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Enhancing Guest Experiences Through Smart Hotel Systems in the Hotel Industry in China: A System Integration Approach

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Abstract **-** "Better, Faster, and Cheaper" was the trend in both the hotel and the telecom industries in China, However, simply competing for the lowest price would not help either to survive a price war. Future Trees International Hotel (Future Trees), one of the biggest hotel operators in China, strove to win market share through a partnership with telecom operators. Through the partnership between hotel operators and the telecom operator, smart hotels had a competitive advantage over traditional hotels by offering innovative guest experiences throughout the entire check-in to checkout journey. With a portfolio of over 40 hotel brands ranging from luxury to economy, Future Trees's strategy was to implement unique digital experiences tailored for each customer segment. The success of Future Trees did not depend on chasing the latest technologies; instead, the focus was to optimize the use of existing technologies. Reflecting on the previous system implementation experience, Future Trees decided to adopt a less common system solution approach within the hotel industry. The open-source system integration solution approach could be rewarding but was also risky. Hotel operators implementing this solution needed to weigh the benefit and risks across strategy, operations, and technology. While many other forward-thinking companies had adopted an open source or system integration solution to capitalize on various strategic advantages, Future Trees aimed to also benefit from the technological advancement offered. Future Trees was convinced that a vendor independent system solution would tremendously contribute to its competitive advantage in the long run. Information systems were increasingly an enabler when in gaining competitive advantages. What was the most appropriate approach to bridge the gap of a set of technologies and an effective business solution? Did an open-source approach offer an ecosystem that allowed the hotel industry to harness technologies to its best advantage?

Keywords**:** Critical role of system integration, smart hotels, digital hospitality user experience, Internet of Things (IoT)

1. Introduction

1.1. Overview of smart guest experience

A smart hotel was defined as "a hotel equipped with disruptive technologies such as Artificial Intelligence and IoT (Internet of Things), with the aim of improving management, efficiency and control from the hotel management, as well as offering a better service to guests." [1]. Smart hotels allowed guests to remotely check in, store guestroom key passes, and control all in-room electronics using their personal devices. Some hotels even offered personalized guest experiences [2]. Themes such as wake mode and sleep mode allowed guests to personally configure the lighting of the room for differently physiological effects according to the guest's preference; the modes were seamlessly integrated into future bookings with the same hotel chain.

The potential of digital guest experiences extended beyond a hotel room, encompassing pre-check-in and post-checkout processes. One of the possibilities was the integration of digitalization in transportation and logistics services, such as luggage storage and pickup by self-driving cars. While smart parking remained uncommon in the hotel industry, there was potential to develop solutions that integrated with the digital hotel journey.

1.2. Future Trees's smart technology integration across its brands

Smart technology referred to the integration of computing and telecommunication technology into other technologies that did not previously have such capabilities [3]. Future Trees was a hotel operator with a total of over 12,000 hotels and 1.2 million rooms in China as of 2023. Future Trees also had operations in North America, Europe, and other Asian countries, with an annual revenue of more than CNY15bn, making it one of the largest hotel operators in the world. When Future Trees launched its own brand of hotel-booking mobile app in 2013, the app was the first of its kind in China. Initially the app was

developed to cater to the same-day booking market, allowing guests to search for last-minute deals while still enjoying the benefits of the hotel chain's loyalty and membership programs. In 2016, Future Trees launched a newer version of the app that extended its coverage to provide end-to-end travel experiences. Guests from mainland China could search across all 40 Future Trees brands for limited-time offers, loyalty rewards, travel tips, car rentals, and much more, all in one app. Future Trees leveraged the app to provide a smooth and consistent digital hotel experience across all its brands. Guests could check in and out remotely and order a room through the same app, enabling even Future Trees's budget hotel brands to offer the same level of smart hotel services without requiring substantial investment in smart technologies.

1.3. A highly adaptable solution for hotels

Jerry Lee, the CIO of a leading information communication technology solution provider in China, had a vision that there was untapped potential in hotel digitization. One of the projects that Jerry's team undertook was a village for retired executives in Hainan Province, China. In the village, each room was configured differently to cater to the specific requests of the customers. Jerry emphasized, "The adaptability of our solution played a key role in securing this project. If hotels were able to offer full customization for their rooms, each guest would have a unique experience. This would be a highly adaptable solution for hotel operators."

Jerry focused on maximizing user experiences by prioritizing simplicity and adaptability. As a result, all of his products were preconfigured and designed to be plug-and-play. This approach effectively differentiated Jerry's products from those of well-known solution providers, as customers were not obligated to purchase accessories from the same brand in order to optimize integration. Instead, Jerry allowed customers to selectively choose the necessary parts to ensure easy and seamless integration.

2. System integration as the key

2.1. Integration to streamline the end-to-end business model

Smart hotel implementation generally involved telecom operators, solution providers, and vendors. While vendors provided the systems and smart devices required, solution providers had the technical capability to integrate all these using the connectivity services from a telecom operator. In the case of InterContinental Shenzhen, a hotel in Shenzhen, China, the telecom operator provided a bundled service that went beyond just connectivity. The strategic partnership with Shenzhen Telecom included 5G connectivity as well as integration of robots and smartphones with the telecom operator's own cloud terminal and applications, resulting in an end-to-end integrated solution. Previously, integrating with hotel operational systems was often challenging, as each system migration or upgrade triggered a multiyear project, depending on the size and complexity of the hotel's system architecture. While this type of bundled service could help hotels streamline their business models, it imposed a burden on the hotel by requiring the use of propriety technology from the telecom operator.

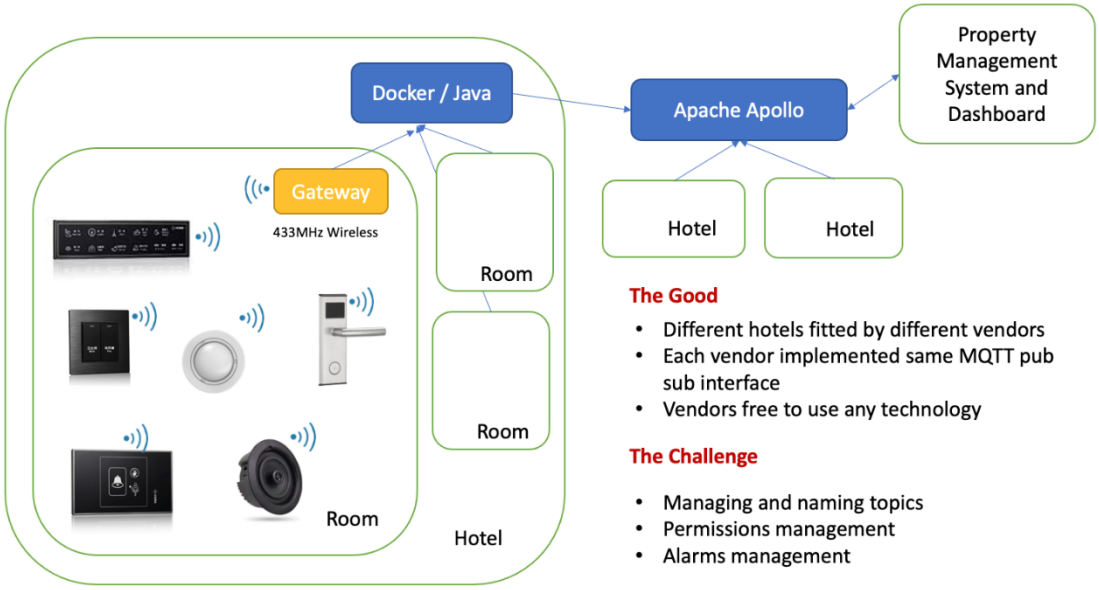
2.2. The solution for Future Trees

There were many vendors specializing in different types of appliances. In the past, the primary selection criteria often revolved around the vendor's quality and price competitiveness. However, this became an issue when hotels wanted to switch to a different vendor for a specific appliance, as the initial configuration was no longer be applicable. To achieve greater flexibility, Future Trees provided a list of predefined hardware and software standards for its vendors to follow. These standards helped Future Trees to ensure its digital transformation was both flexible and scalable.

Jerry, who designed an adaptable technology solution, secured a portion of the Future Trees's digital transformation project from China's top-three telecom operators. Future Trees was able to pick precisely what it needed for each of the 40 hotel brands, and Jerry's solution enabled integration from various vendors without the need for any configuration.

Jerry's design solution was not proprietary; instead, it was based on MQTT, an open-source messaging protocol invented in 1999 [see **Figure 1**]. MQTT messages enabled communication between various devices and applications, making it widely used in today's IoT and smart devices domain [4]. Since MQTT was an open-source protocol, vendors faced minimal technical burdens when integrating this protocol into their hardware and applications. This was aligned with Future Trees's hardware standards.

Figure 1: Integration Solution for Future Trees



MQTT consisted of three components: clients, broker, and messages. Clients, representing devices, sent messages to the broker, which functioned as a centralized back-end system for message coordination. By implementing MQTT in their hardware and applications (as clients), vendors ensured seamless compatibility with Jerry's MQTT broker [see **Figure 2**], without any setup requirement [see **Figure 3**]. Vendors had the freedom to use their own technology on top of MQTT, while Future Trees had the flexibility to choose from any vendors that supported MQTT.

Figure 2: mqtt broker cluster – perfect iot transport

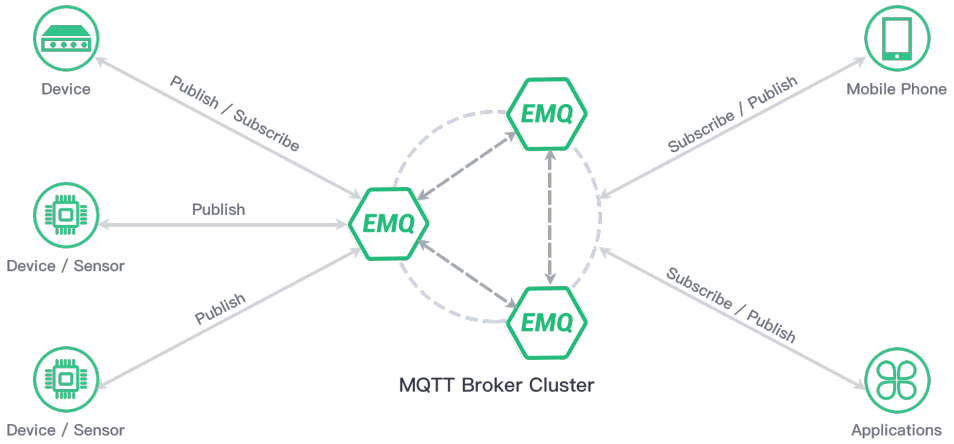
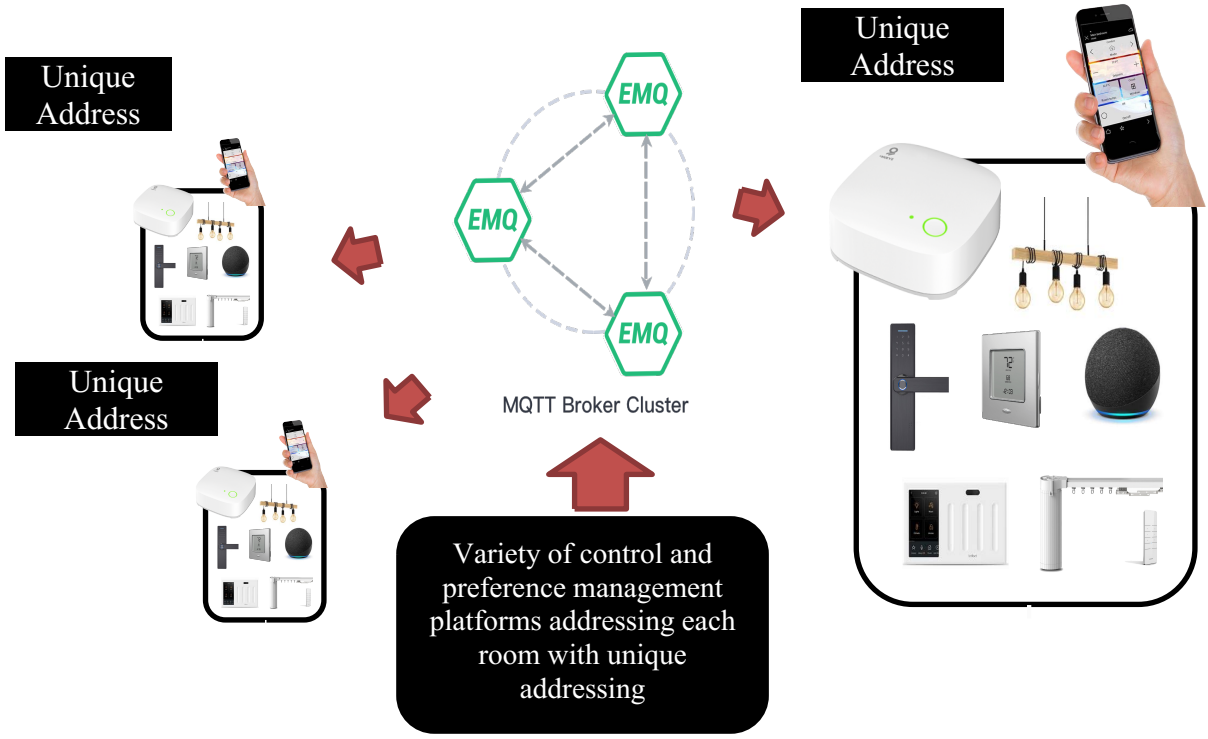


Figure 3: ZERO CONFIGURATION OF IOT



Furthermore, Jerry's solution allowed Future Trees to integrate all the smart devices with its property management system (PMS). An advantage of the PMS was that it provided an integrated back-end solution. This allowed hotel operators to rely on a single system to manage their daily operations, including customer relationship management (CRM), human resources, administration, finance, and accounting management, all in one place. By leveraging the expertise of PMS vendors

in managing maintenance, system enhancement, and system upgrade, hotel operators could minimize the need for hiring and training an in-house support team. As a result, in recent years some renowned hotel brands worldwide had increasingly utilized PMS vendors such as Shiji Group and Jintiane, which specialized in the hospitality industry.

2.3. Turning a common pain point into a win-win solution

One long-lasting pain point for smart hotel operators was that they were not able to gauge the quality of their guests' experience beyond very limited survey responses and guest reviews. Future Trees, however, addressed this issue by developing an in-house monitoring system that could continuously collect data from its smart hotel systems. The monitoring system provided usage analytics for each of the smart features. With the integration across its 40 brands, Future Trees could leverage these insights to make strategic decisions, such as optimizing its product road map for each of the brands. If a particular smart feature was not being used by a specific guest segment, it would not be necessary for the hotel operator to roll out an upgraded version across the brands. Future Trees could instead focus on investing in features that guests were actually using. The monitoring system was also useful in detecting system and appliance defects in advance, allowing Future Trees to arrange for repairs and replacements before guests reported them. This improved the overall guest experience and helped manage maintenance costs for the hotel operator.

After learning from Future Trees's experience, Jerry recognized the potential of adding a monitoring feature to his solution. He developed a vendor version of the monitoring system that was more flexible and could be easily adapted for both individual and chain hotels. A single dashboard could manage the entire chain of hotels, which was also connected to the hotel's PMS. With performance and usage data transmitted back to the hotel's back-end systems, even back-office operations such as HR and finance were able to leverage the analytics to make strategic decisions. This additional feature quickly gained popularity in Jerry's other projects and attracted many new hotel clients seeking to adopt his solution. Since most individual hotels lacked the capability to develop such systems in-house, this solution became a win-win situation for vendors and hotels.

2.4. The future with open-source software

Over the previous few years, open-source projects experienced remarkable growth. According to statistics from GitHub, the world's largest open-source developer platform, the number of active GitHub developers increased from 2.8 million in 2012 to over 94 million in 2022 worldwide [5]. With China's widespread adoption of open-source software, Chinese developers transitioned from being major consumers to becoming contributors. In fact, China had the second most active users on GitHub, accounting for nearly 10% of contributions in 2020. Notably, some of the most significant open-source projects were initiated by Chinese big tech companies, spanning various sectors. Examples included Baidu's Apollo in autonomous driving, Huawei's OpenHarmony in mobile OS, and Alibaba's OpenXuantie in semiconductors [6].

Some PMS vendors had already made themselves open source to target smaller hotel operators [7]. Jerry and his team wanted to prepare for the future of hotel and telecom industries, which they believed would soon be overwhelmed by open-source solution providers. Making a product open source offered many business advantages, including flexibility, efficiency, transparency, and reliability [8]. However, to achieve these benefits, open-source software required a strong customer base to attract volunteer contributors. Therefore, Jerry's primary focus was to increase market share. "Our Phrase 2 was to give away everything for free, just like how Linus Torvalds gave away Linus. But we would still be able to make money through royalties and our supporting services," Jerry explained.

This was indeed a very common business model for open-source software to achieve sustainable long-time revenue growth [9]. Jerry further added: "Our ultimate goal is to establish an app store for our products, where our customers can either hire their own developers or download our existing apps contributed by the community. This approach will enhance the adaptability and scalability of our products."

3. Enhancing Revenue While Reducing Operating Cost

3.1. Cost and benefits of implementing smart hotel technologies

With smart hotel technologies, hotel operators were able to significantly reduce operational cost, thanks to various factors such as decreased staffing requirements and improved energy efficiency. For instance, by replacing concierge services with robots and transitioning housekeepers to part-time contracts, smart hotels in mainland China were able to reduce their staff-to-guest ratio from 2 to 0.5 [10]. Additionally, the automation features allowed for energy-saving adjustments in lighting and temperature when rooms were unoccupied, further enhancing overall energy efficiency [11].

Smart technologies also continuously collected guests' data, which allowed hotel operators to identify the services guests demanded that could bring in additional revenue. As a result, hotel operators strategically implemented digital solutions that targeted customer segments were willing to pay extra for. For instance, budget hotel guests might choose to pay extra for an innovatively equipped room with smart TV installed, while luxury hotel guests would expect smart TV to be installed in all rooms as a standard offering.

3.2. Risk associated with digitalization

As with digitalization in any other industries, there were potential triggers of privacy and data protection risks from technology, people, or process. Data leakage was common for even the major hotel operators; for instance, Shangri-La group reported a data breach incident in 2022 with more than 290,000 customers being affected. As hotel operators were gaining access to more and more personal information, the impact from insufficient data protection would only be greater in the future. Regulators had also introduced global policies like the EU General Data Protection Regulation (GDPR). As per GDPR, any organizations that processed the personal data of an EU citizen needed to comply, regardless of where the organization was located. Failure to comply with these data protection regulations could result in criminal liabilities. As requirements for data privacy and protection were constantly evolving, this would add an additional cost for hotel operators for staff training and cybersecurity.

4. Digitalization of the Hotel Industry in Mainland China

4.1. Recent driving forces behind digitalization

Analysys, a leading provider of data products and consulting services in China, published a research paper in 2021 on the trend of hotel digitalization in China [12]. According to Analysys, China's hotel digitalization trend began during the Beijing 2008 Summer Olympics, but remained in an initial phase until 2017 due to the high investment cost required. Only a few larger hotel chains could afford to embark on digitalization at that time.

However, since 2018, a few catalysts had propelled China's hotel digitalization into the growth phrase. One of the catalysts was the introduction of Alibaba's FlyZoo Future Hotel, which was the first to demonstrate how a fully automated hotel could be exceptionally efficient and profitable. Wang Qun, the CEO of FlyZoo Hotel, claimed the hotel was 1.5 times more efficient than traditional hotels of similar size [13]. The hotel enabled guests to have full contactless digital experiences through Alibaba's FlyZoo app, which swiftly became the industry benchmark in China. Another significant catalyst was the COVID-19 pandemic, which compelled hotels to provide contactless service. Unfortunately, those who failed to adapt were eventually forced out of the market [14]. Analysys predicted that with China's borders reopening in 2023, the digitalization of hotels would enter a mature phase by 2025.

4.2. Different ecosystems between chain and independent hotels

The larger hotel chains led the initial wave of digitalization in the hotel industry. The trend was driven not only by their great financial capacity to invest in digital solutions, but also by the willingness of luxury hotel guests to pay a premium for

an enhanced digital experience. Independent hotels had two main options for digitalization, each with pros and cons. They could either join larger hotel chains as franchisees or develop their own independent digital solutions. Joining a larger hotel chain, such as Future Trees, offered benefits including increased guest exposure and access to guidance from industry leaders. However, there were drawbacks, such as franchise fees and relinquishing some control to the franchiser. Many independent hotels decided to build their own digital solutions, despite the challenges of investing in an in-house team for support. This approach allowed them to align their digitalization strategy more closely with their long-term goals.

5. Telecommunications – A Business Partner Beyond Connectivity

5.1. The importance of having a telecom business partner for smart hotels

The hotel industry was a lucrative segment for telecom operators, and partnerships between telecom operators and hotel operators played a key role in each other's growth and sustainability. InterContinental Shenzhen was one of the first movers that recognized that the success of digital transformation would highly depend on having a telecom partner. In 2019, the hotel entered into a strategic partnership with Shenzhen Telecom, one of China's top-three telecom operators, and Huawei, a leading provider of information and communications technology (ICT), to create the world's first 5G smart hotel [15]. This partnership provided the hotel with not only a reliable 5G network but also dedicated technical support for equipment and smart applications.

The Chinese government had ambitious plans to have 5G coverage for all cities and towns by 2025. As such, even hotels in rural areas were in scope for digitalization in the next few years [16]. With a year-on-year increase in China's domestic travel to rural areas, the potential market would only become larger as more hotels opened [17]. Telecom operators that had already formed trusted partnerships could easily leverage their existing relationships to expand their 5G business to these new hotels.

5.2. Winning business by providing innovative services

While smaller digital solution providers like Jerry's emerged across different segments of the hotel industry, telecom operators needed to expand into innovative services to retain partnerships within their core business. Digitalization often required a capital-intensive investment, and many independent hotels found it difficult to obtain the necessary funding. Due to the lack of guarantors, cashflow, and assets, independent hotels had substantially higher borrowing costs compared to chain hotels. Telecom operators could help to address this issue by providing more affordable financing options to hotels. When hotels decided to renew or extend their telecom service contracts for digitalization, telecom operators could provide the loans required at a much lower interest rate, either through their own cash flow or a secured loan that they backed. From the banks' perspective, lending to a telecom had a much lower default risk than lending to an independent hotel.

This extended the service models of a telecom operator from purely a service provider to a strategic partner with the hotel, as the hotel's ability to repay was positively correlated to the success of the hotel's digitalization strategy. This untraditional service model provided a win-win situation for both parties. Hotels needed funding to reinvent themselves to remain competitive in the market, while telecom operators wanted to develop stronger and more sustainable partnerships with the hotels.

6. Conclusion

6.1. Opportunity for a new business model

Technology advancement had the potential to create disruptive innovations that transformed entire industries. For example, the emergence of Uber and Airbnb introduced new business models to the taxi and hotel industries, respectively. As smart home technologies gained popularity in China, Airbnb guests could enjoy a similar level of digital experience as in

smart hotels. However, smart hotels still held and advantage over smart homes in many aspects. Hotel operators could enhance guest experiences through big data and personalized experience, which were not easily replicable in smart homes.

While most hotel operators focused on transforming their guest services technology, such as appliances and software applications, some vendors believed key opportunities were in guest engagement and hotel operations. Given the numerous uses for next-generation technologies like artificial intelligence, machine learning and blockchains in guest engagement, retention, and acquisition, innovation became the key to hotel competitiveness. Hotel operators wondered how open-source software and next-generation technologies would help hotels to remain competitive in the future.

6.2. Challenges for digitalizing guest engagement and hotel operation

Despite the vast opportunities for hotel digital transformation beyond guest servicing, hotel operators faced challenges they had to overcome. High-quality data was a crucial prerequisite for leveraging next-generation technologies. The hotel operating model relied upon multiple vendor systems that lacked interoperability and compatibility. Ensuring data completeness was a challenge because guest data were stored across multiple vendor platforms, and hotel operators had difficulty obtaining a consolidated view. Additionally, due to online travel agency (OTA) bookings, often hotels couldn't get first-party data because OTAs might not share them. These challenges meant hotel operators hesitated to invest heavily outside of guest services technologies. With Future Trees's open-source system integration approach, what were the other competitive advantages that could be capitalized going forward? If other hotels operators were to learn from Future Trees's solution, what were the most critical factors to determine their effectiveness to follow the same approach? Would the same solution also be applicable to every other industry? If not, which industries were more likely to face challenges in applying this approach and why?

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