POSTMAN

GNSS
VISUALISATION
SOFTWARE

imaginationware

[Background]

The transition from traditional radio-positioning systems to GPS for use in offshore precise-positioning was revolutionary. Radio-positioning was logistically, technically and operationally onerous, so when GPS appeared and began routinely providing accurate positioning globally and with apparent ease, the transition to GPS was incisive and quick.

Although the science behind GPS was well known and was not dissimilar to that used in radio-positioning, the dramatic increases in performance and availability led to an initial scepticism and a subsequent need to understand the position solution more fully, especially as at this time it was being produced within the GPS receiver itself.

Differential GPS corrections injected into the receiver and coupled with internally produced measurements resulted in a calculated position which was then output to the client system. Users therefore had no visibility of, or control over the mechanics of the position calculation.

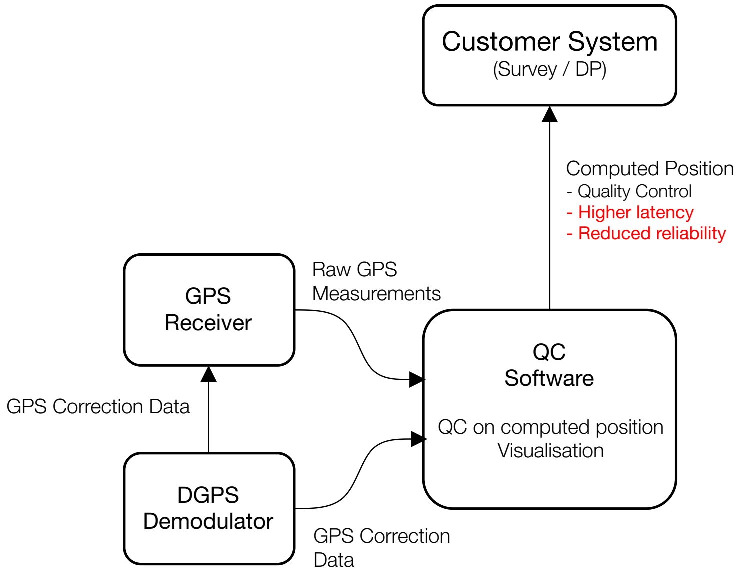
To gain a better view and build confidence, external position processing, or DGPS QC software was developed, which extracted the raw measurements from the GPS and DGPS augmentation receivers (demodulators) and then combined these into a proprietary position calculation.

Although the subsequent position was now understood, the need to transfer raw data from the GNSS and augmentation receivers meant degraded position latency and a potential loss in reliability, however, with all of this data, the software was able to provide comprehensive visualisation of position performance and status.

So, the original purpose of what has become generically referred to as DGPS Quality Control (QC) Software, was to provide recalculation of the position independently of the GPS unit, which was largely seen as a "Black-Box", to provide users with full control and visibility of and ultimately confidence in the position calculation.

GNSS QC Software has subsequently remained much the same over the years, although some providers have added functional enhancements ranging from navigation to position monitoring, as well as extended position calculations, such as the determination of attitude or position derived from multiple antennas or tidal reduction.

The main issue now is that whilst there remains a role for separate GNSS visualisation, safety and commercially critical operations require optimum performance and the extra latency and reliability concerns that this external calculation brings is sub-optimal and unacceptable. Making the transition from an industrial tool to a truly defined product requires a significant rethink.



Traditional QC Software Configuration

Configuration	Issues
Hardware + External QC Software	- Increased Latency of raw data link - QC of incorrect position - Reduced reliability based upon data link
Larger hardware with embedded PC and QC software	- Compromised HW - vents and fans risking corrosion and overheating - Limited visualisation due to restricted graphics capability - Screen in wrong location - Distribution of VGA - added noise, additional cabling

Issues with Traditional QC Software Configuration

[The Rethink]

Before creating a new product it is essential to set out with a clear understanding of the problem that the product is going to solve - from here will come the solution and thereafter the form, well, as one famous engineer and car designer stated If you analyse the function of an object, it's form often becomes obvious [Ferdinand Alexander Porsche].

So we took great time and effort to fully understand the problem, which is that as a real-time user of positioning we want the best position solution possible, with the best availability, which includes; accuracy, resilience, reliability, and latency, however; to achieve this requires a number of fundamental issues to be overcome in the positioning hardware unit, data communications and software architecture.

[Processing, Latency and Heat]

Beginning with the desired outcome, we ultimately want confidence in the position being produced and for this we need to conduct two processes; Quality Control (QC) and Quality Assessment / Assurance (QA). Despite being used interchangeably these are two very different processes. QC is what we, as the producer of the position, do to detect and remove biases and any other position anomalies to ensure that the position is valid at all times possible. The second process, QA, is the assessment and reporting of the final position performance achieved. This is statistical in nature and relies upon substantial empirical information that is then used in both the computation models and final performance estimation.

To ensure position integrity and minimum latency, the hardware unit must have a sufficiently powerful processor, which in a smaller embedded device creates significant heat that must be managed. There are 3 possible solutions to this:

(a) Compromise the position processing to reduce computation burden

(b) Conduct the position processing on an external computer

(c) Integrate the PC into the mobile hardware

Option (a) clearly should be avoided whilst the issue with (b) is that significant latency is incurred and positioning reliability reduced due to the passing of raw GNSS and supporting augmentation data between the receiver and computer. Option (c) results in a compromised hardware product that must now contain fans or other active cooling methods meaning that the core hardware is open to the elements such as salt air and moisture. Furthermore, it is now a much larger housing, consuming more rack space and of course the visualisation is compromised by being presented on a small screen on the unit and in the wrong location. Extension of this then becomes a matter of distributing video signals to external monitors, which again has compromises such as noise interference, lower quality video etc.

So the optimum solution is that the core positioning is conducted inside the hardware product with the heat properly managed – we now have to consider the interface.

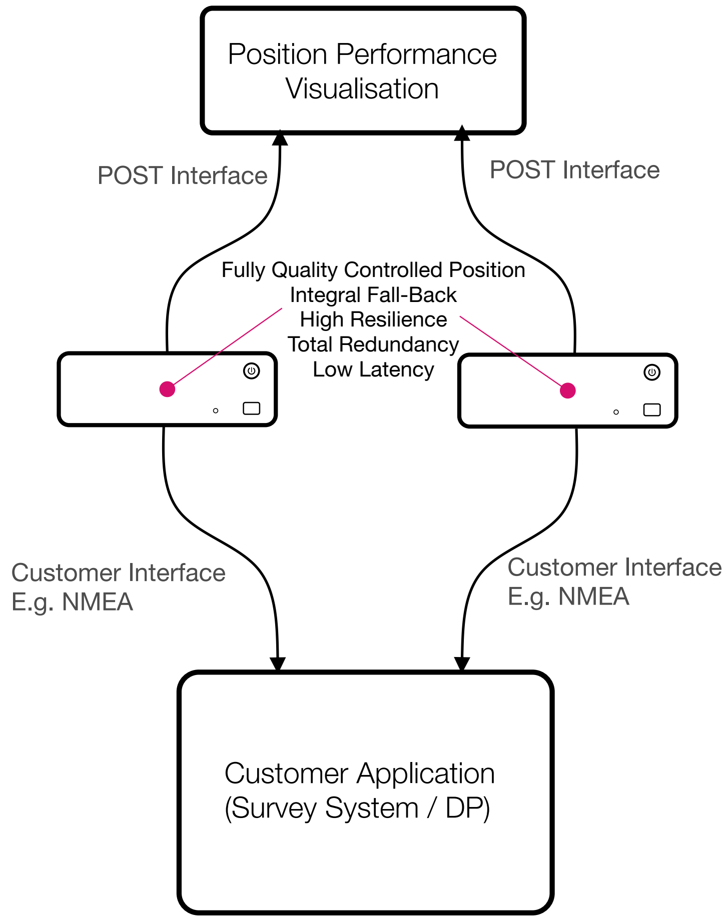
[Interfacing]

The next issue is to provide the required visualisation of all processing and quality information and for this a suitable interface is required...

There are a number of interface standards relating to communication of GNSS data, however, these are generally designed for some other purpose and are far from optimal for the high-end real-time positioning user. For distributing GNSS measurement data there are manufacturer formats, which are usually optimised for real-time communications but these are of course specific to each receiver. To overcome this and be able to share data, formats such as RINEX (Receiver Independent Exchange) were produced by the academic community as a standard for exchanging raw GNSS data. This is however designed for post-processing applications and being an ASCII format and with no integrity or data checking, is highly inefficient and inappropriate for real-time operations. Another example is RTCM (Radio Technical Commission for Maritime Services) V2, which is a format for communicating differential GNSS data such as Pseudo-Range Corrections. The origin of this format is actually not a telegram format at all but is a format for radio transmission designed for low-reliability radio links the result of which is heavy focus on parity rather than efficiency. RTCM V3 is a substantial improvement but again only addresses GNSS augmentation data.

Considering distribution of the final computed position, the main interface standard used is the ubiquitous NMEA, defined by the National Marine Electronics Association. This standard known fully as NMEA 0183 is actually an interfacing standard for marine electronics equipment such as radars, autopilots etc. As a result of its normal basic implementation, the format contains very little by way of quality assurance or detailed computation information required by our specialised needs. This interface is therefore compromised for high-end use but is the only viable standard available for product manufacturers to work with.

So the issue is that we, the scientific / professional positioning community, want to have fast, efficient and reliable data interface formats that provide comprehensive information on our positioning. So on the basis that the position computation is conducted inside an embedded unit the usual interface is not sufficient to provide adequate visualisation. For this we introduce [POST]...



Optimum QC Software Configuration

[POST]

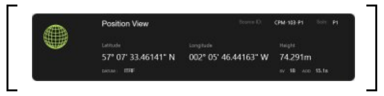
To provide the optimum interface we have designed and developed a proprietary interfacing standard that we call POST:

[**POS**itioneering **S**tandard **T**ransfer]

This is a highly efficient binary format that can be used over Serial, UDP, TCP and File transports and contains every piece of information imaginable relating to the positioning solution and its components including; position quality parameters, observations, statistics, hardware information such as temperature of electronics, CPU loading etc. etc.

The POST message format therefore provides a very efficient format for transferring data from the CPM that not only allows comprehensive visualisation of each position solution being provided to the end user but all aspects of the QC and QA too.

So at this stage everything is in its correct place. All positioning measurements and computations are produced in the CPM core hardware including full QC and QA with the low latency of an embedded system. All data required for comprehensive visualisation is available on an external computer via the POST interface. The final stage is to manage the POST data and for this we introduce POSTMAN…



Based upon information available in NMEA GGA

Based upon information available in POST Position
[same size as GGA]

[POSTMAN]

Of course, when there is POST, there must be a POSTMAN. Our POSTMAN is a very special one who is a key player in creating a very different experience in positioning software. POSTMAN is the name of our position visualisation software suite throughout which the analogy to a mail distribution service is used quite effectively.

The vision of the software is to provide a platform for our customers to enjoy comprehensive visualisation of all aspects of the precise positioning installation and resulting position solutions in a graphically rich manner. Additionally the suite will permit easy production of extended value-adding processing based upon the derived position and any other available data.

The software is fully consistent and coherent in presenting information relating to the actual position solutions being used in the end application. As all of the hard work dealing with interconnections and decoding of data is dealt with by the background Mailroom service, users are able to focus on application content and functionality. Once again, because the architecture means that all critical processing is conducted within the CPM hardware and subsequently no recalculation is required, the POSTMAN Apps can be adventurous without the fear of upsetting any of the core positioning function. As every App is independent then in the event of any interruption to any one or more of them means the others can continue uninterrupted and of course core positioning remains unaffected throughout.

At the core of POSTMAN is the Mail-Service, which allows plug and play connection with any CPM within the local network or connected directly via serial communications. A foundation suite of software Apps is provided to deliver core visualisation of all positioning components and overall quality information to finest level of detail. Apps are continuously developed to deliver extended functionality and new ways to visualise the positioning solution.

The overall objective was to provide a similar architecture and function to the smartphone App-World such that in addition to standard Apps, users can also, through a simple interface, produce their own Apps in their own style and create not only the look and feel they desire but also generate extended functionality that may provide a competitive edge in their market and without substantial investment in major software writes or rewrites.

Precious Data

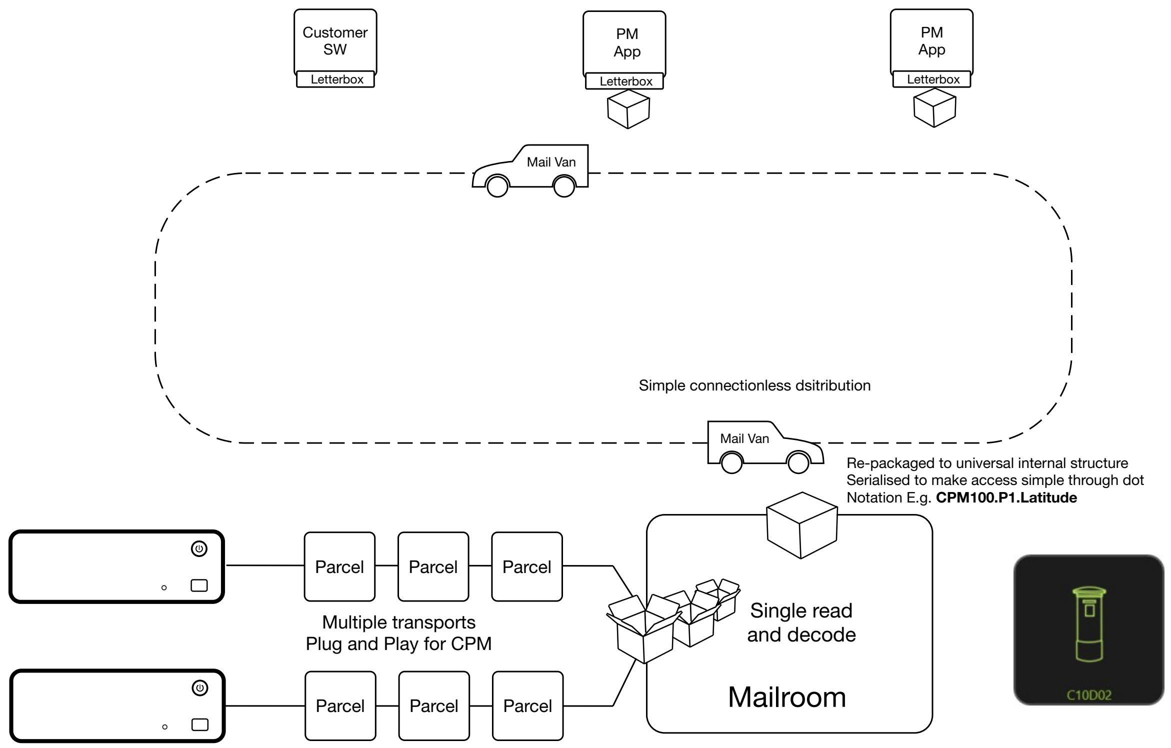
All data is precious and POSTMAN treats it as such by automatically archiving everything it receives in its raw form, compressed into standard archive formats and organised by time and date. As POSTMAN is completely transport independent it is able to reread this data as though in real-time, presenting the information in the same Apps used in real-time operation.

The CPM also logs data internally in two key forms; firstly system data is stored so that any event can be investigated relating to base operation and positioning and secondly POST data may be logged continually. This data can then be recovered and replayed through the POSTMAN software and Apps to inspect what may have occurred, conducting analysis and producing subsequent soft and hard copy reports.

Flexibility Unlimited

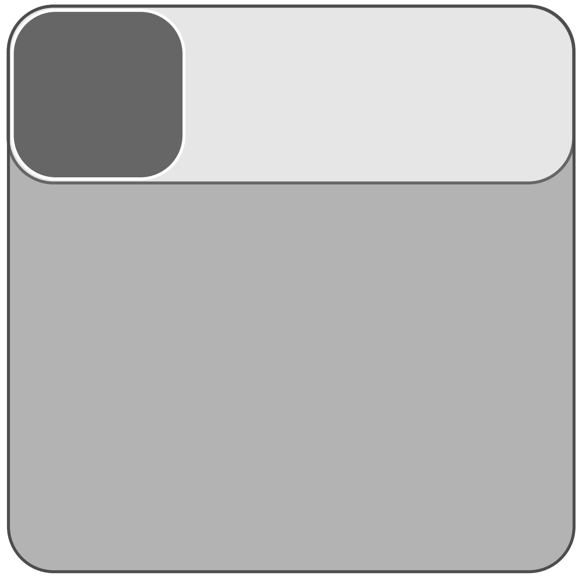
As all of the complexity of data communications, decoding and checking is conducted just once in the Mailroom application, POSTMAN allows the production of any application whether the most simple or most complex to be produced quickly and effectively. If our users have a preference for look and feel or wish to integrate the functionality into their own software then the POSTMAN SDK makes this quick and simple.

POSTMAN ARCHITECTURE



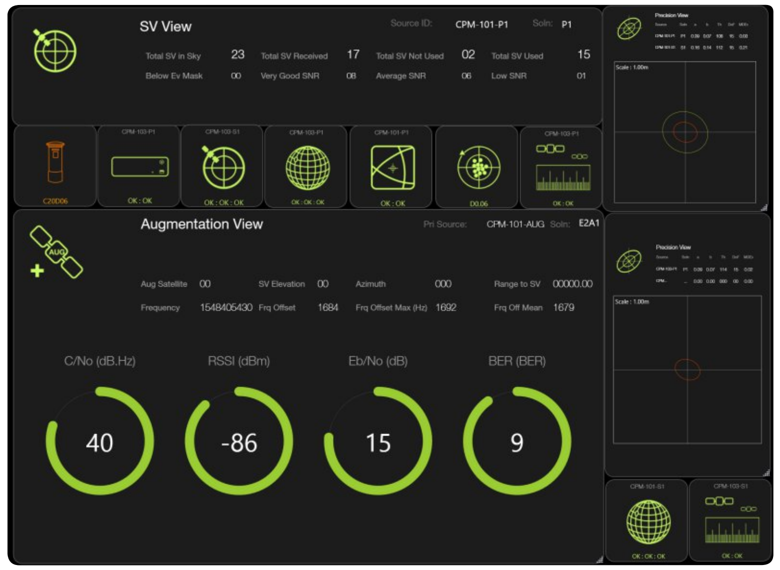
Feature	Benefit
Deployed Architecture	Allows optimum function across all areas of operation including remote access and control
App-Orientated	- Permits fast and efficient development of Apps on and for any platform - Reduces operational risk and permits unlimited functional potential
POSTMAN SDK Mail-Service API	- Allows easy integration of data and functionality directly into customers own software or for customers creating their own applications. - Allows user to easily develop their own functionality and Apps with minimal development effort
Centralised core functionality	Core function of data reception and decoding conducted only once minimising processing burden, reception and decode errors as well as improving development efficiency and robustness
Non-critical operation / Visualisation only	- No risk to position solution used by the customer application - Allows for more adventurous implementation without incurring functional risk.
Connection-free distribution Transport transparency	- Prevents any software lock-outs or sticky operation if data is delayed or interrupted. Updating will recommence without any user interaction allowing reliable unattended operation. - Permits connection to any source data using any transport protocol
POST Interface	Allows comprehensive visualisation of all information present throughout the positioning process

[Constrained App sizes to optimise organisation]



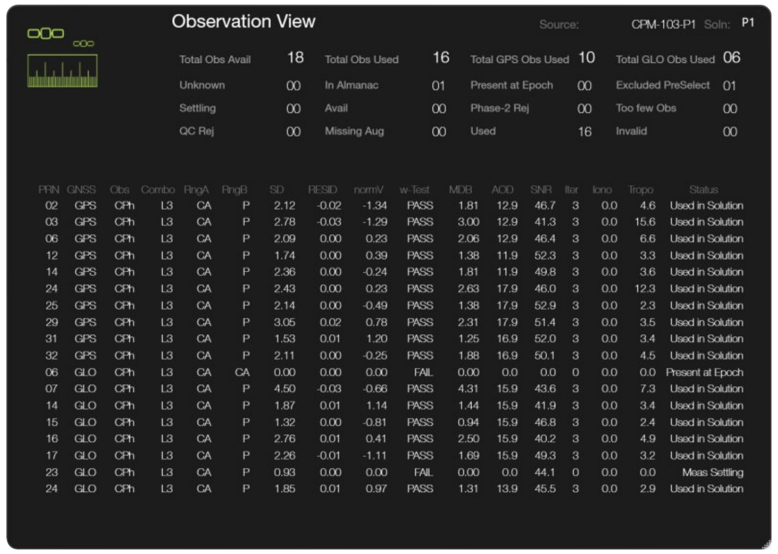
[Flexible View

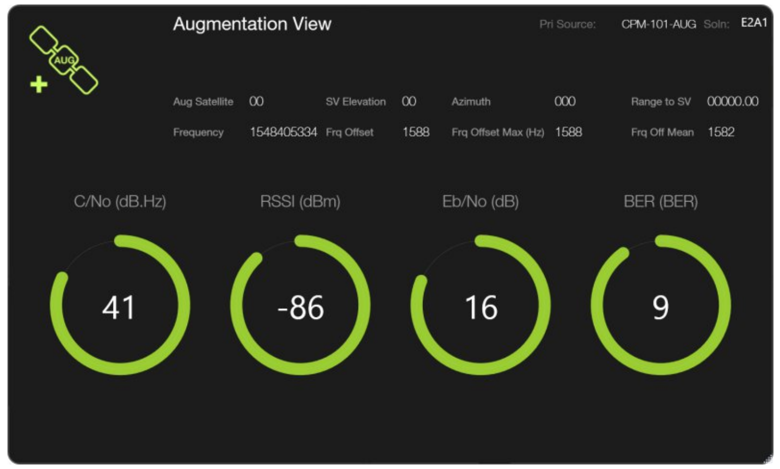
Shows any combination of Apps as Indicator, Panel and Full View
Organised in logical order to reflect operating status
App Manager allows pre-configured App layouts optimised for different user cases
Global App control allows organise all, close all



[Full View

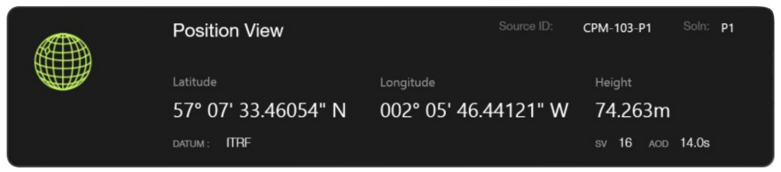
Shows Indicator
Shows Panel
Graphical or textual view of data





[Panel View

Shows Indicator
Shows key data in textual form
Shows currently connected CPM's and connection state]

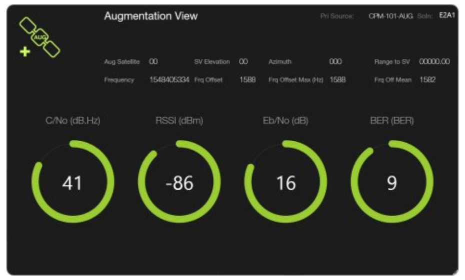


[Indicator View

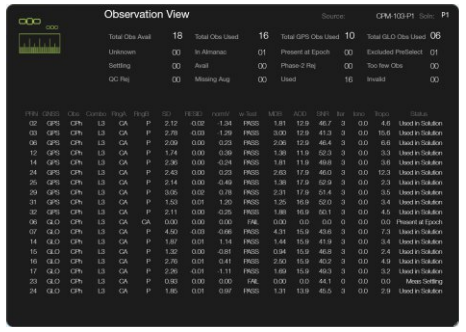
Indicates the application Icon in a colour representing App state
Indicates the state and value of monitor parameters
Indicates data connection state
Indicates the currently connected CPM]
Can be organised into Alarm / Indicator panels

[Some Foundation Apps]

Pos View]
[Presents all components relating to the selected position computation]



[Aug View]
[Provides a graphical indication of the signal and reception quality indicators for the currently selected augmentation link]

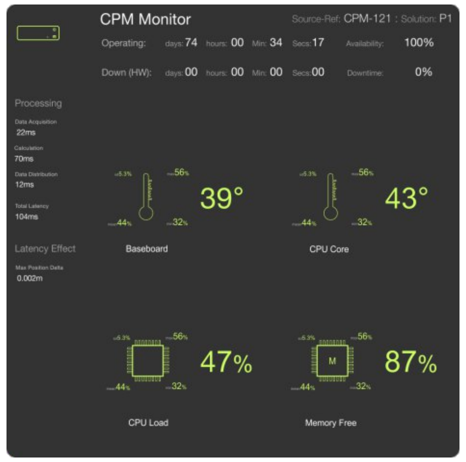


[Obs View]
[Displays all observations, adjustment and related QC information relating to the selected position from the chosen CPM]

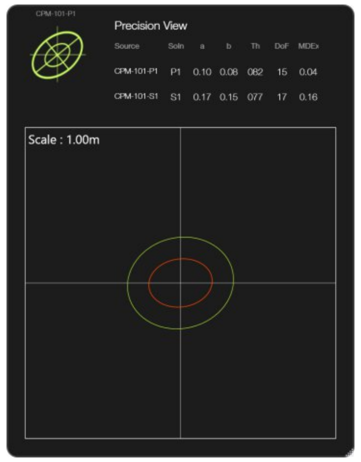
[LOP View]
[Visualises from the users zenith the position lines of the selected position solution]

[Mail Room]
[Core communications App responsible for connecting to all external CPM's and other sensors and then subsequent distribution to all Apps]

[SV View]
[Displays the current polar position of all GNSS satellites reported in the sky and their current status]

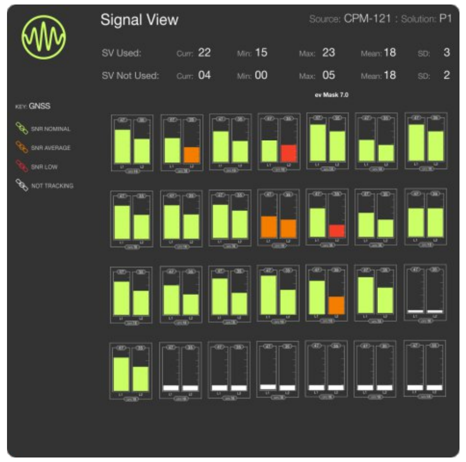


[CPM View]
[Provides textual and graphical indication of the main operating and performance parameters of the selected CPM]



Precision View]
[Visualises the precision of the selected position solutions]

[Scatter View]
[Visualises the differences between two position solutions and / or a choice of reference positions and modes]



[Signal View]
[Visualises the signal levels of all received GNSS satellites]

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