FTTH AT THE HEART OF A SMART CITY

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SUMMARY

Smart cities require fast fibre networks at their heart. The problem is that the existing networks and communications infrastructure is often very varied in terms of technology, capability and ownership.

This paper discusses those trade-offs and explores how this creates challenges that a new smart city does not face.

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INTRODUCTION

There is a general assumption that a fiber optic network is needed to run an effective smart city and smart homes. However, this is rarely questioned and not always understood.

For the purpose of this article, we will consider a brownfield smart city as the subject – a city where the infrastructure already exists. In contrast, a greenfield location enables a fibre network to be designed in from the start and so creation of a network should not be any kind of challenge. However, it is worth noting in passing that any greenfield smart city should be built around a philosophy of ducting and fibre infrastructure as the number one priority.

In a brownfield city, it is important to consider the communications infrastructure already in place. This is important as this is the start point the city has to then develop all of the smart services.

WHAT COMMUNICATION RESOURCES ARE AVAILABLE IN AN EXISTING CITY?

Inter-City

Inter-city connectivity allows networks to transport communications traffic to other cities (obviously) but also to international gateways where traffic can be connected to other countries. At these gateways, the connections will often be to a submarine cable or other international network that allows the traffic to get to the Cloud. This means that information can be accessed from sites across the World with a charge made for the volume of this traffic to the operator.

Metro and Points of Presence (POPs).

There will be a number of metro networks that pass around the city, a little like ring roads that carry major traffic around a city. The metro networks carry traffic to various points of presence (POPs). These POPs allow communications operators and businesses to connect to the network and then pay for their traffic to be transported to other points. The end point may be another POP where a business connects up to another office or data centre. Alternatively, the other POP may be a peering point where different operators connect to one another to share traffic. A peering point allows an operator to access content from another operator without the need to transport that traffic over longer distances or even internationally.

At these peering points, operators are caching data. This means they are storing data from international sites such as YouTube. They do this to fetch data once that may then be accessed locally many times on their network. The alternative is that each individual data request from a user will need the information fetched internationally – and that costs money. So the caching is a cost saving measure.

Metro networks are not like the access network that connect residential and business customers to a network. The number of points to connect is far lower. This is a rational business decision as

digging a network is expensive but adding in a large number of manholes and or hand holes to allow connections to the network is very expensive. In Oman for example, an FTTH network was quoted the equivalent of around $750 per man hole. Clearly there is no need to have more man holes than are absolutely necessary.

There may well be a number of metro networks provided by the incumbent operator and other competitors. A degree of over-build is to be expected as well as areas that are relatively badly served.

The metro network will normally be fibre based and working on 10 gigabit circuits. For comparison purposes, the length of the network is likely to be as little as 1% of the total street length in the city.

Access Networks

In an existing city, as opposed to a new build city, there will be a variety of fixed access networks. In the Middle East, the main one is likely to be the copper network that formerly or still belongs to the incumbent operator. This is commonly poor quality, paper-wrapped copper that has been in the ground for some time. In addition, the distance from the central offices to homes is often high . That limits the speed of broadband that can be delivered as all copper-based broadband technologies suffer from a reduction in performance as the line length increases.

The use of a copper network may be shared by other operators due to unbundling rules put in place by the regulator. In this case, some copper lines from a central office through to a customer, or from a street cabinet, may be under control of a different operator.

As well as a copper network, there may be one or more co-axial cable based networks put in place by cable operators. The metro networks for cable companies are likely to be the same as that for copper – based on fibre. However, the last access part to homes is the co-axial cable.

In the Middle East Qatar has put in place a future proof solution by replacing the copper by Fibre and shifted all their existing subscribers to FTTH services.

In some cities, there may also be a Fiber to the Home (FTTH) network that provides the ultimate in terms of broadband performance, with speeds as high as 2 Gbps for residential services in Hong Kong, as an example.

At the other extreme, Africa has a different challenge because fixed networks are very limited and so the existing infrastructure is not there in most brownfield situations to support a smart city implementation.

Mobile Networks

The metro network is also likely to be supporting a mobile network. Depending on the extent of 3G and 4G rollout, the mobile base stations are likely to be connected to the metro network via fibre. Where possible, base stations will physically be located directly onto the metro network to limit the extra distances that have to be dug.

One trend in mobile is the sharing of base station locations. Throughout Africa for example, there are tower companies that own the tower and associated infrastructure. They then lease access to

this tower to any mobile company that wishes to use it. In these cases, you often see a metro fibre company creating an access point near to the tower within a very close working relationship. The metro company recognises that it can generate revenue from backhauling the mobile traffic from the base station for the different operators.

WiFi

In public areas, WiFi may be available free (such as in cafes) or more widely (e.g. in airports). This is a simple extension of a residential or business broadband connection in some cases, or a policy to provide public WiFi in others.

COORDINATION IS CRITICAL

From the information above, it is clear that there can be multiple network owners and different technologies – even several owners for parts of the same network.

This means the challenge of delivering the full range of smart city services is exponentially greater in a brownfield situation where existing networks are used.

A smart city plan therefore needs to consider how to use a very disparate set of resources.

Example: To automate traffic lights and improve traffic flow, a city will traditionally need to have cameras or sensors coming back to a central control room where decisions can be made on manual changes to routing within the city. The more modern version of this would see traffic light timings, routings and traffic information updated automatically to reflect the current state of traffic. Obviously, in most cities there is a larger flow of traffic into the city in the morning and then out of the city in the evening. That means being able to re-configure routes can be an important way of reducing journey times and pollution.

In this case the challenge is to connect up cameras, sensors, traffic lights and information signs. Some of this could be done with mobile but using the existing infrastructure is not easy:

- The roads to be managed may be across the city but the metro network is only limited in the number of locations;
- Individual access networks may not fully cover the areas that want to be managed;
- Different networks will use different technologies – making a consistent approach to coordinating data and controlling the road system more difficult;
- Even together, all the access networks may not provide the necessary coverage.

A smart city deployment in a brownfield city will therefore be limited by the availability of networks and the need to coordinate across different networks with different technologies.

WHAT IS THE RIGHT WAY TO PROCEED?

There is a very simple truth to understand with smart cities. If the network is not sufficiently good, the number and performance of smart services will be severely limited. There is not much of a grey area in between. Truly smart cities need truly smart and super fast networks.

Consider first how things sometimes go wrong in the real world.

Setting up individual projects in isolation from one another is likely to lead to a very ineffective use of investment money and significant wastage. For example, setting up a traffic system with a dedicated network may seem appropriate but if the water, electricity, gas etc. systems then create their own networks, there will be significant redundancy.

The answer to the problem of the overlapping networks is to manage a smart city at a higher level, coordinating across the different project areas (heat, light, traffic, power, waste, communications etc.). Rather than wasting money in multiple bespoke networks, the investments to coordinate these different smart city elements can be viewed as a single network approach.

The first lesson should be that any investment made in fixed networks should be in fibre. The cost per metre is similar if not lower than copper, but the ability to transport the highest capacity as well as the lower operating expenditure means that fibre should be the automatic choice.

The second lesson is that FTTH is often viewed simply within the context of providing communication services to residents and businesses. However, a more sophisticated business case within the context of a smart city needs to consider how fibre going deeper into the network (closer to end users) will also support the different utilities and other smart services.

The reality of brownfield smart cities is that they are handicapped by the way they have evolved and grown over time. The clean sheet approach of a greenfield location is far simpler but there are far more brownfield cities to be made smart.

The extent of smart services in a brownfield city will therefore come down to a simple trade-off. If a city is to embrace significant smart features, it will need an extensive fibre network deployed as close as possible to homes and businesses. This can then provide the high bandwidth and near real time information exchanges needed as well as providing world class communications. Anything less than this will either be a complicated compromise or will end up costing as much while delivering only a fraction of the overall benefits possible.