

Bridging the Wireless Divide: The Dubai Customs Hatta Trial

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Abstract—Governments across the world are gearing towards efficiency and optimisation in all of their processes. The Dubai Government specifically has also put consumer satisfaction and happiness at the forefront of its strategic development.

We present a solution that has seen an adoption and implementation to resolve an actual challenge that has existed for many decades. We bridge the wireless divide around the challenging terrain of the Dubai Customs Hatta headquarters by enabling mobile smart offices to become an integrated part of their headquarters; bridging the office operation intelligently to the consumers.

We provide a proof of concept simulation study and cost benefit analysis of the solution and present architectures that could be adopted in many scenarios. We provide a novel solution to a number of challenges and conclude by studying its effect on the efficiency of the office operation simply by bridging the gap that has ever existed in such situations.

Keywords—Smart Networking; Mobile Office; Prevasive Computing; WWAN; Wireless Bridging

I. BACKGROUND AND CHALLENGES

The concept of a mobile office is not new in its conceptual context. Indeed, a taxi rental service when a vehicle is connected to the main office, receiving customer orders; or the fleet of a logistics company that is connected to the operation centre are prime examples of mobile office solutions when the office has been extended to the roads and became mobile in one context or another.

It is however a necessity that has driven the provision of our proposed solution and a requirement that in its entirety is realistic extension of operations that were typically confined into the office until recently.

The challenge under investigation is one that has persisted for decades since the inception of Dubai as a global hub for trade and communication. Hatta is a boarder city between the UAE and Oman on the Dubai borders, traffic in Hatta's boarder is considered one of the busiest for both visitors and trade. However, the terrain of Hatta as nature persisted dictated that its customs office be built in a mountainous area where access to the office and the boarder itself is only possible through a single carriage way. Traffic as such has been a problem in the area for decades.

Figure 1 represents an over view of the terrain, and where the Dubai Customs Hatta branch office is located. As the figure shows, the building itself is in a part of the mountain

that does not necessarily allow direct access for vehicles especially if customers are required to park in order to process their custom documents. When it is as simple as processing custom forms, there certainly is no requirement for customers to park their cars and attend the office. Documents of such cases can be processed quickly on the go while the customer is waiting in their car.



Fig. 1. The Dubai Customs Hatta branch and its surrounding terrain

When His Highness Sheikh Mohammed bin Rashid Al Maktoum visited the branch, he instructed that a solution must be found to resolve this issue. Such a solution can only be realised by extending the processing environment to the road, whereby customers will not be required to embark in order to process their documentation, especially if the case is as simple as fulfilling the custom forms requirements.

However, many challenges exist for such a solution to succeed including:

- **Reachability:** There is a requirement to extend the main building network beyond its parameter and to the terrain around expanding the network to the roads down the mountain as far as possible to allow customers to process their documents when remaining seated in their cars.
- **Security:** The documents to be processed on the go are of a sensitive nature. Whether that being for the customers themselves or the department. The access to such documents and their databases, needs to be conducted in as a secure manner as possible.
- **Reliability:** When such a system is enabled, it will be essential for the department to ensure that once a case has started processing, it concludes successfully without reverting to a visit to the main building.
- **Terrine and Weather:** The nature of the terrain in the area presents a challenge for any wireless networking signal, for it is to be received reliably. Also, the weather of such areas can become unbearably

allowable for anyone to operate comfortably outside of their air conditioned offices.

- Processing Time: Considering both the unavailability of parking and the nature of the terrain and weather, it is therefore equally important for both the customers and the department for the processing time to remain as less as possible.

By providing a solution for such a challenge we are not only improving the performance of the Dubai Customs department allowing them to meet their performance obligation requirements but are also able to increase customers' satisfaction and happens by processing their documents as soon as possible and allowing them to progress through the boarder comfortably.

In this paper we present our solution in the following sections. Section II, details the proposed solution, Section III provides detailed implementation strategies that can be considered and the one chosen for our implementation. Section IV provides an evaluation, and finally Section V concludes the work.

II. PROPOSED SOLUTION

Our proposed solution contains many novelties in it presents a one of its kind solution for all the challenges presented in Section I. The solution relies on extending the Wireless Network from the main building through the terrain to the mobile office cars that are capable of processing customs documents and cases and conclude along the road, without the need for the customer to park their cars and in turn block the traffic for other users along the way.

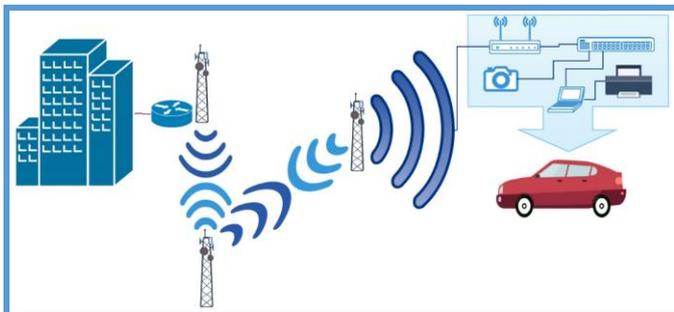


Fig. 2. An overview of the proposed solution architecture

Figure 2 presents an overview of the solution which has three dimensions:

A. Mobile Office

In order for customs officers to be able to process customers' documentations while both parties are comfortably enjoying the air conditioned environment of their cars, their offices need to be fully extended to their cars. This dictated that a connected fully equipped office is transformed into the car or rather transforming a car into a connected office. We have provided a modeling solution to this by adapting an on the road car to a mobile office equipped with all necessary equipment such as a laptop, VoIP phone, Printer/Scanner and a security CCTV camera. The picture in Figure 3 shows this implementation which was demonstrated during the GITEX Technology Week, held in Dubai recently.



Fig. 3. Our implementation of mobile office model

B. Extended Networking Infrastructure

The network infrastructure of the main building needs to be extended to its surroundings across the challenging terrain. Many solutions do exist for such a challenge as would be presented in Section III, however a solution needs to realise the requirements of reliability, reachability and security as defined in Section I. Figure 4 presents an illustration of the challenge and a typical solution.



Fig. 4. The challenging terrain and a typical networking solution

C. System Interface

As would be expected, an online system interface would be an ideal solution for such a system. That would not only allow customers the ability to access their detail and perhaps initiate the processing of their application, but would also enable operators to have a direct interface to the system that does not rely on the current connectivity of their mobile devices. In effect an application can be started and finished ubiquitously.

III. IMPLEMENTATION STRATEGIES

Many networking implementation strategies exist in such practical scenarios. These technical documentations by Cisco [1, 2] present many strategies that can be adopted, one of which we have selected. However, any of the following solutions can be considered:

A. An Extended Service Set Access Point Connectivity

Figure 5 illustrates such a solution whereby outdoor access points can be connected to the main building by rigid cabling. Such a solution although possible for small implementations, in our case would rather be challenging considering the terrain where we are expected to lay the cabling for the network. This solution is a typical wireless networking infrastructure.

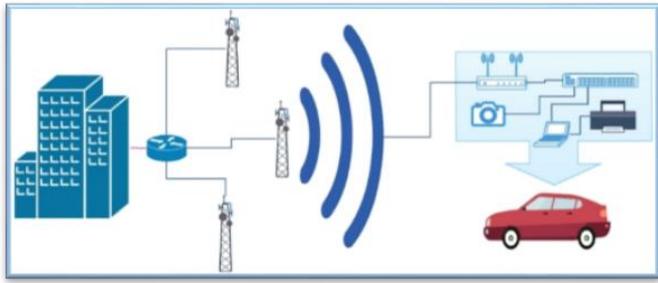


Fig. 5. An Extended Service Set Access Point solution

B. A Point to Multipoint Access Point Connectivity

Figure 6 illustrates this solution whereby an extended range Access Point will be installed within the main building and bridged to other Access Pointed connected across the road from the building. This is a typical bridging network which would instantly resolve the challenge however providing a single point of failure.



Fig. 6. A Point to Multipoint Access Point Connectivity

C. Outdoor Wireless Mesh Access Points

Figure 7 illustrates a Wireless Mesh Access Point network, where by all Access Points across the terrain are connected in a mesh topology using our vendor, Cisco, proprietary Control and Provisioning of Wireless Access Points (CAPWAP) protocol. Many city wide wireless network implementations use such strategy which has proven successful and effective for such implementations.



Fig. 7. An Outdoor Wireless Mesh Access Point Solution

IV. SOLUTION AND EVALUATION

In order to provide a proof of concept for our proposed solution, we simulated our network in Cisco Packet Tracer. Figure 8 illustrates the network built as part of this implementation.

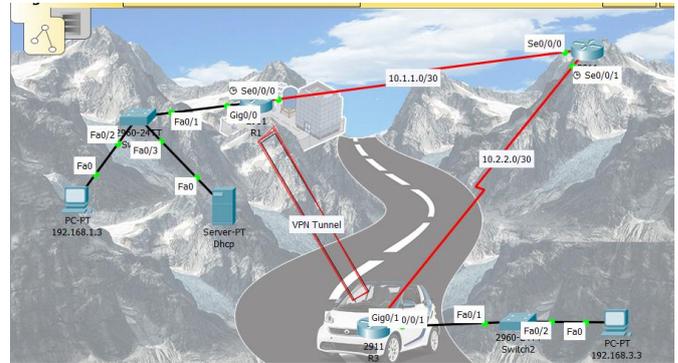


Fig. 8. Our Solution Cisco Packet Tracer Simulation Environment

As anticipated we were able to proof the validity of our solution and effectively proven that the provision of such a network would only be successful if we adopted a Wireless Mesh Networking topology.

Furthermore, we have also simulated the handover functionality of the network as illustrated in Figure 9. We were able to proof the reachability of the network across a large distance using the Access Points self-management and self-control functionality.

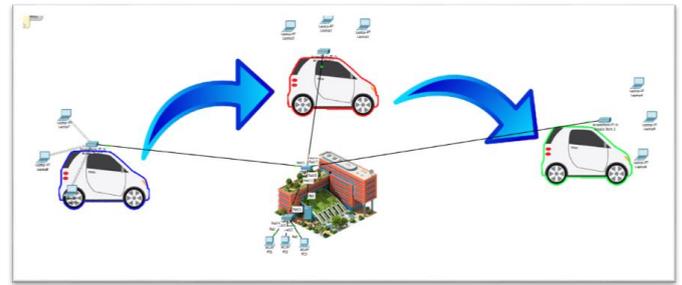


Fig. 9. Our Solution Handover Simulation Environment

We built a demonstration of a back office application for document processing and were able to demonstrate the functionality of processing the documents on the go. Figure 10 presents the front page of the system.

Fig. 10. Our Solution System Interface Simulation Environment

Figure 11 presents a snapshot of the resulted registration customer database.

1111@hotmail.com	Mr Mohanan	Vistor	Sunday, 8 Oct 2017
Abdull@hotmail.com	Abdulla	Vistor	Sunday, 8 Oct 2017
samantha@qblanaka.com	SAMANTHA	Qblanka private limited	Sunday, 8 Oct 2017
H.AL.9@HOTMAIL.COM	Hamad	DMC	Sunday, 8 Oct 2017
khalifa@hotmail.com	khalifa al zaabi	Etisalat	Sunday, 8 Oct 2017
alexlam@epuls.co	Alex	Epuls	Monday, 9 Oct 2017
Masouda@hotmail.com	Masouda	Alyahsat	Sunday, 8 Oct 2017
asif.jaffri@amandlaservices.com	Asif Jaffri	Amanda Services Pvt Ltd	Monday, 9 Oct 2017
sarthak.sethi@hotmail.com	sarthak sethi	BITS Pilani	Monday, 9 Oct 2017
Aleasandi@gmail.com	Alea Sandi	Vistor	Monday, 9 Oct 2017
kgopal@gmail.com	Gopal Koka	TLC	Monday, 9 Oct 2017
harisutharaj@daksada.com	Hari	Daksada	Monday, 9 Oct 2017
nafjanan@gmail.com	Abdulhameed	SA	Tuesday, 10 Oct 2017
Hafez@hotmail.com	Hafez Ali	HCT	Tuesday, 10 Oct 2017
Ammar@hotmail.com	Ammar	Vistor	Tuesday, 10 Oct 2017
Mohammed@hotmail.com	Mohammed	Exhibitor	Tuesday, 10 Oct 2017
ABDULLAAA@HOTMAIL.COM	ABDULLA	VISTOR	Tuesday, 10 Oct 2017
Salem-Alkendi@hotmail.com	Salem-Alkendi	Vistor	Wednesday, 11 Oct 2017
Taha_Taher@gmail.com	Taha	Taher	Wednesday, 11 Oct 2017
Hasan-Alansari@gitex.com	Hasan-Alansari	Vistor	Wednesday, 11 Oct 2017
Matar_Almehairi@gitex.com	Matar	Al Mehairi	Wednesday, 11 Oct 2017
fbosalam@hct.ac.ae	Faouzi	Bosalam	Wednesday, 11 Oct 2017
Media@gitex.com	Ziad	Media	Thursday, 12 Oct 2017
DMC@gitex.com	Faouzi	DMC	Thursday, 12 Oct 2017
dmc1@gitex.com	Mohamed Abdi dmc		Thursday, 12 Oct 2017
Vistor @gitex.com	Sultan Ali Al Shi	Vistor	Thursday, 12 Oct 2017

Fig. 11. Sample of Our Solution Registration Database

Our solution was selected for presentation during GITEX student' lab his year 2017. For the purpose of this event we implemented the mobile office dimension as part of the overall solution. Figures 12 present photos taken during the event.



Fig. 8. Our Solution Presentation at GITEX 2017

V. CONCLUSION

In this paper we demonstrated a practical solution that we implemented in order to resolve a challenge that has existed for many decades for the Dubai Customs Hatta Branch.

A solution was only possible using recent advances in wireless networking and innovations that were intelligently adapted by us as part of our work with the branch utilising technologies that enabled us to achieve our objectives within the domain of our research.

Many future developments can be considered including the adoption of solutions integrating cellular networks in case of a wireless network shutdown. Such solutions would increase the security consideration of the network and should be investigated further if they are to be adopted.

REFERENCES

- [1] Cisco Systems, "Mobile Government Transformation with Next-Generation Cisco outdoor Wireless Solution", Cisco, 2007.
- [2] Cisco Systems, "Success Strategies for Deploying a Citywide Outdoor Wireless LAN", Cisco, 2006.