expand the size of Pudong International Airport. Land reclamation will be included for the fifth runway and some of the cargo terminals.

This next ambitious task is planned for completion by 2015. It will make Shanghai Pudong International airport one of the world-class airports in the world, becoming one of the world’s largest airports in terms of land area.
Phase I System Overview

The Phase I security systems involved both access control systems and Closed Circuit Television (CCTV) systems.

The main contract for the access control was between Tyco Fire & Security (then Sensormatic) and the airport. The access control system involves a redundant C•CURE 800 with Client workstations. The client workstations are operated by the Security Check Department of the airport.

There is a total of more than 100 units of apC control panels working with around 800 readers at about 500 doors throughout the airport. The main objective of having the access control system is for air-bridge access, personnel control and surveillance. This is achieved by the integration of the access control point with CCTV such that each time an employee tries to access a door, the event will be recorded, regardless of whether it is a successful or unsuccessful attempt. Other function of the access control system includes fire evacuation and badge printing.

The assignment of badges is controlled centrally by the Public Security Bureau (PSB). PSB programs the personnel data and prints the card. The card is then handed over to the Airport Security Department to assign the clearance level for each personnel.

As for CCTV, it was awarded to Tyco Integrated Systems (then Philips Engineering). The system employed was the Burle 8900 matrix systems with around 700 cameras in the field.
The illustration above depicts the system design during the Phase I of the project. During that Phase, there was a total of 4 badging stations in various locations. The PSB was primarily in-charge of the badging stations as it had to carry out due diligence for each new card applicant, before issuing the access card.

Each of the 8 workstations were centrally located in the control centre. Six workstations were manned around the clock and each would monitor over 30 critical doors.

The apC control panels were hardwired in 10 RS485 data bus and connected to the Server via 232/485 connections. Intergration with CCTV matrix switcher was handled.
by event initiation at the Server with data sent to the Matrix Switcher via RS232 data line.

The systems central server, badging stations and workstations are all communicating through TCP/IP network.

**Phase II System Overview**

![Illustration 2: System Design for Phase II](image)

**Illustration 2: System Design for Phase II**
The first system was completed in 1998. After the system was in operation for 3 years, the final acceptance by customer was confirmed by 2001. Shortly after the acceptance, ADT China was called in again to look into improving the system.

With the large volume of access events per day and the high requirement to have every event recorded at occurrence, the load on the server had to be separated for greater efficiency. There was also the problem of badging transactions taking up large amount of CPU resources on the server whenever it took place. This resulted in a lapse in the processing of access events and video footage by a few seconds after the access event took place. Though it was only a matter of seconds, the strict requirement that every transaction had to be done real-time meant that this shortcoming was not acceptable.

Hence, in order to resolve this shortcoming, ADT China managed to overcome it by making the following modifications:

a) To split the system into 2 different servers, each handling a different function. 1 of the server was dedicated for access operations and the other strictly for the purpose of badging. This is to overcome CPU processing time taken up when badging, affecting the access operations.

b) Added one card centralization database (modified after C•CURE Central with specific customer requirement, but developed from scratch in China).

With this modification, the system architecture remained the same on the access control operations part. However, on the badging side of things, the access details of each card holder go through a synchronization process. All new badge details will go into the central badging server. From there, using the Open Database
Connectivity (ODBC) software and the auto-import function, data is extracted from the badging server and automatically imported into the access control server. While the badging server holds all the database of the card holders, it is the Access Control Server that holds the access rights information and controls the whole operations. All 3 servers, the badging, Card Central and PuDong Terminal 1 server, synchronises with one another once every 24 hours and is dependant on one another through TCP/IP to ensure secured and smooth operation.

**Phase III System Overview**

![Diagram of Phase III System Overview](Image)

Illustration 3: System Design for Phase III
With the expansion to meet with the air travel demand for the Beijing Olympics and upcoming 2010 Shanghai World Expo, the decision to build Terminal 2 meant that the access control system had to expand as well.

Being a high profile project that granted the bid winner bragging rights, ADT China faced many competitors during the bidding process. In the end, even though our quotation was far higher than the cheapest bidder, we managed to secure the major portion of the access control project (To supply and install the access control software and controllers, hence the overall system testing and commissioning). This was largely because ADT China has managed to prove its capabilities over the years, being able to understand the airport’s unique requirements and needs, at the same time, technically competent to translate those requirements into a usable solution.
This time round, the airport called for a system that could work seamlessly with the existing Terminal 1 system. As the system was to be totally IP-based, the iSTAR controllers were used instead. The network-ready iSTAR controllers were connected via LAN to the Terminal 2 server. This LAN is being connected to the LAN of the original Terminal 1 system.

For CCTV integration, a external driver that based on ODBC and API was developed to send command code to the IP video system via TCP/IP network.

The badging database still resided in the badging and C•CURE Central database servers of the original Terminal 1 system.

Similarly, card database are downloaded to the Terminal 2’s access control server.

**Expansion of Hongqiao International Airport**

The Hongqiao International Airport is located in the western suburbs of Shanghai, only 13 kilometers away from the city center. For many years, it has always been an alternative name of Shanghai airport.

The Hongqiao International Airport has one runway (3400m by 57.6m) and one taxiway, about 486,000 m² apron and a total of 66 aircraft positions. It covers an area of 82,000 m², with 15 waiting halls, 18 VIP lounge and 15 luggage-conveying belts. Currently, Hongqiao International Airport accommodates an average of over 300 aircraft movements per day.
In January 2007, the Shanghai Hongqiao International Airport won state approval for a 15.3 billion yuan expansion that features a second runway and a new terminal. It will be an important part of the Shanghai Hongqiao-based integrated transportation hub. The hub is targeted to finish construction at the end of 2009 and be in service while the 2010 World Exposition is being held in Shanghai.

The growth plan for the smaller of the city’s two airports is expected to boost Hongqiao’s capacity to 40 million passengers a year by 2010. The expansion project comprises a 3,300-meter runway and a new terminal with an area of 250,000 square meters, plus new public facilities.
Phase IV System Overview

The next phase of the airport project involving the new Hongqiao International Airport calls for integration with the Pudong International Airport. The badging operation for both airports are to be working as one seamlessly system.

Building on ADT China’s previous experience in the Pudong International airport expansions, ADT China’s proposed system design is similar for the new Hongqiao airport. The new Hongqiao terminal, the West wing, will have its own server to manage its access and integrated CCTV operations through a LAN. The existing access and security operations of the old East wing terminal will also sit on the same
LAN. By establishing a Hongqiao card central database server and badging server, the airport will have an independent security operation that works in a similar fashion as the two terminals in Pudong.

This third LAN is then connected to the LAN where the original Terminal 1 system in Pudong is. Now, the Card Central database servers from Pudong and Hongqiao will synchronize the card database between themselves and with the local access control servers.

**The Project and the China Team**

The Shanghai Pudong International Airport project has been a significant project for the China team since the very first day ADT China bid for the job. From the project management point of view, it kick-started and helped develop ADT China’s capability to handle large-scale projects. It was also the first time ADT China worked on all aspects of developing a customized solution for the customer, which included developing customized software to integrate the various systems into a unified control system. The project also helped put Tyco’s name into the direct security contracting business and propelled our brand throughout the country as a reliable and trustworthy systems integrator.

**Looking ahead – Future Opportunities**

Talks about building a Pudong Satellite Terminal (S3) 3 kilometers east of the existing T2 terminal is already underway. The S3 will require about 100 readers and is scheduled for implementation, tentatively by the end of 2009.

The airport is currently looking to replace all HID readers in all the terminals in the future. ADT China has already presented the multi-technology card readers solution
to the authorities for consideration.

Apart from this, the authorities are looking into upgrading the old apC controllers in Pudong Terminal 1 and Hongqiao Terminal 1 to the iSTAR controllers. This further signifies the reliability and stability of our products and the airport’s trust in Tyco.

A Summary of Tyco’s work on the airports

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<thead>
<tr>
<th></th>
<th>No. of Controllers</th>
<th>No. of Readers</th>
<th>No. of Doors</th>
<th>Software Customization required</th>
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<td>Over 100 apC</td>
<td>800</td>
<td>500</td>
<td>Data centralization</td>
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<tr>
<td>Pudong T2</td>
<td>80+ iSTAR</td>
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<td>600</td>
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<tr>
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