NOKIA

Innovation 2020: Connected bus shelter

A foundation for new applications and business models

About this report

Traditional bus shelters are quickly becoming obsolete. Outside of aesthetics, bus shelters have remained the same for ages. This is changing. New technologies and applications are now being used that enable bus shelters to be much more. Within the context of a smart community, bus shelters equipped with ultra-broadband connections can come alive, improve user experiences, and enable new business opportunities. This report describes the scope of a market trial of new, modern shelters with ultra-broadband connections that was recently performed in Auckland, New Zealand. It presents the results and key findings and outlines the opportunities for future applications.

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Executive summary

For a long time, bus shelters have remained virtually unchanged. Typically, they have provided a sitting area that can be used while awaiting transportation, as well as shelter from the elements and static advertising for both those waiting and passing by.

But, traditional bus shelters are quickly becoming obsolete. New technologies and applications are now being used that enable bus shelters to be much more. In fact, bus shelters are transforming into a foundation for the creation of new business models. These new shelters are also one of the key elements in smart or livable cities and communities.

A market trial of new, modern shelters with ultra-broadband connections was recently performed in Auckland, New Zealand by an Auckland consortium of companies, which included ng Connect members Chorus, Downer, Nokia and Solta. During the trial, a survey was conducted to get a perspective from users about the features offered and to test reactions to potential future capabilities. This paper describes the scope of the trial, presents the results and key findings, and outlines the opportunities for future applications.

Smart cities and bus shelters

All around the globe there are a number of initiatives to create smart or livable cities and communities. Cities are planning and investing to become more efficient, provide a better environment for citizens and visitors, and be more attractive to businesses. In all cases, one of the first steps is to invest in ultra-broadband infrastructure to create the communications network that will support smart community applications and business models. Ubiquitous ultra-broadband communication is the key building block that will enable all of the capabilities a smart city can offer. It will provide the network connection at speeds required to deliver the communication benefits valued by today's users.

In today's economic climate, government alone cannot provide all of the funding required to deploy ultra-broadband and build a smart community. Financing must come through public and private partnerships (PPP), and by the creation of new business opportunities that are possible with the right communication infrastructure.

Assuming that an ultra-broadband infrastructure is in place, the next step on the road to a smart community is to leverage the infrastructure to enable platforms that permit more things to be connected and smart. With these connected elements, the infrastructure can have a positive impact on public administration, citizens, visitors, and workers that make up the community. And, new business models can be created that make a smart community economically sustainable and self-funding.

The move to smart bus shelters

Outside of aesthetics, bus shelters have remained the same for ages. Through the years, they've provided shelter from the sun, wind, and rain, a place to sit, and a mounting surface for static advertising. Historically, shelters have been a cost to a transportation authority. An initial capital investment was required to build them and some level of on-going expenditure was needed for maintenance. Documents published in the US suggest that shelters cost from $2,000 to $15,000 USD to build, and $500 to $30,000 USD annually to maintain, depending on size, location, degree of vandalism, and shelter quality.[1] These costs have been offset by revenue from advertising, but they have still been net costs to the owners.

Beginning about 15 years ago, many communities, such as Chicago, IL, in the US began to outsource ownership of the shelters to advertising companies. This new outsourced business model relieved the transportation authority of the initial capital expenditure (CAPEX) and annual operating expenditures (OPEX), and provided an annual revenue stream for the leased locations. These shelters went from becoming a cost to a profit center. The advertising companies benefited by being able to pocket the difference between the costs associated with building, maintaining, and leasing the locations and the ad revenue they generated. So, a precedent was set for transportation authorities to relinquish ownership to third parties for contractual revenue streams from advertising revenues.

The fact that shelters also served as a prime location for revenue-generating advertising offset the costs to some extent. But, the shelters typically did not have a business model beyond simple advertising and did not generate a positive return-on-investment. This is changing. Within the context of a smart community, bus shelters equipped with ultra-broadband connections can come alive, improve user experiences, and enable new business opportunities.

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1 "UT proposal to Town Council to outsource bus shelters", Salt Lake City, 2006.

How?

Ultra-broadband links connect a shelter to the network. Once the connection is in place, the shelter can become self-sustaining and perhaps even a profit generator by delivering new services. For example, it can serve as a host for small cells. Beyond small cells, there are a number of other business opportunities that can be layered onto the broadband foundation, such as dynamic advertising, enhanced services for users, hosting sensors, and data collection and monetization options.

With that in mind, a few projects have attempted to do more with bus shelters over the past few years.

MIT demonstrated the "interactive bus stop" almost a decade ago.[2] It provided real time transportation information and acted as a community social networking platform. While suggesting a few possibilities for new shelter concepts, it didn't really propose much in the way of new business models.

In Los Angeles, CA, JCDecaux and Outfront Media launched what they termed the "smart" bus shelter.[3] This shelter featured a Wi-Fi hotspot, USB charging station, iBeacon and real-time digital signs displaying video and audio transit information. While not explicitly stated, it is assumed that advertising is part of this shelter too, probably with some degree of dynamic capability. The mayor hinted at a vision of future shelters of this type, and described them as "a platform capable of unlocking future innovations that we can barely imagine."

The City of Paris and JCDecaux have partnered to deploy 2,000 new, modern, smart shelters.[4] The focus of this deployment is on visual design and providing dynamic transit information to users. This is done with bigger, brighter screens, better maps, and user-friendly interfaces. While these shelters are an upgrade from previous generations, they may be overlooking the business model opportunities that can be created by providing the right set of capabilities as basic features.

Finally, in Amsterdam, JCDecaux in partnership with Vodafone and Nokia deployed 200 4G small cells in bus shelters.[5] With the installation of small cells in the bus shelters, Vodafone has a way to move voice and data traffic from its spectrum-constrained, wireless macro cell access networks to improve performance, user experience and costs. But, this also creates new business model opportunities.

By allowing small cells to be mounted on a shelter, a city government can add a new revenue stream to their advertising revenue model. And, the network provider can generate new access fees from the owner of the shelter. The business model also works for the mobile provider because it can offload network traffic as a way to meet increasing demand and avoid the expense associated with investing in macro sites, which are more expensive and more difficult to deploy because of the increasing challenges associated with obtaining site approvals. A recent study by Bell Labs concluded that small cell implementations offer a 55% cost advantage over macro expansion.[6]

2 "Interactive Bus Stop", MIT Mobile Experience Laboratory, 2006.
3 "Los Angeles Bus Shelters get Smart", Thetransitwire.com, September, 2015.
4 "JCDecaux Paris Unveils its New Bus Shelter", JCDecaux, March, 2015.
5 "JCDecaux is deploying 4G small cells into its bus shelters in Amsterdam", JCDecaux, June 2014.
6 "Metro Cells: A cost-effective option for meeting growing capacity demands", Nokia.

Connected bus shelter solution

What are the next set of new capabilities that can arise from the ultra-broadband connections at bus shelters and how can new business models support them?

As noted earlier, a market trial of new, modern shelters with ultra-broadband connections was recently performed by the transit authority and a consortium of companies which developed the following solution, including ng Connect members Chorus, Downer, Nokia and Solta.

The first phase solution developed by the ng Connect members tested the waters for a next generation bus shelter and introduced capabilities to users in a manner that did not overwhelm them with new technology. The initial version of the connected shelter (Figure 1) consisted of:

- A new physical design
- A Chorus broadband connection enabled by Nokia gigabit passive optical network (GPON) equipment
- Nokia service aware routers
- Interactive, touch screen displays
- A user interface (UI) developed by Solta

Figure 1. The initial version of the connected shelter developed by the ng Connect members

Solution details

Each of the companies involved contributed important elements that, when integrated, provided the shelter with its design and functionality.

Chorus - New Zealand's Ultra-Fast Broadband (UFB) project and the Rural Broadband Initiative are unique government-driven plans. They are among the most pioneering nationwide broadband network projects in the world. Radically improving universality and affordability of broadband services, these infrastructure projects will provide fiber-to-the-home (FTTH) and wireless broadband access to businesses, schools, and hospitals, as well as rural and remote areas, to ensure that most of New Zealand's 4.6 million citizens will have fast broadband regardless of their location. The Rural Broadband Initiative is a powerful example of a successful PPP project. It involves Crown Fiber Holdings, Chorus, and Nokia, as trusted technology partners.

Downer - Downer is a leading Australasian provider of infrastructure solutions in the transportation, communications, utilities, energy and industrial sectors. It is committed to providing proactive managed services capabilities for innovative partners and clients. As cities strive to achieve connected infrastructure, Downer works with technology partners to develop ideas and bring them to life.

Downer took the lead as the project manager for the connected bus shelter trial and took responsibility for delivery of the final product. It managed the project deliverables, budget and communications, and leveraged its existing local and international relationships to ensure seamless provision of a quality smart city service. With its extensive experience in collaborative contracting and partnering, Downer merged the capabilities of the seven consortium members and numerous suppliers to produce an excellent industry collaboration and valued smart city project.

Solta NZ - Solta created the extensible software platform for the two interactive screens in the shelter, including the look and feel of the interface. It focused on how best to convey simple, clear messages and provide the right platform for the transit authority to continue developing the capabilities of the shelter. The resulting solution uses best practices and leading innovation standards to emulate a mobile device. It is simple and attractive to explore and extremely intuitive, but offers the right level of data.

Nokia - The Nokia 7705 Service Aggregation Router (SAR-W) aggregates and backhauls mobile traffic from the shelter. Its rich feature set facilitates fixed-mobile convergence, provides cost-effective scaling and supports the transformation to Internet Protocol/ Multiprotocol (IP/MPLS) networking. Utilities, resource, transportation and government/ military networks benefit from the 7705 SAR's legacy service support, quality of service options, security and reliability.

In this trial, the Nokia 7705 SAR-W was used as a ruggedized outdoor networking termination device that allowed for the direct connection of bus shelter applications and tenants. The 7705 SAR-W allowed Chorus to deliver innovative new services that went beyond the baseline service set offered by UFB today. Moving forward these services could include mobile backhaul for the deployment of small cells on shelters for mobile service providers, such as Spark, Vodafone or 2 Degrees, as well as RS-232 services for traffic light controller direct backhaul connectivity, and power over Ethernet (PoE)-enabled closed-circuit television (CCTV) services, where the camera powering is provided directly by the 7705 SAR-W.

Its rich feature set facilitates fixed-mobile convergence, provides cost-effective scaling and supports the transformation to IP/MPLS networking.

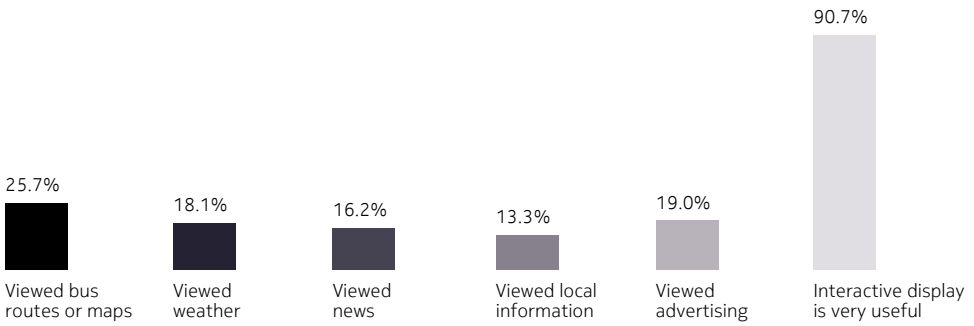
Business benefits

The market trial of the connected bus shelter that occurred in Auckland, New Zealand took place beginning in August 2015. To introduce the connected bus shelter concept to transit users in small steps, this initial deployment focused on the broadband connection and interactive signage. A survey of users was performed by the Auckland University of Technology (AUT), a ng Connect member, to assess user acceptance and experience associated with this new, more capable shelter.

Among the notable findings of the survey was that, despite the fact that the shelter was trialed for only a short period of time and the features were not really publicized, a surprising number of users actually interacted with the screen and tried out the different content types without any instructions or training (Figure 2). This indicates that users consider interactive displays useful and more features can be deployed to support new business models in future versions.

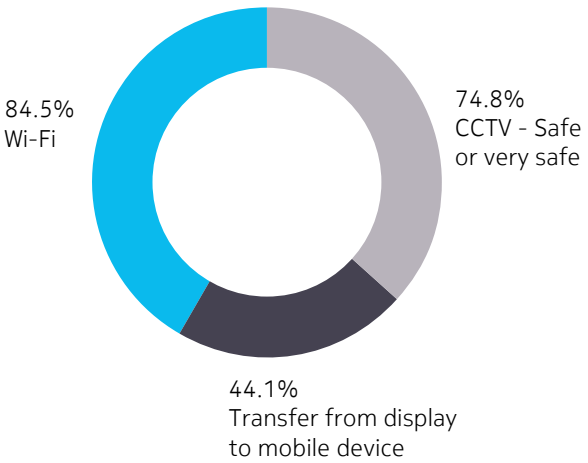
CCTV at the shelter would make nearly three-quarters of users feel safer.

Figure 2. Usage of the connected bus shelter interactive display (% of users)



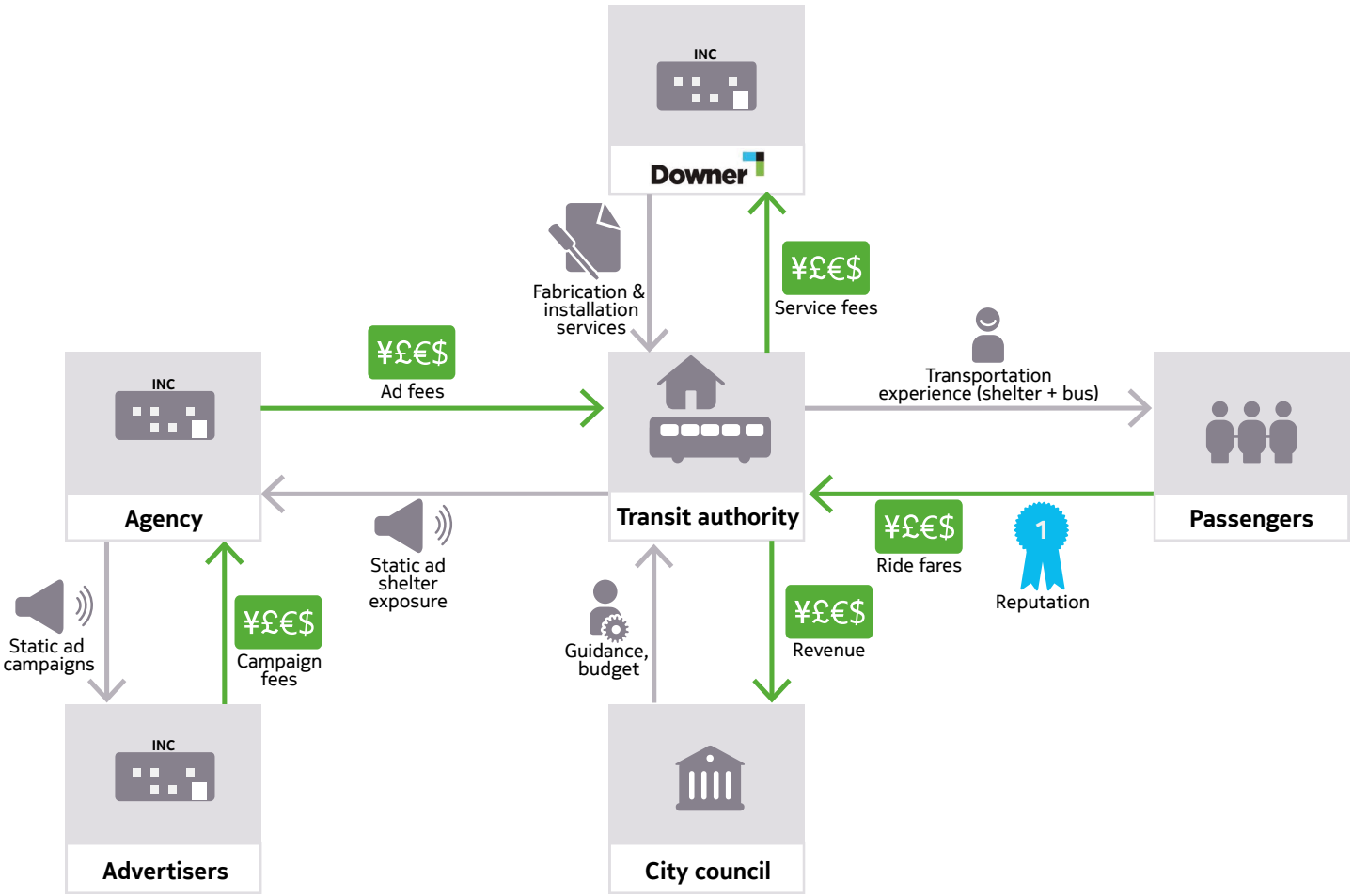
Some survey questions were aimed at potential future features that could be deployed (Figure 3). Wi-Fi capability had a strong positive response. Nearly 85% of users would like Wi-Fi to be available. CCTV at the shelter would make nearly three-quarters of users feel safer. And, 44% of users would like to be able to transfer information from the interactive display to their mobile device. This is valuable feedback when considering future features and business models.

Figure 3. Feature desirability (% of users)



A good way to envision potential business models based on this data is to think in terms of layers. The first layer is based on the traditional bus shelter business model, which is the model under which the shelter was deployed (Figure 4). In this model, the city transit authority owns the shelter, Downer builds and installs it, and the city transit authority receives revenue from an advertising agency who manages the static advertising.

Figure 4. The traditional bus shelter business model



The next business model shows the “connected layer” (Figure 5). Alternatively, this layer can be viewed as the future base layer. In this model, the shelter is connected to the Chorus UFB broadband network via a Nokia service aware router. Mobile service providers install small cells to cover increased demand, provide better performance and improve the user experience. Such small cell deployments have been demonstrated to afford a 55% cost savings relative to deployments of larger sites. Therefore, mobile operators are willing to pay a monthly fee to mount their equipment on the shelter.

Figure 5. Future bus shelter business model, connected platform layer

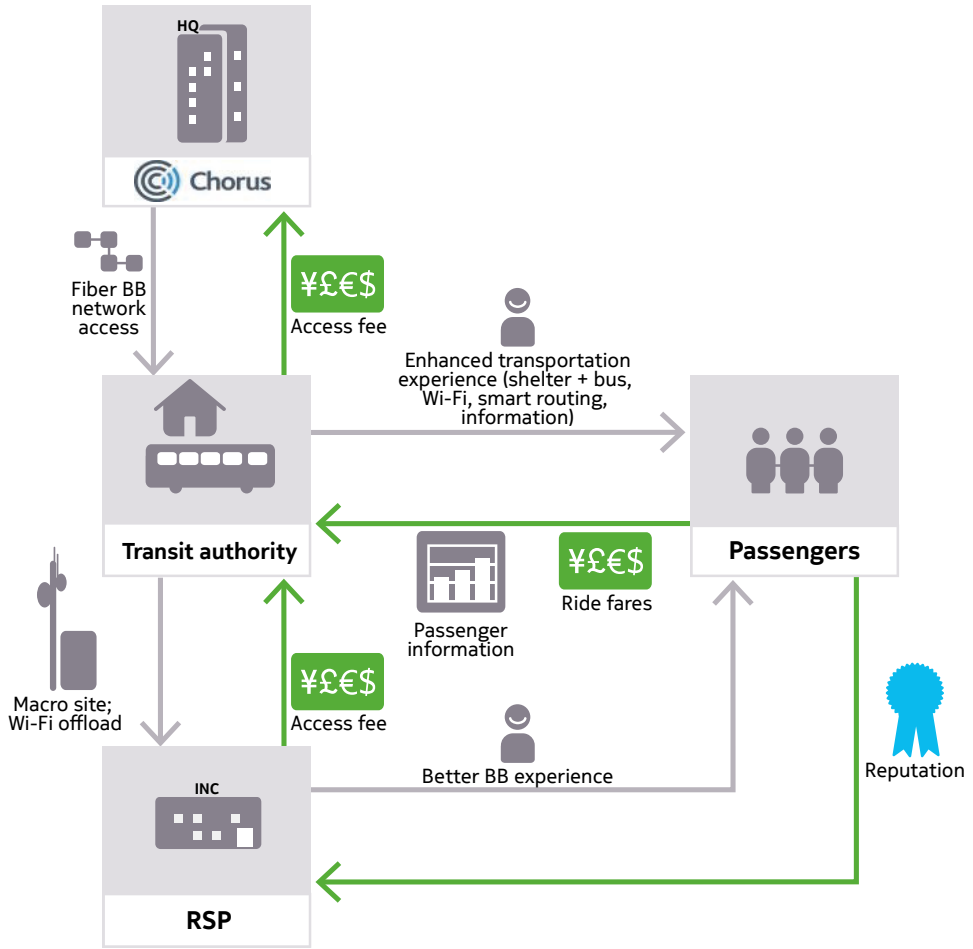
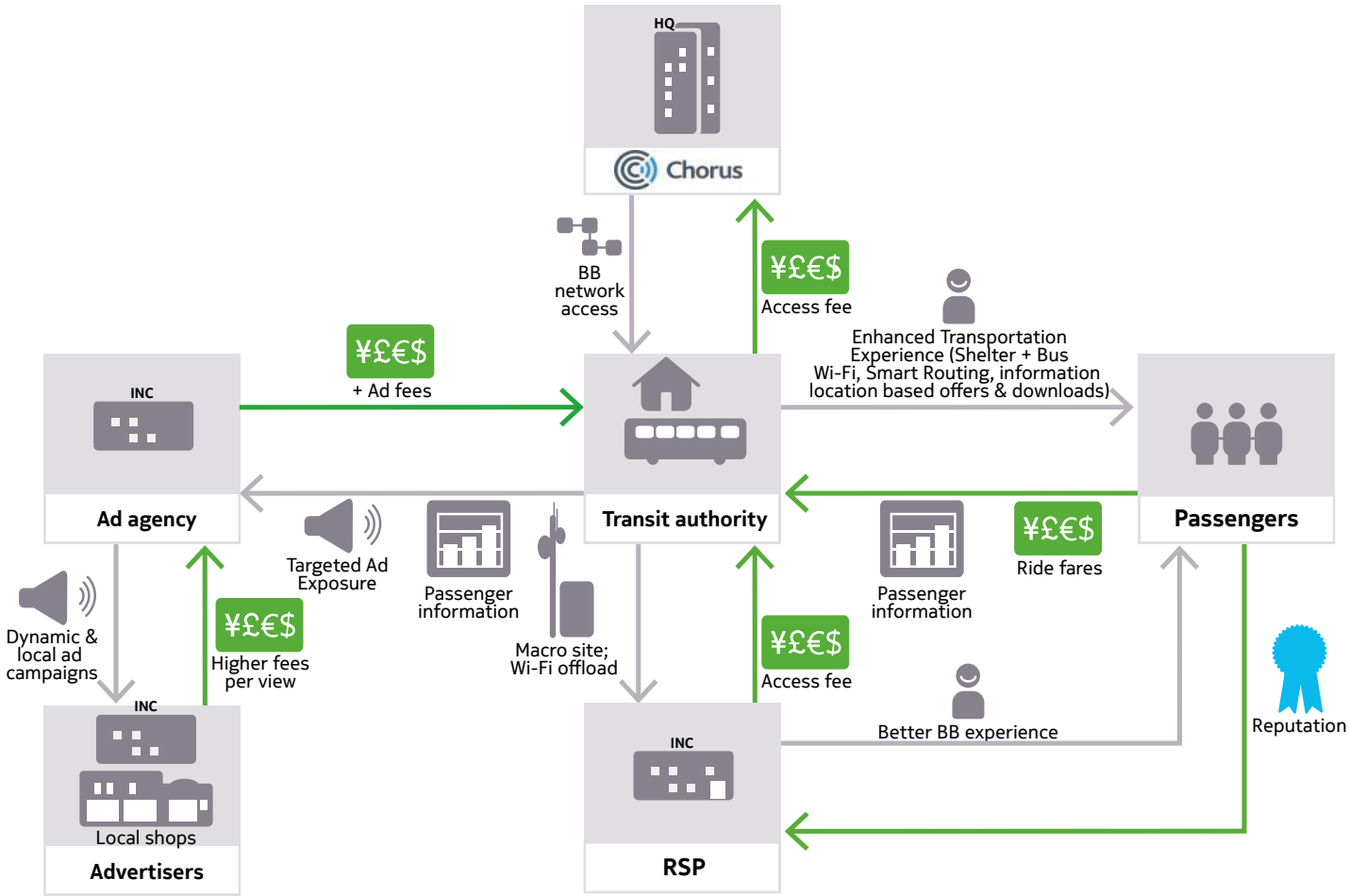


Figure 6 shows the advertising layer or business model of the future. This advertising model is dynamic and interactive, and opens up new advertising opportunities from local businesses. Users have an enhanced experience and the shelter provides a base from which higher value, targeted advertising can be presented. Again, the city transit authority is shown at the center and is the owner of the shelter. But, as the value of the physical shelter increases due to ultra-broadband capabilities, so does the business models where third parties become the owners and managers of the shelter, while the city transit authority can capture a steady revenue stream without the hassle of ownership.

Figure 6. Future bus shelter business model advertising layer



An enhanced services layer business model is also possible. This business model could be based on the interactive signage becoming kiosk-like in capability. This would allow users to interact and make transactions based on ticket purchases, dynamic offer purchases, or other revenue-generating actions. The interactions could begin from the signage and move to the user's mobile device. This could be useful for visitors who may need help routing through modes of transport to determine what to see and when. And, this possibility ties in with the survey results that indicated 44% of users would be interested in transferring information from the display to their smart device.

Finally, Figure 7 shows the sensors and data layer. This layer can include a multitude of sensor types and a number of potential business models, including the option to charge a monthly fee to permit third parties to mount and connect their sensors, for the owner to connect sensors, collect data and sell access to the data, as well as for a city transit authority to mount sensors and use them to monitor traffic, security, the environment, and more. During the trial, we successfully deployed a low-cost, single board computer running a Wi-Fi device sensing application to count the number of mobile devices present and, based on length of presence, their associated dwell time. These types of analytics can be useful to the transit authority in a variety of areas, such as assessing advertising revenue potential and other operational insights.

Figure 7. Future bus shelter business model, sensors and data layer

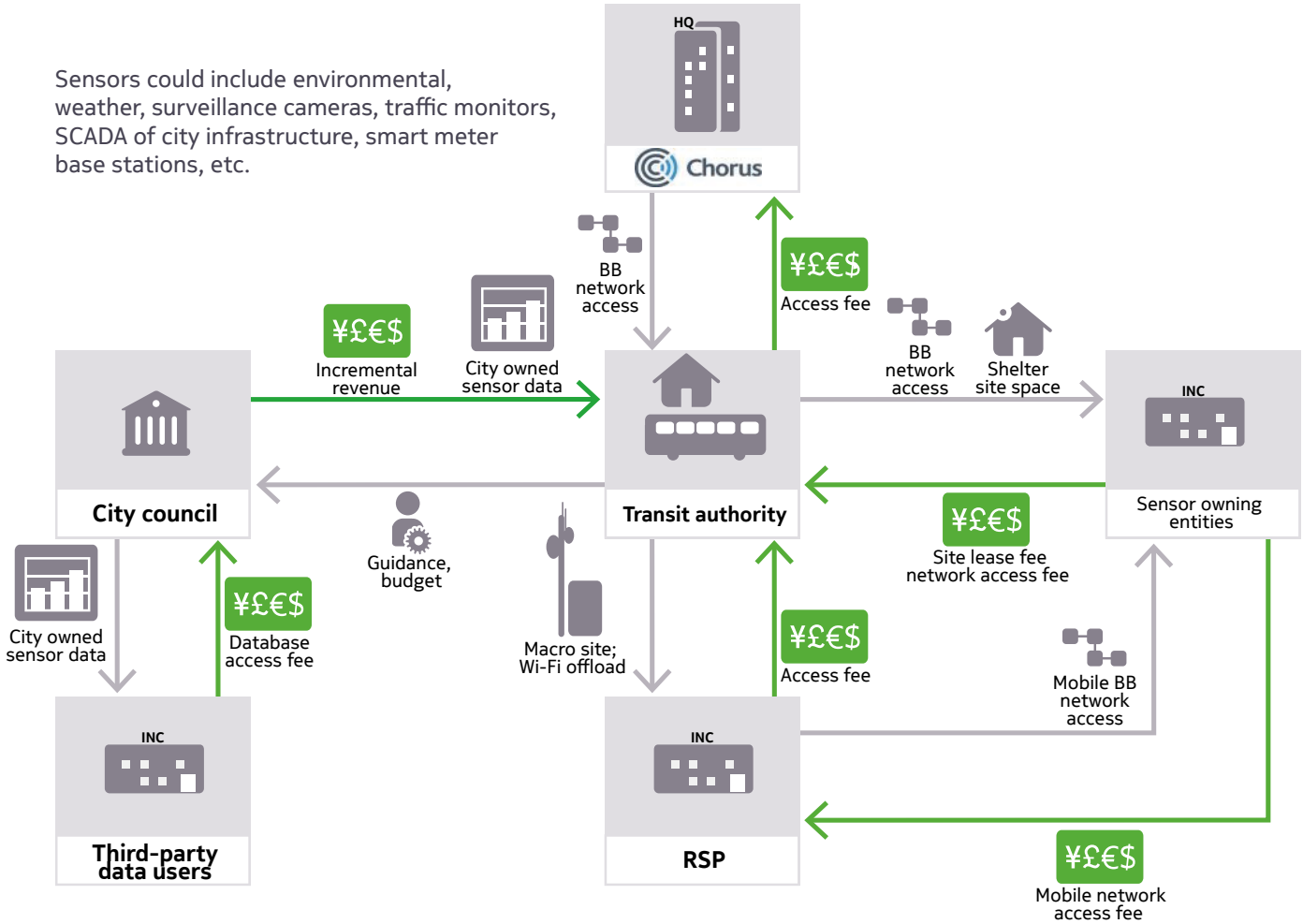
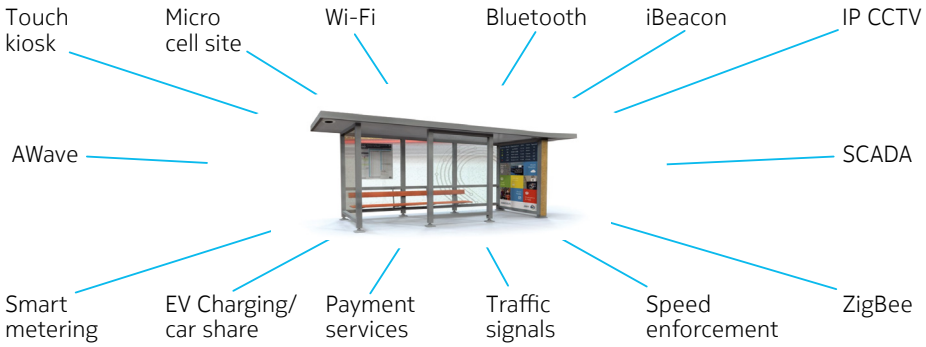


Figure 8 shows potential additions to the shelter beyond the basic examples on which the trial was based.

Figure 8. Potential additions to a connected bus shelter that will enable more business models



Conclusion

With the basic functionality used for the trial in place, a next iteration of a connected bus shelter can begin to add the features that are enabled by the Chorus ultra-fast broadband (UFB) connection and the associated business model opportunities. As noted earlier, a foundational revenue generating opportunity lies with mobile service providers. As wireless demand increases in cities, mobile operators must keep up with the traffic and manage the user experience. The bus shelter owner can rent pre-certified mounting space for small cells and offload wireless traffic using the ultra-broadband connection. At the same time, advertising can move from static ads that change infrequently to dynamic ads that change based on contextual information. Interactive signs can adopt kiosk-like capabilities that enable revenue-generating features. Sensors can be mounted in a similar manner as small cells to enable the collection, analysis, and monetization of data by allowing access to paying third parties. Alternatively, sensor owners can simply lease the space if they want the data to remain private.

As potential business model opportunities are identified, a broader set of companies interested in owning and operating shelters may emerge. For example, transportation authorities may be able to outsource ownership and let others incur the cost and risk, while they continue to collect a predictable revenue stream. As noted above, an ultra-broadband connection to the shelter opens up a whole world of additional revenue opportunities beyond advertising.

Meanwhile, in New Zealand, the ecosystem involved in the trial is interested in exploring additional capabilities and testing the associated business models for the connected bus shelter solution concept. It is also interested in extending the concept in a multi-modal framework to include buses, trains, trolleys, ferries, and other modes of transportation.

Acronyms

CAPEX	capital expenditures
CCTV	closed-circuit television
FTTH	fiber-to-the-home
GPON	gigabit passive optical network
IP/MPLS	Internet Protocol/Multiprotocol
OPEX	operating expenditures
PPP	public and private partnerships
UFB	ultra-fast broadband
UI	user interface

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