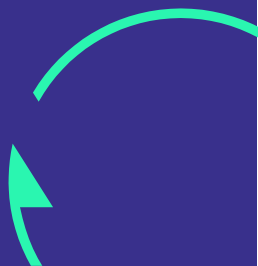




## MS3112 GNSS Foresight Subscription Service for Automotive

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GNSS performance forecasting tool



# GNSS Foresight Subscription Service for Automotive

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## Purpose of this Document

This datasheet describes Spirent's GNSS Foresight Forecast Service for Automotive, a tool available via subscription that provides users with an easily interpreted forecast of GNSS performance for a customer defined time and area of interest.

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# GNSS Foresight Subscription Service for Automotive

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## Referenced Documents

- a) MS3115 Foresight Risk Analysis
- b) MSSA Master Subscription Services Agreement

## Glossary

AD	Autonomous Drive
ALC	Automated Lane Control
AOI	Area of Interest
API	Application Program Interface
ATM	Air Traffic Management
AWS	Amazon Web Services
Az	Azimuth
BVLOS (BLOS)	Beyond Visual Line of Sight
CDN	Content Delivery Network
COTS	Commercial Off-The-Self
DEM	Digital Elevation Model
DOP	Dilution of Precision
DTM	Digital Terrain Model
EI	Elevation
GA	General Availability
GNSS	Global Navigation Satellite Systems
MS	Marketing Specification
MSSA	Master Subscription Services Agreement
OS	Operating System
OTF	One Time Forecast
PDOP	Position Dilution of Precision
PosApp	Positioning Application
RA	Risk Analysis service
SDSP	Supplementary Data Service Provider
SV	Satellite Vehicle
TB	TeraByte
UTM	UTM Unmanned Aircraft System Traffic Management

# GNSS Foresight Subscription Service for Automotive

## Introduction and scope

Spirent's GNSS Foresight is a cloud-based forecasting service that uses 3D maps and precise orbital information to enable users to find out where and when GNSS will be reliable, allowing them to plan routes to optimize navigation performance and operate safely.

Spirent's GNSS Foresight solutions are provided as a Risk Analysis report (see Ref.a) above), or as cloud delivered Forecast Service, the subject of this document.

GNSS Foresight works by ray casting each GNSS satellite's line-of-sight availability over an Area of Interest e.g. along a route, using high-definition 3D maps and precision orbital models. The Foresight engine calculates with a high degree of accuracy the times and locations at which each satellite will be obscured by buildings or other impediments, accurately predicting satellite availability and associated positioning performance.

## Foresight Forecast Service

*Second by second predictions for assured navigation in challenging environments*

Where buildings and obstructions interfere with GNSS, such as urban areas, the GNSS Foresight Forecast Service provides second by second predictions to ensure GNSS continues to meet operational requirements for PNT. Locations and routes previously viewed as unreliable for GNSS navigation now become predictable and accessible for expanded operations.

The Forecast Service calculates GNSS availability across a geographic area, every second, from 1 – 100 meters above ground level for up-to three days<sup>1</sup> into the future. The data can be accessed via an Internet accessible API, with data response within seconds.

The Forecast Service is available as an annual subscription by service area.

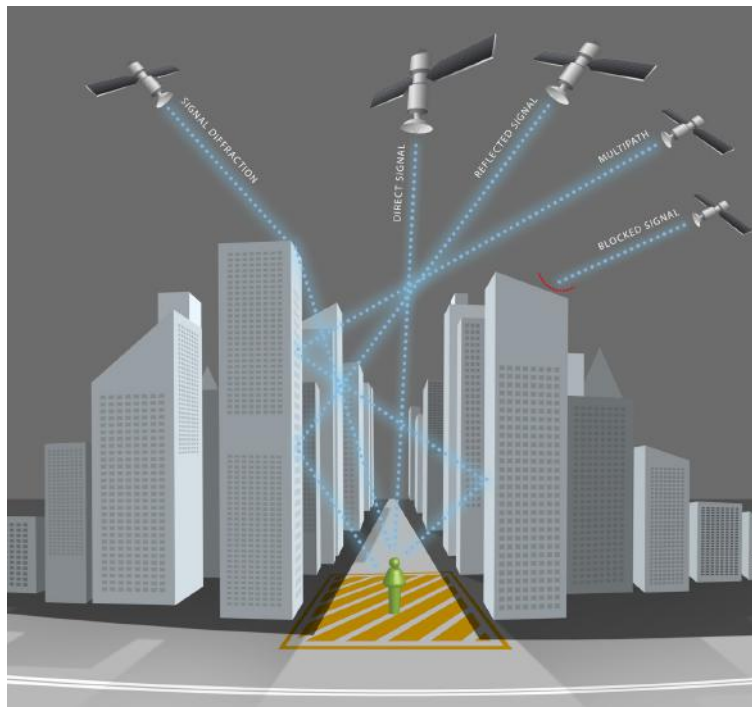


Figure 1 GNSS Signal Obscuration or shadowing

<sup>1</sup> 24hrs by default, longer by arrangement.

## Use Cases

### Know in advance

Autonomous Vehicles (AVs) operate in environments where obstructions to GNSS signals are common, resulting in unpredictable GNSS navigation performance. A forecast of GNSS signal reception based on the actual city environment, including buildings and other signal obstructions, can ensure the AV knows the expected performance, and knows when to utilize & prioritize GNSS as part of the navigation solution. This knowledge informs user's route planning<sup>2</sup> by forecasting GNSS quality for all possible routes between point A and point B.

### Performance and Reliability

GNSS sensors are common across virtually all AVs, delivering a high level of availability. However, users need a system that can be relied on consistently. Spirent's GNSS Foresight gives users the confidence to qualify and quantify their GNSS positioning data, identifying safe areas of operation, and detailing challenging areas.

For example, assume an automated vehicle approaches a slow-moving vehicle 300 meters ahead. To safely perform an overtaking maneuver, a DoP of 2.0 is needed to provide and maintain the required 0.3m or better positioning accuracy. With Foresight, it is known ahead of time whether a safe automated lane change to overtake is possible along this specific section of route. In this way, GNSS Foresight can be used to improve quality control and integrity of accurate GNSS positioning.

### Route Selection

Using Foresight's precise modeling, users can plan a route with the best GNSS availability, know when to utilize GNSS, and when to rely on other sensors to traverse an area safely. Furthermore, fast data response times mean these decisions can be made in real-time. Assured navigation planning enables you to save time, plan better, and deliver consistently, gaining the greatest return on your investment in autonomous technology by maximizing availability and reliability of a proven technology. Any detours due to traffic can quickly be recalculated to continue achieving optimized Autonomous Drive (AD) feature performance. For example, the Foresight user may deploy a system that enables vehicle infotainment systems to present the vehicle operator with three routes: the fastest, most efficient, and most AD enabled route. The driver then chooses their preferred route.

### Performance Improvement

Satellites are in constant motion, meaning GNSS positioning precision fluctuates constantly due to changes in line-of-sight satellite availability. With GNSS Foresight, users can accurately predict when and where their systems will operate accurately, enabling more reliable absolute position performance.

Table 1 Summary examples of use cases

Embedded	<ul style="list-style-type: none"> <li>• Support real time functionality by providing situational awareness e.g. Autonomous Drive, V2X, automated lane keeping</li> <li>• Forecast of GNSS availability for upcoming intersections</li> </ul>
Software	<ul style="list-style-type: none"> <li>• Forensic aftercast e.g. understand possible sources of observed performance</li> <li>• Autonomous systems L1 through L5 e.g. ensure appropriate strategies deployed based on GNSS confidence level</li> </ul>
Operations	<ul style="list-style-type: none"> <li>• Route planning e.g. to avoid GNSS compromised routes.</li> <li>• Test route optimisation e.g. optimise field trials to ensure desired impairments are encountered</li> </ul>

<sup>2</sup> Route planning not provided by Spirent's GNSS Foresight service.

# GNSS Foresight Subscription Service for Automotive

## Deliverables

GNSS Foresight creates **GNSS signal confidence level maps** as datasets, through **GNSS forecasting algorithms** and **accurate environment models**. The cloud-based system generates data that can be accessed and processed by the user via a powerful API.

Subscription to the service, available on a 3-month or annual basis, provides the user with an account that enables access to the Foresight generated dataset for the users defined area(s) of interest. Forecast downloads are initiated by the user via the supplied Application Program Interface (API), and delivered by the Content Delivery Network (CDN).

Deliverables are authentication details (key) and API documentation.

## Features and Capabilities

The Foresight toolset is subject to constant development and so the following list may not be exhaustive. Please contact Spirent for current user documentation or to enquire about any features not listed below.

Table 2 GNSS Foresight features

Feature	Note
Satellite visibility	LOS, SV azimuth and elevation
GNSS Constellation Support.	Multi-GNSS operation incorporating GPS, Galileo, GLONASS, Beidou and QZSS.
DOP basis	Dilution of Precision calculated using the line of sight satellites from all constellations combined.
DOP type	PDOP,
Forecast time	Up to 72 hours in advance of current time
Resolution	1m X 1m X 1m X 1s resolution at ~1m AGL to 5m AGL Variable spacing depending upon obscuration environment beyond this, up to 100m AGL
API request rate	50 <sup>3</sup> End user API requests per minute of 1kmx1kmx1m size with <500ms latency (additional capacity available on a per customer basis)
Interface	a) Fully featured and documented API b) Account management via web admin console

<sup>3</sup> Higher rates upto 500 requests per minute available by arrangement.



## Overview

### System Architecture

There are three building blocks for the GNSS Foresight system:

- 1) Forecast Engine is where the forecast calculation is carried out using 3D high-resolution maps, terrain data, and satellite orbit information
- 2) Content Delivery Network (CDN) is used for edge caching and real-time data delivery.
- 3) Web Admin Console is designed for API key and user management

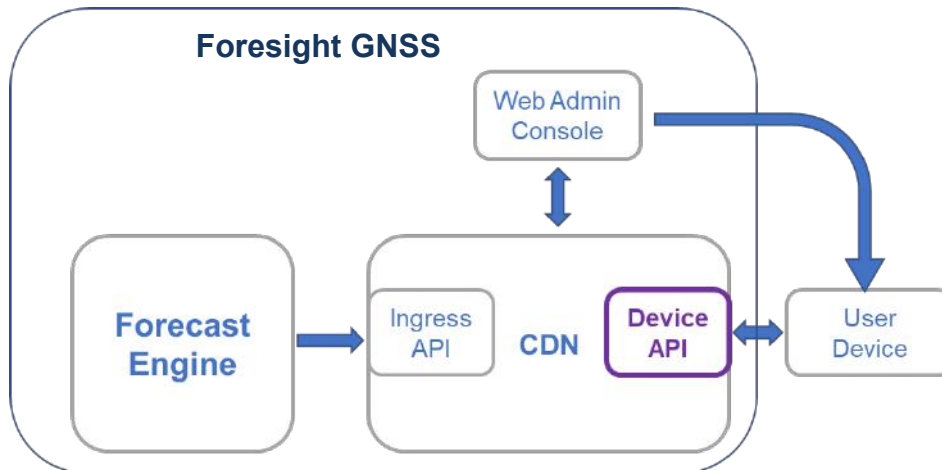


Figure 2 System Architecture Overview

### Accessing Foresight data

Supported data types and API methods are detailed in the API documentation provided

- The forecast is conducted and a list of files (Manifest) containing the data and available for download is generated
- The user (user application) selects from the manifest file and downloads the required data

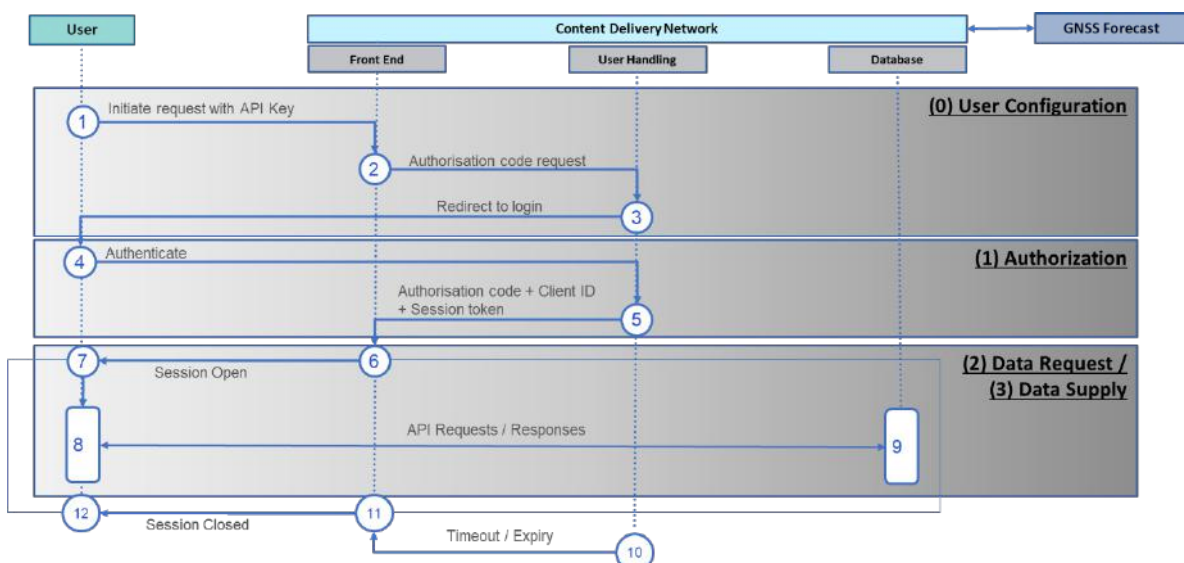


Figure 3 High Level API Flow

# GNSS Foresight Subscription Service for Automotive

## Foresight Integration Support

Deployment of Spirent's GNSS Foresight can be accelerated by using Spirent's technical staff to assist in integration and verification. Spirent Integration team can support the design, execution and reporting of on-site trials.

Spirent's dedicated team can assist with your unique application saving time and money and ensuring that you secure the benefits of Foresight that you need for your business.

## Ordering Information

Initial subscriptions for a given area of interest (AOI) will use the "subscription" part codes. Pricing encompasses setup and initialization. Subsequent renewals will use the "renewal" part codes.

Note that Integration Support and Visualization parts are recommended but optional.

Table 3 GNSS Foresight for Automotive part numbers

Part Number	Description
FORESIGHT-GN-A-001	FORESIGHT GNSS AUTOMOTIVE ANNUAL SUBSCRIPTION (MS3112)
FORESIGHT-GN-A-002	FORESIGHT GNSS AUTOMOTIVE ANNUAL RENEWAL (MS3112)
FORESIGHT-GN-A-003	FORESIGHT GNSS AUTOMOTIVE QUARTERLY SUBSCRIPTION (MS3112)
FORESIGHT-GN-A-004	FORESIGHT GNSS AUTOMOTIVE QUARTERLY RENEWAL (MS3112)
FORESIGHT-IN-A-001*	FORESIGHT INTEGRATION SUPPORT SERVICE FOR AUTOMOTIVE (MS3112)

\* optional

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## Terms

Note that access to the GNSS Foresight tool is provided under the terms of a Master Subscription Services Agreement (MSSA) that will be provided during the ordering process, is available online and will be supplied on request.

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Europe

Asia

## About Spirent Positioning Technology

Spirent enables innovation and development in the GNSS (global navigation satellite system) and additional PNT (positioning, navigation and timing) technologies that are increasingly influencing our lives.

Our clients promise superior performance to their customers. By providing comprehensive and tailored test solutions, Spirent assures that our clients fulfil that promise.

## Why Spirent?

Over five decades Spirent has brought unrivalled power, control and precision to positioning, navigation and timing technology. Spirent is trusted by the leading developers across all segments to consult and deliver on innovative solutions, using the highest quality dedicated hardware and the most flexible and intuitive software on the market.

Spirent delivers

- Ground-breaking features proven to perform
- Flexible and customisable systems for future-proofed test capabilities
- World-leading innovation, redefining industry expectations
- First-to-market with new signals and ICDs
- Signals built from first principles — giving the reliable and precise truth data you need
- Unrivalled investment in customer-focused R&D
- A global customer support network with established experts



## About Spirent Communications

Spirent Communications (LSE: SPT) is a global leader with deep expertise and decades of experience in testing, assurance, analytics and security, serving developers, service providers, and enterprise networks. We help bring clarity to increasingly complex technological and business challenges. Spirent's customers have made a promise to their customers to deliver superior performance. Spirent assures that those promises are fulfilled. For more information visit: [www.spirent.com](http://www.spirent.com)