Mission "Possible": DTV Surveillance Solution at National Taichung Theater

Site Name	National Taichung Theater
Country/City	Taichung, Taiwan
Industry	Public Facilities
Solution	DTV Digital Full-HD Integrated Solution
Solution Provider	Ubiquity Smart Technology Inc.
Reasons of Adoption	■Retrofit without recabling ■System Expansion by Daisy Chaining ■Long-distance transmission ■Full HD video quality ■Hybrid (IP/DTV) system
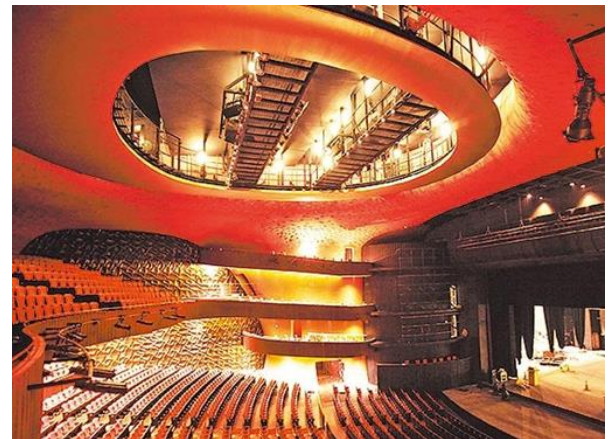
CUSTOMER NEEDS AND PROBLEMS

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壮大な宇宙の輝やきを間近に感じることのできる身体全体に訴えかける建築です。---伊東豊雄

Designed by Japanese master architect Toyo Ito for Taiwan, the National Taichung Theater is reputed as the "9th new world landmark"[1] for its bold design and construction difficulty. By introducing the concepts of natural caves and tree houses, Mr. Ito creates a building that can be accessed from every direction. The entire structure is full of curved lines and surfaces. There is hardly any straight line, right angle, or flat surface except the floors. It is arguably the first concrete building in the world without any column or beam. The design is so advanced and construction so difficult that it took a total of eleven years to finally finish on Nov 23, 2014. However, the challenge did not stop there as several problems led to the shutdown of the theater for additional repairs from Jan 1, 2015 and reopening on Sept. 30, 2016, after the problems were fixed.

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[1]The nine new landmarks of the world include the Freedom Tower in New York, Sea Orbiter on the Atlantic Ocean, Le Phare in Paris, the Absolute Towers in Canada, the Pabellón Puente in Zaragoza, Spain, the Hex Towers in Mexico, Le Centre Georges-Pompidou in Paris, the Louis Vuitton Foundation in Paris, and the latest addition, the National Taichung Theater.

At the time when the surveillance system was installed, 300k-pixel cctv analog system was the main stream solution and was selected. However, because the construction of the theater took too long, by the time the theater was ready for opening, dozens of cameras experienced degradation. Noises, "snowflakes", and ripples appeared in the videos. In addition, during the eleven years of construction, there were multiple events of international terrorism and random killing. The general public had greater demands for safety at public places. By reviewing the original design in 2004 with today's new criteria, several problems were found: (1) security blind spots were found at places such as rooftop garden and grand lobby, and more cameras were required; (2) some of the places had strong daylight exposure due to glass floor windows. The huge light contrast led to under exposure for indoor cameras. These surveillance issues had to be dealt with before the theater was reopened to provide a recreational space that is visually pleasing and safe at the same time.

DIFFICULITY OF IMPROVEMENT

What seemed to be a walk in a park became a nightmare to execute. The structure of the theater consists of 58 curved wall units. These curved wall units are constructed with a special construction technique. Steel reinforced bars are curved into a 3D shape and concrete was poured to create the 40cm-thick wall with curved surfaces in both sides. These units serve both as the vertical supports of the building and as structures to resist lateral loading, and they can further extend to form various domains and spaces. In a nutshell, it is like making Lego pieces and putting them together to make a building instead of the old-fashioned way by tying rebar and pouring concrete in place. The "Lego pieces" (curved wall units) were lifted and wedged together to form the almost one-piece architecture. Because of this special construction technique, all the wires and pipelines should be embedded when the units were made, including those for surveillance. It would be a daunting task to alter the wires or pipelines because (1) it is completely not an option to drill the wall in order to re-cable, for this may affect the structure safety; and (2) it is also not an option to install and expose the new cables, for this will definitely ruin the aesthetics integrity.

Requiring more cameras without drilling holes on the walls or exposing new cables; wishing intelligent surveillance for better security, while keeping as many existing old cameras as possible; these put together seemed to be a mission impossible. When the news of renovation request spread out, lots of surveillance manufacturers, system installers, and security companies were very interested in such a high-profile surveillance project of National Taichung Theater designed by the maestro, but every one of them backed out as soon as they read the specifications. The reopening was only weeks away and there seemed to be no solution to the security improvement project.

At the end, Taiwan's top security brand SECOM found Ubiquity Smart Technology Inc. (UST), who is a member of the ccHDTV Alliance. UST's "DTV Digital Full-HD Integrated Solution" could meet all the specifications stated in the bidding documents. With only SECOM entering the bidding, SECOM and UST joined force to fulfill the theater's requirement in every stage, including qualification review, technical demonstration, and field installation. With DTV, the aesthetics and audio effects of this grand architecture were preserved.

DETAIL OF DTV DIGITAL FULL-HD INTEGRATED SOLUTION

Accompanied by SECOM and the theater contractor, the solution provider UST did a field survey and proposed the following:

Integration with existing system: surveillance density and strength enhancement with existing cables

1. The outputs of the existing cctv cameras are analog signals, which deteriorate over distance. The farther the cameras are from the video servers, the weaker the signals are at the input of the video servers. Therefore, replace first those cctv cameras that generated poor signals at locations far from the video servers.

2. The outputs of the existing cctv cameras are analog signals, which are susceptible to ageing cables, low-frequency interference, and noise. In contrast, the outputs of DTV cameras are digital signals, which are immune to the above-mentioned factors. Therefore, replace next those cctv cameras that are seriously affected by the interference and noise.

3. At locations where there are surveillance blind spots due to insufficient cameras, add DTV cameras and combine the DTV signals into the existing coaxial cables with the readily available TV splitter. Thanks to DTV's unique "multi-video over on coax" feature that the aesthetics of the architecture is not compromised.

4. Considering green earth and treasuring resources, keep as many existing 300k-pixel cctv analog cameras as possible if they still work and add new 2-megapixel DTV digital cameras in between. Arrange the cameras such that every spot of primary and secondary passages and places are covered by one major and one supporting cameras. When something happens, it is possible to access videos from both cameras to determine what has happened and DTV's HD videos should be able to provide the key details.

5. In addition, for easy operation, use DTV AOC BOX to convert the analog signals of the existing cctv cameras into DTV digital signals. By doing this, the cctv cameras can also be managed by the DTV video servers and the system is unified.

Security improvement of the facilities

1. The lobby. Because of the large area, install 5-megapixel DTV fisheye cameras and PTZ cameras in order to reduce the number of cameras. This prevents visitors from overwhelming by the psychological pressure, while enhancing surveillance density and strength in the meantime.

2. The rooftop garden. There used to be no camera installed. Install 2-megapixel zoom cameras at key points and combine the signals with TV splitters to the existing cables to transmit video feeds to the video servers located at the basement.

3. Under exposure. The problem caused by indoor and outdoor light contrast is solved by DTV cameras with WDR (wide dynamic range) and BLC (backlight compensation). The two functions allow the cameras to catch clear images day or night, rain or shine.

4. TV walls at control center. The aggregated surveillance videos at the video servers are relayed through network to the control center. Images from hundreds of channels are shown on 4 TV walls through intelligent warning or pre-selected functions, allowing security staff a clear view of surveillance, fire protection, entrance access and alarms.

5. The P100 server. The powerful server features fisheye calibration, TV wall, disk hot swapping, hard disc array, hard disk extraction cartridge, digital image zoom in/out, instant alarm remider, and intelligent fast image retrieval. The integration of P100 with major access and alarm systems has already been done and ready to use. If the theater later decides to extend the service for better safety, these functions can be turned on quickly.

CUSTOMER BENEFITS

In a few weeks and with several simple steps, SECOM and UST successfully converted the analog surveillance system of National Taichung Theater into "DTV Digital Full-HD Integrated Solution". The videos are much clearer and the system is more reliable. The engineering work was done on time for a trial operation on Aug 26, 2016 before the scheduled reopening in September.

DTV products use ccHDTV chips developed and provided by ITE Tech. Inc.. The core of the chips is digital TV technology with functions designed especially for surveillance applications. In the technical aspect, the characteristics of digital TV transmission solved the difficulties of the theater's request to enhance surveillance strength without recabling. In the installation aspect, it took less time and there was no need to drill holes on the walls, thus saving costs. In addition, the budgets were saved significantly because (1) converting analog signal to DTV digital signal prolongs the service life of analog cameras, and (2) using fisheye and PTZ cameras, which have greater coverage, reduces the number of cameras. The surveillance server provides features including user-friendly interface, instant alarm reminder, fast image retrieval. Those features greatly improve the performance of surveillance system. In the future, with the integration of UST's server with other servers, it is possible to unified the control of access, alarm, and video surveillance systems.

Among all available surveillance technologies and product solutions in Taiwan and around the world, the "DTV Digital Full-HD Integrated Solution" is the only one that preserves 100% the design ideas of master architect Toyo Ito and his team and meet the tight schedule set by the National Taichung Theater.
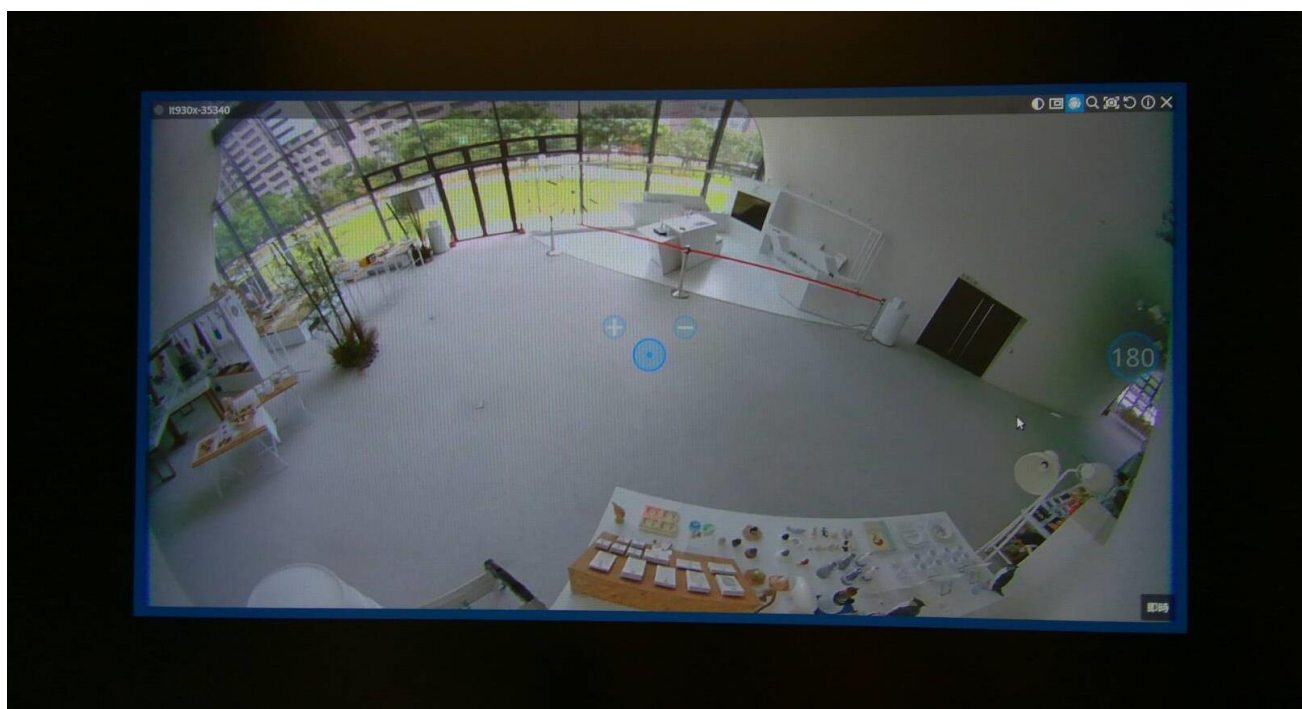

Figure 1. Images from the DTV digital Full-HD surveillance system.

Figure 2. The installed DTV cameras in the lobby and the rooftop garden.