

An InfoVista White Paper

Cityscapes HD - Delivering Accuracy "Out of the Box"



Executive Summary

Advanced wireless technologies continue to be deployed around the world to enhance data throughput on limited spectrum. The requirement for network design and optimization software to accurately model complex technologies and environments has never been greater. While advances continue in network design and optimization software like InfoVista’s Planet®, the critical geodata input used within them has remained largely the same. InfoVista’s innovative new Cityscapes HD Geodata, which delivers variable height attributes to a clutter layer that has historically had a single assigned value, can dramatically assist wireless operators in their rollout of 3G and LTE networks. Untuned Cityscapes HD data provides comparable results to tuned 2D medium-resolution data providing a dramatic reduction in drive-test expenditures and related tuning efforts. Accuracy “out of the box,” combined with an attractive pricing model makes Cityscapes HD a compelling value for metropolitan areas.

Today’s wireless subscribers’ obsession with mobile data is sending shockwaves throughout the wireless vendor ecosystem. According to the 2013 Cisco VNI report, smartphones represented only 18 percent of total global handsets in use in 2012, but represented 92 percent of total global handset traffic. In 2012, the typical smartphone generated 50 times more mobile data traffic (342 MB per month) than the typical basic-feature cell phone (which generated only 6.8 MB per month of mobile data traffic). Of course, smartphones represent only one device type, with tablets, laptops and M2M devices adding their own impact on the capacity delivered through today’s wireless networks.

Wireless operators are responding to this increase in demand for mobile data by deploying more spectrally efficient networks. According to the GSA, an industry vendor group, there are 473 operators in 138 countries investing in LTE networks as of Q3 2013, with over 126 million LTE subscriptions worldwide. Based on its initial pace of deployments, LTE is the fastest developing mobile system technology ever. Wireless operators and their vendors are scrambling to deploy WCDMA/LTE overlays, and in some cases greenfield deployments, in conjunction with new architectures centered on the concept of heterogeneous networks (i.e., using a variety of cell types including macro, pico, WiFi) and technologies (e.g., GSM, WCDMA, LTE) to deliver capacity in the most efficient manner possible.

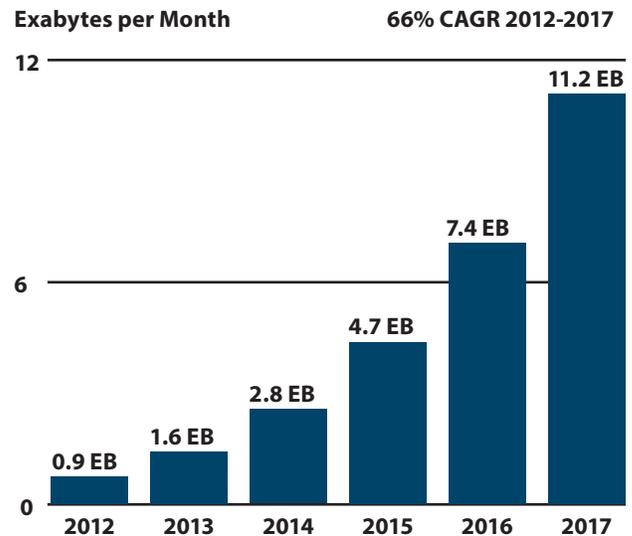


Figure 1 – Mobile Data Growth Forecast¹

Operators are deploying new technologies, acquiring new spectrum and improving engineering processes in an attempt to keep up with surging demand for mobile data on a host of devices.

¹Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2012–2017 February 6, 2013 page 5

With advanced technologies being implemented to squeeze more data throughput, the requirement for network design and optimization software to accurately model complex technologies and environments has never been greater. Interestingly, with the advances in network design and optimization software like Planet, the geodata used as a critical input to their simulations has remained relatively the same since their inception. Until now...

What if there was a new type of geodata that provided accurate predictions untuned? Imagine the drive-test savings. Cityscapes HD delivers accuracy “out of the box.”

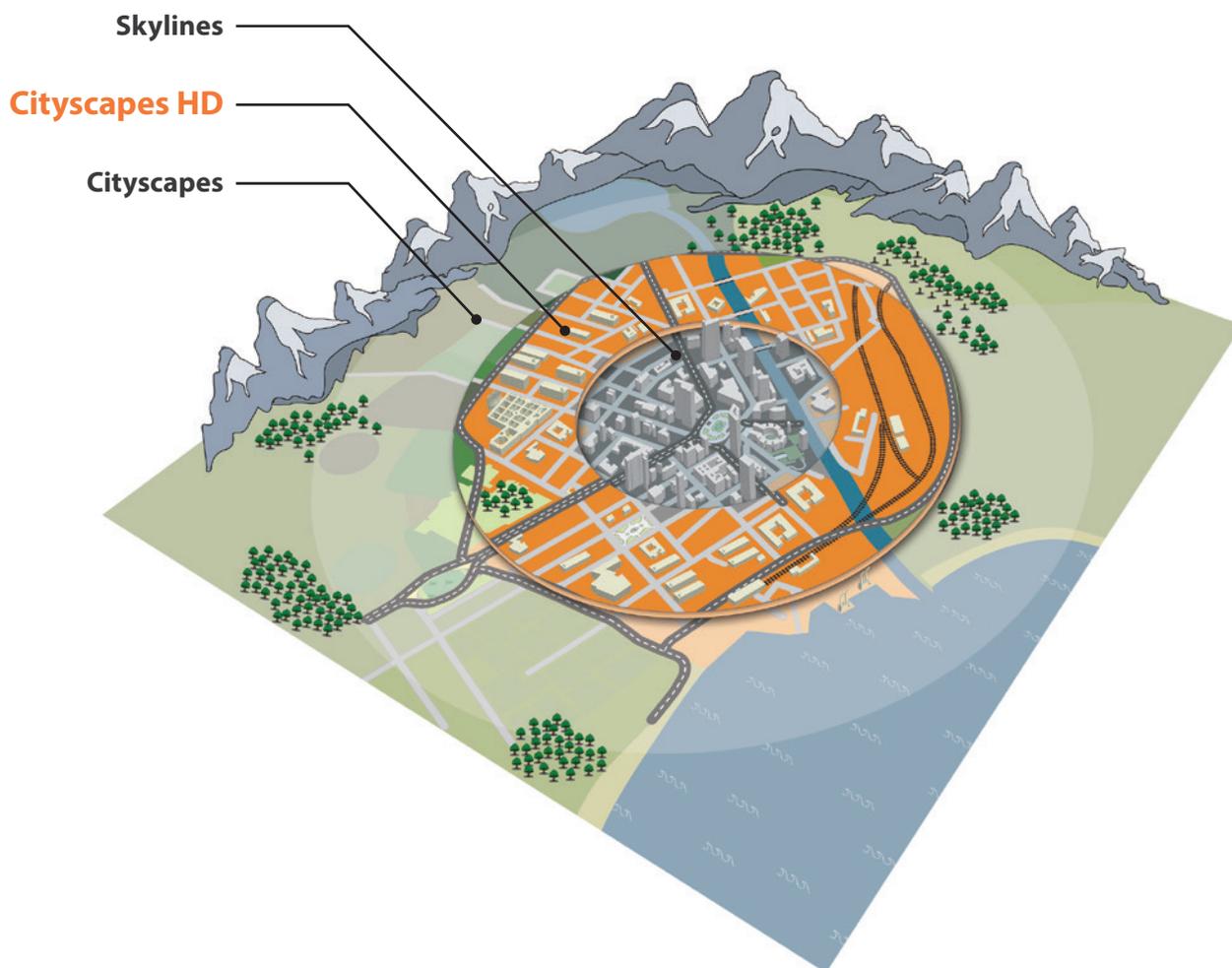


Figure 2 – Introducing Cityscapes HD

InfoVista's innovative Cityscapes HD Geodata, which introduces variable height attributes to a clutter layer that has historically had a single assigned value, will assist wireless operators in their rollout of 3G and LTE networks.

Network Design - Simulating the Wireless Experience with Accurate Geodata

Since the introduction of the first network design tool Planet in the early 90's, geodata has played a critical role in RF simulations and the wireless planning process. Network design tools are used daily by the engineering team throughout the network lifecycle: in initial dimensioning work and greenfield planning, compliance, inventory and asset management as well as ongoing optimization processes. As the goal of any simulation is to represent the real world where wireless networks are deployed; accurate geodata is critical. Without an accurate world model, it does not matter if the propagation models employed are the most efficient as there will be inherent inaccuracies in the simulation from the start.

Geodata Basics

While network design tools have evolved tremendously since their inception, the geodata they employ has remained largely the same – even if its availability and resolution has improved. Geodata is geographical information provided in databases derived from satellite, aerial or radar imagery, as well as traditional maps. There are five layers of particular interest to RF engineers:

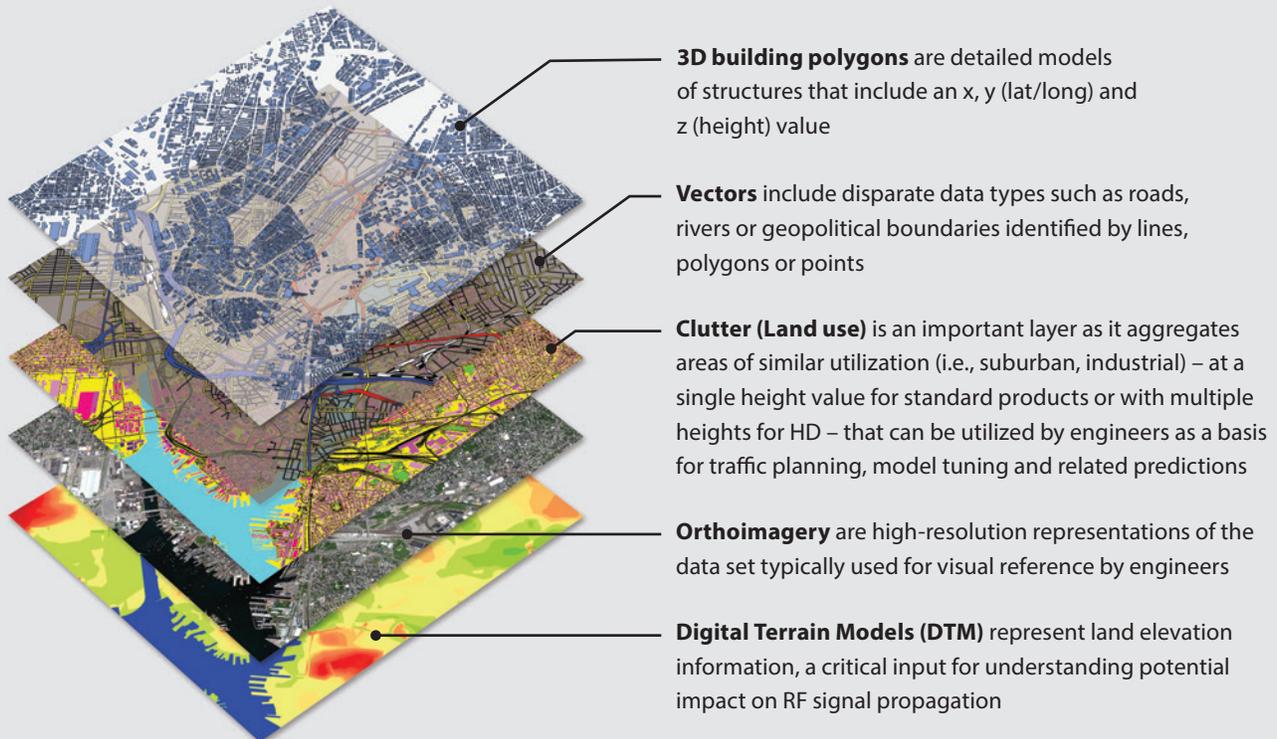
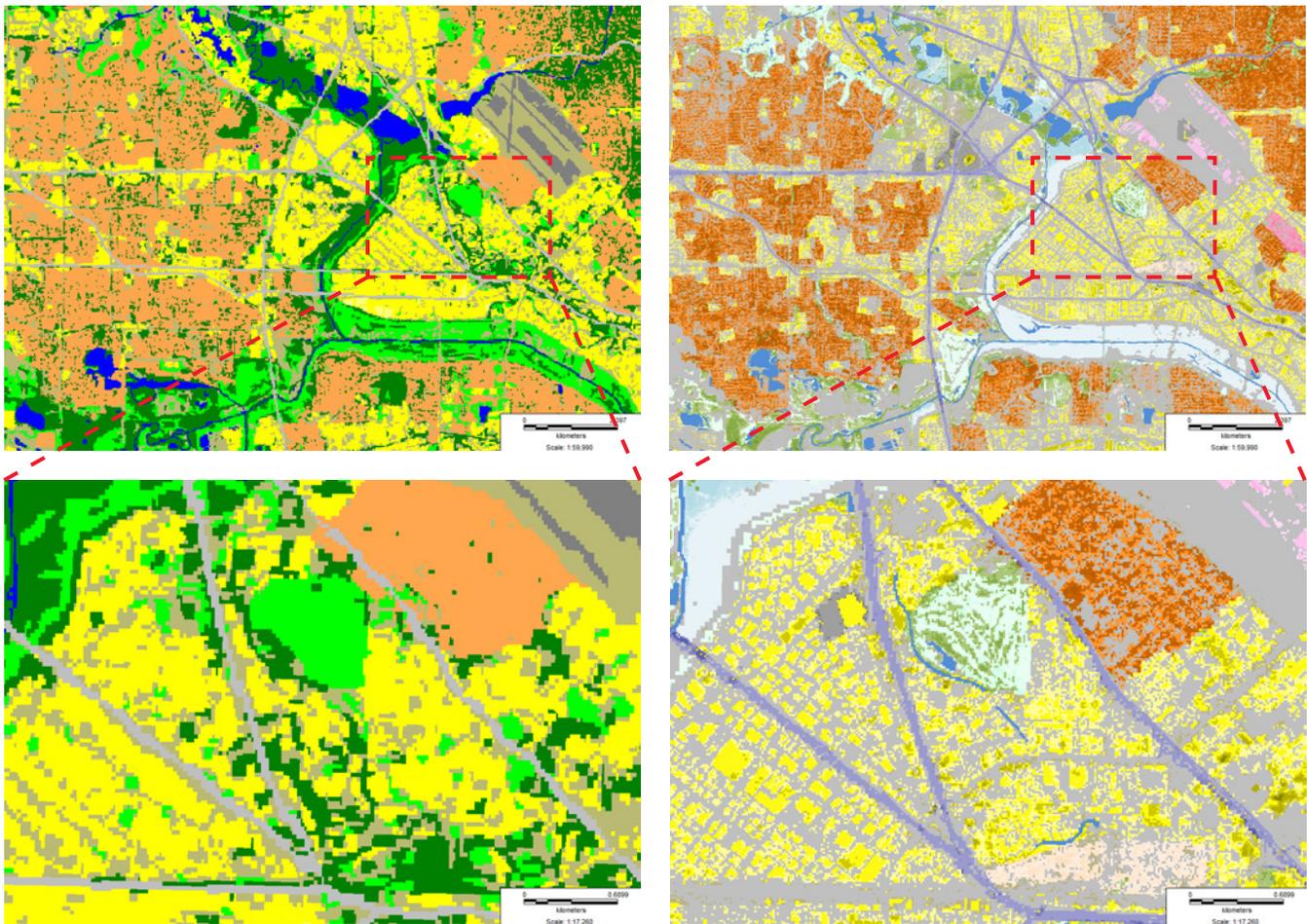


Figure 3 – InfoVista Geodata Layers Applicable for RF Engineers

Geodata is typically delivered with layers requested by the customer. Greater satellite availability and advances in satellite imaging capture techniques means more imagery is available to enable geodata creation.

Typical data sets provided to wireless operators for network design purposes will include the layers on the previous page, with DTM and clutter provided at 10-30m resolution. If the area includes a dense urban area (i.e., with high-rise buildings) 3D building polygons will also be purchased. This geodata layer, called Skylines in the InfoVista portfolio, is the highest resolution (1-5m) and best overall product where and when available for all network design. However, it comes at a price premium to 10-30m medium-resolution data. Engineers have traditionally needed to justify the improved accuracy offered by the 3D data, with the move down to medium-resolution 2D data as the logical alternative. Cityscapes HD provides an attractive option for engineers planning and optimizing the suburban/industrial areas that are critical for wireless operators, but that are not optimally addressed by traditional high-resolution 3D or medium-resolution 2D data.



Cityscapes, 30m

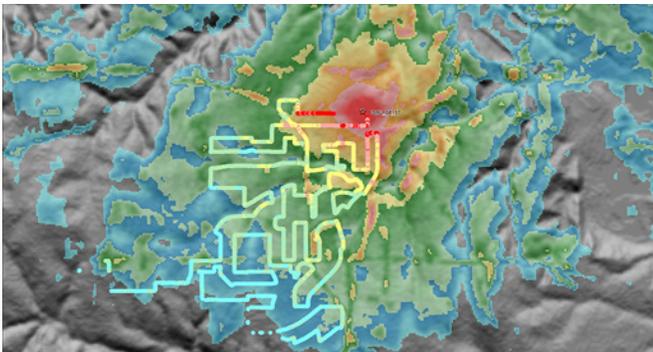
Cityscapes HD, 10m

Figure 4 – The HD Difference – The Importance of Height Values

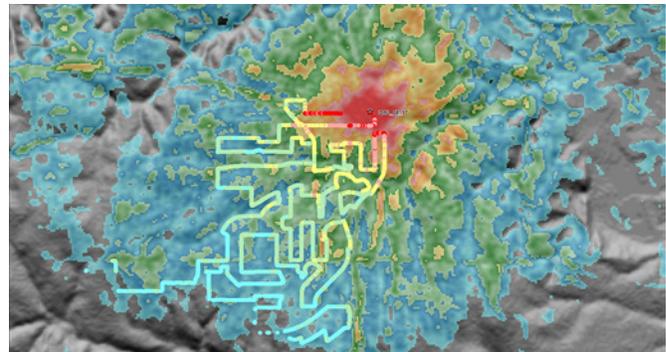
Engineers like the accuracy delivered by 3D data because the height obstructions are critical for accurately modeling RF signal attenuation. With Cityscapes HD, users are provided varying height values per clutter type that offer a meaningful input to accurate predictions but at a much lower cost than 3D data. Cityscapes HD data provides more detail than medium-resolution data sets.

Network Design - Simulating the Wireless Experience with Accurate Geodata

InfoVista’s new Cityscapes HD geodata bridges the 2D and 3D network design environments. Created with the specific requirements of the telecom industry in mind, it provides a unique combination of high-accuracy and high-resolution geodata at an attractive price. Where traditional clutter provides a single height attribute, it is variable in Cityscapes HD. It makes this unique geodata ideal in areas where neither traditional medium resolution nor high-resolution 3D data optimally fulfills cost and accuracy requirements, e.g., in urban, suburban and industrial areas outside the city center or in smaller cities without a dense urban core. This footprint is of significant interest to wireless operators, given it is where large proportions of their subscribers live and work. With Cityscapes HD, engineers can consider buildings and vegetation that will impact propagation characteristics – at a fraction of the cost of 3D data. This translates into higher accuracy in the network planning of large areas, with better network related decisions and higher return on investments (ROI).



A Prediction Using Traditional 30m Cityscapes Data



A Prediction of the Same Site Using 10m Cityscapes HD

Figure 5 – Making RF Predictions HD – Without Model Tuning

Using an untuned model, it is possible to deliver very accurate predictions with Cityscapes HD. Note the more detailed coverage predictions and similarity with the drive-test data displayed on top of the predictions for the CityScapes HD data.

Simulation and Measurement Data

Propagation model tuning or calibration, as it is sometimes called, refers to a process whereby propagation models are improved based on observed values in the measurement data (i.e., drive tests). These values include the attenuation, absorption, fading and reflection that are affecting the radio waves. The goal is to create a propagation model for each morphology – typically an area with 3-5 clutter types or an area that has very common physical characteristics – based on 4-10 observed drive-test routes. Once the model is fully tuned, it is reused in other similar morphologies, providing accurate simulation results and reducing the need for further drive tests. Engineers that use well-calibrated models, with a high correlation to measured data, can reduce dependence on drive tests and improve their network performance.

Engineers grade propagation model accuracy by using key metrics for simulation results versus measurement data. The key benchmark value is RMS (Root Mean Square) error, a statistical measure of the magnitude of a varying quantity (i.e., a measure involving both mean error and standard deviation). Standard deviation illustrates the variation/dispersion from the mean value. Average offset should always be close to zero when tuning has been performed.

Performance	RMS	Average Offset	Correlation
Exceptional	< 6 dB	< 2 dB	> 0.90
Very good	6 dB – 7.5 dB	2 dB – 3 dB	0.85 – 0.90
Good	7.5 dB – 8.5 dB	3 dB – 5 dB	0.80 – 0.85
Fair	8.5 – 10 dB	5 dB – 7 dB	0.70 – 0.80
Poor	> 10 dB	> 7 dB	< 0.70

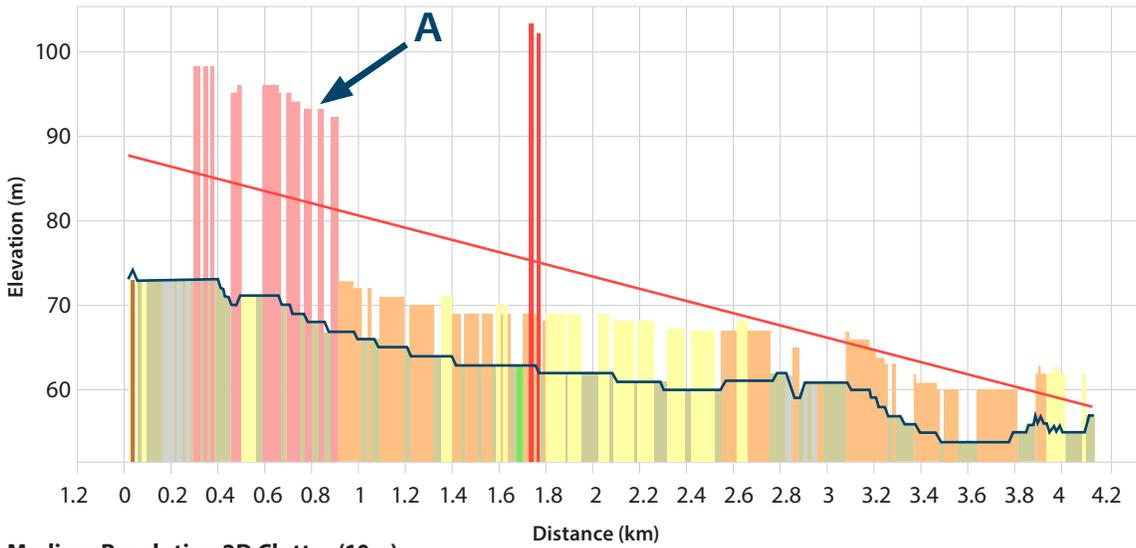
Table 1 – Target Values for Propagation Model Accuracy

Values derived by InfoVista. Achievable values depend on the type of tuning undertaken, accuracy of measurement data and geodata.

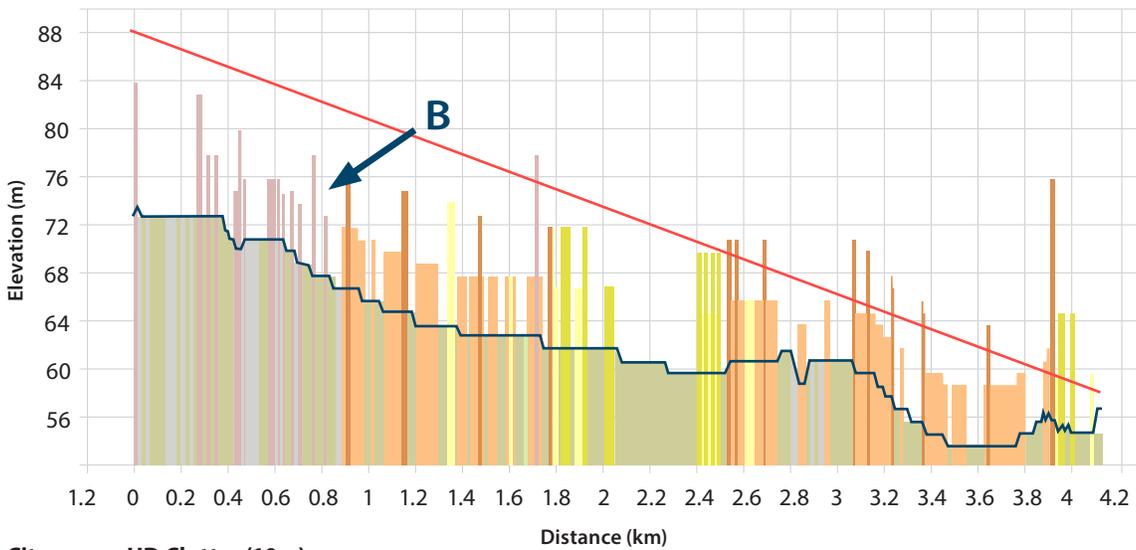
When calibrating propagation models the field measurements should be utilized in an optimal way. Of course, to be meaningful, the models should be calibrated in conjunction with the most recent geodata that has been uniformly constructed (i.e., so that any clutter class is consistent in its composition across all areas). This is another potential area of concern. Allocating budget on drive tests that are used to calibrate propagation models for geodata that is knowingly stale is a waste of time – and money.

Accuracy “Out of the Box”

Typically delivered at 10m resolution, Cityscapes HD data includes individual height levels for each clutter bin or pixel. Standard 2D clutter provides a single height attribute per clutter type. The result is much higher granularity in the Cityscapes HD data. This granularity adds accuracy in the RF predictions in clutter classes that are tangential to urban core areas; particularly in suburban and residential areas with buildings under four stories in height, as well as business parks, shopping areas, industrial areas and train yards. All the clutter classes that constitute the area outside the dense urban core, but inside the city ring road, of large cities. For smaller cities they typically constitute the whole metropolitan area.



Medium Resolution 2D Clutter (10m)



Cityscapes HD Clutter (10m)

Figure 6 – Path Profile - The Importance of Accurate Heights

These two point-to-point profiles (transmitter on the left, receiver on the right) are of the exact same area. With traditional 2D clutter, a series of obstructions close to the antenna (indicated with arrow A) would dramatically impact the coverage prediction. The Cityscapes HD data shows that this area (indicated with arrow B) is clearly below the antenna height and would allow for better propagation further from the site.

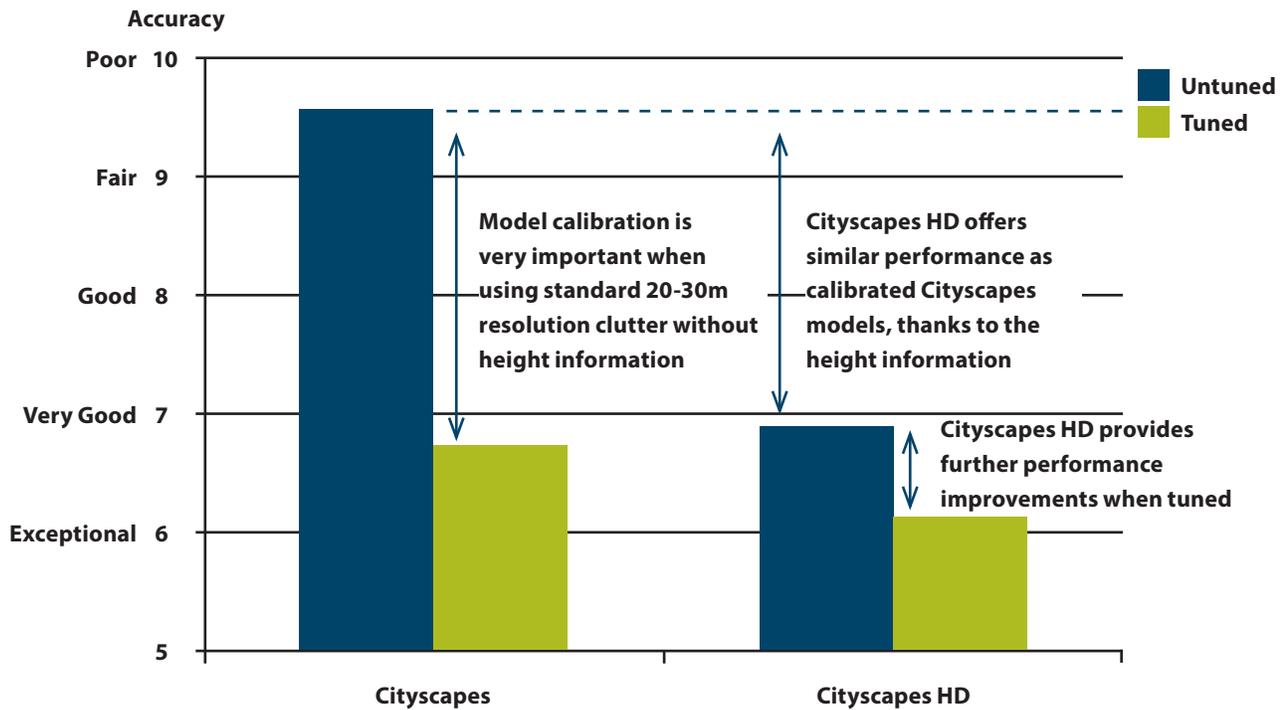


Figure 7 – Accuracy “Out of the Box”

An InfoVista study discovered that untuned Cityscapes HD data provided comparable results to tuned 2D medium-resolution data. A reduction in drive-test expenditures and related tuning efforts will more than offset any added expenditure for the Cityscapes HD data.

The Value of Cityscapes HD

Cityscapes HD provides three fundamental advantages to its users:

- Improved accuracy “out of the box” compared to tuned 2D data
- Cost efficiency for large metropolitan areas
- Reduced requirement for drive tests and related model-tuning expenditures

Cityscapes HD is not intended to replace 3D Skylines data. However, it can be used to replace areas where 3D building data might have been considered “nice to have” in the past but hard to justify from a budget perspective. Given that it can be used without being tuned, Cityscapes HD also saves time and money related to drive-test collection as well as the actual process of model calibration.

Key Considerations	Medium resolution data with tuned propagation model	Cityscapes HD with untuned propagation model	Cityscapes HD with tuned propagation model
Size of the area	2500 sq. km	2500 sq. km	2500 sq. km
Cost for new geodata	\$3000	\$25,000	\$25,000
Number of required tuned propagation models	5	0	2
Cost for drive test & calibration	\$125,000	0	\$50,000
Expected accuracy	Very good	Very good	Exceptional
Cost	\$128,000	\$25,000	\$75,000

Table 2 – Reduction in Drive Testing

Using only two calibrated models – as opposed to a standard of 5 per morphology recommended by many model-tuning experts – it is possible to get excellent results with Cityscapes HD data. The example above illustrates more than 40% savings for one market area.

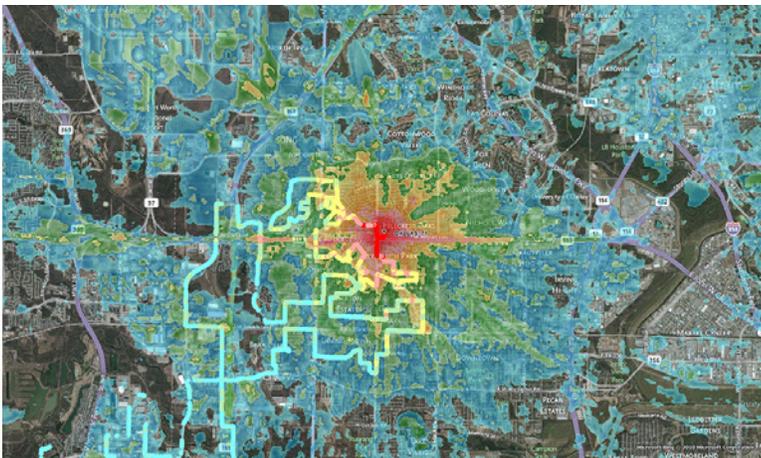


Figure 8 – Cityscapes HD Tuned: Less Drive Tests for Calibration

While a primary benefit of Cityscapes HD is its accuracy “out of the box,” the geodata will provide even more accurate results with tuned models. The good news: tuning typically takes fewer surveys than standard models developed using medium-resolution 2D data. Note the similarity between the coverage prediction and drive-test data.

Clutter Data for Every Environment and Budget

As a vertically integrated company with network design software, geodata production and model tuning services, InfoVista provided the perfect environment for long-overdue innovation in the field of geodata. Cityscapes HD delivers a hybrid product that fills a niche between traditional 2D low-cost, medium-resolution and 3D high-cost, high-resolution data. Its ability to provide accurate results “out of the box,” means it will pay for itself in reduced drive tests and related model-tuning exercises. It also allows for more concentrated purchases of Skylines data, dedicated to where this product provides its greatest value: dense urban areas.



Figure 9 – Clutter Type, Resolution and Accuracy - Recommendations in the InfoVista Geodata Portfolio

The InfoVista Geodata Department can source products to meet all of your requirements for price, vintage and resolution – anywhere in the world.

InfoVista Geodata delivers a set of telecom-grade digital mapping data products designed specifically to work with network planning and optimization software products, including those developed by InfoVista and others in the industry. Cityscapes HD is a unique product that demonstrates our commitment to innovation in this industry. The Geodata portfolio has the breadth to provide operators, vendors and consulting firms with products that fulfill their map requirements. Unlike generic geodata suppliers, InfoVista Geodata products are specifically designed to deliver best-in-class radio performance to the telecom sector, and are adapted to operator budgets.

To learn more about Cityscapes HD and the InfoVista Geodata portfolio, visit www.infovista.com

About InfoVista

InfoVista is the leading provider of IP and RF planning, assurance and optimization software solutions and services that enable efficient network and IT transformations. Our award-winning solutions empower communications service providers and IT-intensive enterprises to deliver high-performing and differentiated services while cost-effectively planning, operating, optimizing and monetizing their network. InfoVista's combined expertise and technology innovations in radio and IP networks provide more than 550 customers worldwide with a new level of network intelligence, visibility and control across the entire network life cycle. Using InfoVista's solutions, they deliver optimal quality of service, ensure a high-quality user experience, invest appropriately and consolidate their OSS/BSS ecosystems while keeping total cost of ownership as low as possible. For more information, please visit www.infovista.com.



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