Virtual Australia and New Zealand (VANZ): Creating a piece of Digital Earth

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Abstract. VANZ is an Initiative of a wide group of research, government, industry, technology and legal stakeholders in Australia and New Zealand. Its purpose is to broker development of the ‘Authorised Virtual World’ that brings together 3D Spatial and Building Information Modelling within a proposed new Legal Framework. The aim is to create an ‘authoritative’ and ‘enduring’ 3D model of both the ‘physical attributes’, and ‘legal entitlements’ relating to every property. This ‘authorised virtual world’ would be used in all ‘property-related’ activities - to deliver better, quicker and cheaper outcomes. It would also be used as the context for serious games and to model dynamic processes within the built environment, as well as for emergency response and disaster recovery. Productivity savings across Australia have been estimated at $5 billion pa for the design and construct phases alone. The problem for owners, bankers, insurers, architects, engineers and construction companies, and others, is that they require access to ‘authoritative’ and detailed 3D data for their own purposes, that must also be securely shared with others up and down the ‘property’ chain, and over time. All parties also need to know what are the rights, responsibilities and restrictions applying to the data, as well as to the land and buildings that it models. VANZ proposes the creation of a network of Data Banks, to hold the ‘authoritative data set’, ‘in perpetuity’, along with the associated software and virtual hardware used to model it. Under the proposal, rights of access to the ‘authoritative data’ will mirror each person’s rights in the property that the data models. As more and more buildings are modelled (inside and out), privacy, security and liability become issues of paramount importance. This paper offers a way for the global community to address these issues. It is targeted at all who have an interest in the practical implementation of Digital Earth for the built environment – including new business opportunities worth $billions.

1. Background to Virtual Australia and New Zealand Initiative (VANZI)
Across Australia and New Zealand, there are currently many initiatives aimed at developing 3D virtual models, ranging from individual buildings to cityscapes and beyond, as well as underlying address and topographic data, etc. Access to these is governed by each jurisdiction (Local, State and National) - with little regard for National Productivity. Inevitably too, integration of ‘private’ and ‘open’ 3D data will give rise to different laws in each jurisdiction to address privacy, security and liability concerns.

These are not criticisms. They simply reflect the fact that each government has responsibility only to its own constituents. As a result, property owners, tenants, developers, financiers and insurers, as well as architectural, engineering and construction (AEC) companies, not to mention legal firms (that operate across jurisdictional boundaries), face the prospect of a complex web of regulations that threaten to undermine the many productivity benefits offered by the new 3D technologies.

The opportunity is to recognise this threat, and to act collaboratively, to create a new national and international framework that facilitates integration of individual private and public 3D models into a seamless ‘authorised virtual world’, while minimising the regulatory burden. This does not mean...
giving up ‘sovereign rights’. It does mean working together to create a framework that benefits all stakeholders.

Here we are not talking ‘technical standards’. It is about the laws and regulations that govern use of the emerging ‘virtual world’. These go much deeper than ‘productivity’.

With the virtual world becoming embedded in the design, construction and management of every aspect of our built environment, many now recognise that, to meet the needs of the market, the virtual world must include both: the physical attributes, and the legal entitlements, relating to every property. Ideally, based on a ‘single point of truth’.

Less well understood is the market’s need for systems to emulate in the virtual world, the rights of access that pertain to each property in the real world. As reported in The Economist (May 1996 p16.), history shows: “secure property rights” and “reliable enforcement of contracts” are fundamental to the efficient operation of the ‘free market’. On this evidence, for the physical and virtual worlds to be efficiently integrated, it means that access to each object in the ‘authorised virtual world’ must be tied in law to ownership, as well as contract & statute. This requires a unique data set to which the law applies (the ‘authorised data set’), with access based on the principle: “rights in the virtual = rights in the physical”. Any move away from this principle simply adds unnecessary complication and cost.

More importantly, it is a critical requirement to protect privacy, maintain security and determine liability - so that trade can be conducted with ‘certainty under the law’ in the virtual domain.

Of key concern to legislators, application of this principle allows each jurisdiction to retain its own unique laws that relate to all real property. It simply avoids added complication when linking the physical, legal and virtual realms. Nor is it intended that all virtual models fall within the framework. The idea is for the principle to be applied solely to a newly defined ‘authorised data set’ that is used for all transactional purposes throughout the ‘property cycle’. It means quite simply, if I know my ‘property’ rights in the real world, I know them in the ‘authorised virtual world’.

Apart from the broadband ‘pipes’ required to carry the data, the ‘authorised virtual world’ is potentially the most important piece of new infrastructure in the 21st Century - if we can get it right.

We can either follow the practices of the past that have given rise to parochial road, rail, water, energy and property regulations that still inhibit trade today. Or, take a universal approach to establish a new ‘infrastructure’ (the ‘authorised virtual world’), built upon a common legal framework that defines: a new ‘authorised data set’, new ‘structures to hold the data’, and the ‘rights of access to the data’.

Given the pace of change, we only have a small window of opportunity before new National, State and Local regulations entrench positions that, based on history, could take forever to undo.

2. What is VANZ?

VANZ is simply a shorthand description for: the Authorised Federated Fully-integrated Secure 3D computer model of the natural and built environment (including inside and out of every structure and utility, above and below ground) on all scales required for decision making: (m’ for remote, ‘cm’ for cityscapes, ‘mm’ for buildings and ‘sub-0.1 mm’ for plant and equipment), together with a 3D Cadastral Model that includes the geo-references of every address, and administrative boundary of all Laws and Regulations that pertain to any property – with access based on the principle ‘rights in the virtual = rights in the physical’.

The same definition can be applied globally.

3. What is the Purpose of VANZ and What are its Benefits?

The Federated Model (VANZ) is seen as a new piece of ‘infrastructure’ that will be used to plan cities and design, test, and market new infrastructure, buildings, equipment, processes and products before they are created in the physical world - to deliver better quicker outcomes, at substantially reduced cost. Its use covers the whole ‘property cycle’: planning, surveying, design, engineering, costing, financing, construction, fit-out, painting, lighting, landscaping, insurance, asset and facility management, induction, leasing, valuation, marketing, sale and decommission.
Like the real world, it can be built bit by bit – but perhaps 10 times faster. The driver will be savings in: 1) management of existing buildings, 2) new building design and construction, and 3) city development.

As it is built, VANZ can also be used as the context for ‘serious games’ (to help solve real-world problems), and to help manage our traffic, energy and water flows, as well as the movement of goods and people – to achieve more productive, liveable and sustainable outcomes. It can also aid in emergency response and disaster recovery.

Many people are already working on separate projects covering these activities - in many cases using separate models of the same areas. Ideally, all elements need to be integrated.

The Framework set out in this paper is offered as a possible way of achieving this integration - though it is not cast in stone. If there is a better way, the aim of the VANZ Initiative is to find it.

In Building Modelling, the benefits of integration based on a ‘single point of truth’ are already evident. VANZ offers the opportunity to do the same across the whole built environment by providing a ‘single point of truth’ in regard to the ‘physical attributes’ and ‘legal entitlements’ of each property, with rights of access based on each person’s real-world rights - removing complexity, cost, time and errors at every stage. Studies by ACIL Allen Consulting indicate productivity benefits of S5-10 billion per annum over the whole property cycle - if implemented across Australia, with more savings available within New Zealand. Scaled up, global savings could be more than $1 trillion per annum.

Location services will also benefit from having an ‘authoritative data set’. At the moment, many organizations are competing to capture attributes of the physical world that are in the ‘public domain’, to create their own ‘virtual version’ of the natural and built environment. Given the level of competition, it is possible that soon there will be little difference in the quality of ‘base’ data (that represents the physical attributes of most cities) - as each provider has to match the market, or be out of business. Under these circumstances, the sooner they all get access to the single ‘authoritative data set’, the cheaper for everyone.

Another benefit is the improvement in data quality over time as a result of having a ‘single point of truth’ that can be updated by the whole crowd – no matter which portal or product they are using. Ultimately, business value is derived from the services that utilise the data – not the base data itself.

Once it is in place, the use and value of VANZ is, quite literally, limited only by imagination.

4. Why can’t the Market deliver the vision?

Some commercial providers already offer to hold private 3D models ‘for free’ within their own ‘virtual earth’. However, with most taking ownership of the data, there are no assurances and few rights provided to protect privacy, maintain security and limit liability. In many cases too, the data are held in ‘external’ jurisdictions. Already we have seen cases where data have been frozen offshore, at great cost to the data owners. And, with the recent disclosure of US mandated government access to all US ‘corporate’ data, the whole issue of ‘property rights’ and ‘privacy’ and ‘security’ have become further complicated. Importantly too, such providers have different objectives to most users. Their requirement is to achieve sufficient fidelity to provide services that attract advertising and/or the purchase of devices. They are not set up to achieve the levels of fidelity required for ‘legal performance’. This is not to say that they could not do so – given the imperatives of a new legal framework. Indeed, it is expected that the major ‘cloud’ providers will very quickly adapt their service offerings to accord with any new National Framework… as it provides a new business opportunity for them.

From a community perspective, as the virtual world becomes increasingly embedded in every aspect of the planning, development and operation of our cities, it will be too risky and complex to simply rely on ‘service level agreements’ to protect this new National Infrastructure (the ‘authorised virtual world’) – without the regulatory framework to back it up.

In fact, during the whole course of the project to date, few people have indicated that they would be willing to grant access to data that represents their own private spaces, secure facilities and structural elements - without the necessary legal, technical and process protections.

It is the aim of VANZI to broker development of these protections within a new National Framework.
5. What is the VANZ Framework and How would it Operate?

It is proposed that VANZ be built out of the separate 3D models of each and every property, *under the control of each owner*. To understand how this would work, we need to understand the relations between the physical world, our property rights and the virtual world.

We don’t expect ‘property’ to move location, or morph overnight into a different form, or instantly disappear altogether. And, while we may own private property, such ‘ownership’ is not absolute. We are constrained by laws that dictate its construction and use, even its demolition. Without clear ‘property laws’ (and police and judiciary to enforce them), the market is ruled by force and fear… as evidenced by the drug trade, or in places like Somalia. Value can only be *traded securely* when each party knows they can give and get good title, and that the thing being traded is what it purports to be. In property, *registration of title and certification processes*, provide this assurance.

The virtual world is far more ‘ephemeral’ and is currently governed by copyright, communications and contract laws that are quite different to those applicable to ‘real’ property. How then to marry these three realms: the physical, legal and virtual - to provide users with the privacy, security and liability protections they require?

The key is to *create, hold and modify* the ‘authorised model’ in such a way that it *endures through time* (in parallel with the physical property that it represents) - *independent of the owner for the time being* - so the model cannot be destroyed, or modified (except to reflect changes in the property). To give effect to this requirement, it is proposed that specific legislation be passed to establish ‘Data Banks’. Much like traditional banks compete to hold our money and conduct transactions on our behalf, the ‘Data Banks’ would compete to hold our property models (and the software and virtual hardware used to generate them) - *in perpetuity* - on National soil, under new National/State Law. The Government would provide ‘holder of last resort’ facilities - to ensure continuity in the event of any Data Bank failure. The network would also include secure links to each Titles Office - to reflect changes in ownership at the moment of registration and to protect against unauthorised access. While no security is perfect, the Data Banks would form a ‘regulated cloud’, with active security and strong audit functions to track and signal *to the owner* who is accessing any data, for what purposes - in real-time - with algorithms to help identify unauthorised breaches.

Under the proposed legislation, Governments and Utilities would be able to establish their own Data Banks to hold the models of their own assets - or outsource to a commercial Data Bank, as they choose. Private owners would be free to create a VANZ model of their own property using the technology of their choice, and to lodge it with the Data Bank of their choice. Once created *and lodged*, a model would be subject to the laws governing the ‘authorised virtual world’. All models would be accessible according to a person’s usual rights of access to the information they contain. That is, if you could get it over-the-counter, or via email or phone direct from the property owner - you would be able to access it via the Data Bank network. Each user would be able to delegate access, subject to the terms of any contract with parties up the chain. Officers of any Local, State and National body would also have access based on their existing statutory rights to get access to the property/data.

Another key requirement is ‘certification’. Just as 2D plans are lodged and signed to certify ‘truth’, so it must be possible for each authorised entity to lock any part of the model with their own ‘digital certificate’ (to set the bounds of liability). For example, the engineer may certify and lock the final structural design, while the local council may certify and lock the model ‘as approved’, and the construction company and building inspector do the same for ‘as built’. A bank or insurer may also put their own locks on - to ‘fix’ the model used to set their rates. Just as it is not legal to change or destroy lodged 2D paper plans and documents without going through a process, the same would apply to the 3D world of electrons within the VANZ framework. Without such processes, the risk is that virtual copies and versions abound, including changes made ‘after the fact’, making it difficult to know ‘the truth’ – at huge cost and inconvenience to the community at large.

Under the proposal, 3D data gathering, data holding and data modelling services are all intended to be market driven - within the new legal framework - ensuring competition, and promoting innovation.

6. What is the Business Case?

Throughout the property cycle, stakeholders now suffer long delays and considerable cost in gathering and processing information about any building, the utilities that service it, and the regulations
The opportunity is to create a legal and commercial framework that allows stakeholders to capture savings at every stage of the property cycle, while generating substantial income for Technology Providers, Local Councils, Titles Offices and ‘Data Bank’ operators. All parties (government and private) could charge a small fee every time any model is accessed by any person, and/or a time based subscription. These charges would cover the cost (and profit) to provide the service. Ultimately, they will be passed on to the owner, who will happily pay, as they are expected to be much less than current costs. It is expected that most small councils would use commercial Data Banks on a fee for service basis. Dial Before You Dig could provide ‘Data Bank’ services for Utilities. For major cities, the potential cash flow from having their own Data Bank is huge, given the scale and value of ‘property-related’ transactions that occur across all sectors on a daily basis, particularly in relation to the management of existing buildings.

For Councils, any ‘Data Bank’ role would be independent of its Local Government role, subject to the new National Framework. Access by council officers to any private model would be possible only to progress a specific planning or building approval, or for other lawful purposes. This should encourage owners of existing buildings (that have no current application before council), to lodge their own model with a council Data Bank – knowing their privacy is protected.

Regardless of which entity holds their data, the owner (and other authorised users) would have the same access rights via the Data Bank network to all other third party data they are entitled to view, eg the municipal and utility models that relate to their property, as well as the Cadastre and the legislation that impacts it. Whether an owner chooses to lodge with a council or commercial Data Bank, or none at all, will ultimately depend on the cost and service offerings… as with ‘money banks’.

Owners (and other authorised users) will benefit from lower overall cost and faster response times, as well as more accurate data (over time) as a result of the integration service provided by the Data Banks. Users will also be able to see any property in its ‘official spatial context’ (the City’s own model, used for all planning and building purposes), as well as having access to the models of every ‘utility’ servicing a property.

We are already seeing benefits on a project by project basis. For example, using 3D City models to speed approvals by as much as 80% (reference the work of Urban Circus), as well as using 3D Building Information Models to reduce cost in the design and construction phase by 20% or more (based on recent UK experience). In simple terms, use of the model has the potential to speed processing while reducing errors and cost for owners and all other parties involved throughout all stages of the ‘property-cycle’. In addition, some owners and managers are just now starting to expand the technology into asset and facility management. With life-time operating costs up to twice the build cost, the additional potential productivity benefits are huge. It is these savings that can finance the creation of the Data Bank network.

As well, the ‘authorised virtual world’ will fundamentally change the way we hold and access data that has a ‘spatial’ context. LiDAR and Photogrammetry ‘point cloud’ models can be conceived of as 3D filing cabinets. The idea is to use ‘pattern recognition’ software and human skill to identify specific objects within each model (such as pipes, equipment and fittings, etc.). Already the technology exists to do this automatically to some degree, and is rapidly improving.

This ‘feature recognition’ can be done on an ‘as needs’ basis, with all information about any object being attached to its virtual counterpart (eg details of the manufacturer, cost, material, maintenance manual, even an operating video of, say, a pump) – as needed. This information can then be accessed by simply pointing a camera in a smartphone, tablet or ‘glasses’ at the physical object (using ‘pattern recognition’ where ‘the camera’ knows its location and the direction in which it is pointing), or by clicking directly on the virtual object in the model. Similarly, other data can be related to specific statistical and administrative boundaries – accessible by a ‘click’ on the boundary.

No more searching for information in physical filing cabinets, or through asset registers or computer folders. No more panic when the person managing the facility is away and no one else can locate the needed information. No need to understand ‘plans’, ‘elevations’ and ‘sections’. No more having to think in ‘categories’ to search. Just locate the object in 3D ‘space’ (real or virtual) and point at it, asking what you want to know. Of course the reverse would also hold. If you know ‘what’ you
are looking for, but not ‘where’ it is, you will also be able to locate every object by simply asking about it, and have the model highlight its location... so you can go straight to it. Or ask how many there are and where, or values, etc... and have the answer instantly displayed.

The model (in its full spatial context) will also become the basis for assessing property values, as well as for finance, insurance and lease 'condition' reports. It will be used to quote rates and premiums (based on the building in its spatial context) and also for emergency response, disaster recovery and claims processing – saving cost, time and lives. When you add it up, the business case for an ‘authorised federated fully-integrated secure 3D virtual world’ is compelling.