PRIOCEPT

CASE STUDY

AirborneWeather

Android, Google Cloud Platform and Netty

BACKGROUND

LiftedIndex develops mobile apps and related software that provides real-time aviation weather information to pilots, in the cockpit, using off-the-shelf mobile devices. This case study provides an overview of the technology solutions that have been developed by Priocept, on behalf of LiftedIndex.

Delivery of real-time weather information to pilots during flight can contribute to improvements in flight safety and planning. Weather analysis has historically only been performed while on the ground before a flight. In-flight access to current and forecast airport weather ("METARs" and "TAFs"), plus rainfall radar, lightning strike data, cloud heights and other weather information, can aid in the successful completion of a flight, and allow better informed decisions on the need for a weather diversion.

Access to real-time weather data from the cockpit is common in commercial air transport and business jets, but relies on sophisticated radar systems and satellite data links. Both technologies are expensive and typically beyond the budgets and/or capabilities of private and "general aviation" aircraft. NEXRAD in-flight weather is available to general aviation in the USA, but is not available throughout the rest of the globe.

The AirborneWeather mobile app from LiftedIndex addresses these issues by using a proprietary and highly optimised datalink that runs over regular mobile cellular networks. This allows access to aviation weather data, inside the cockpit at altitudes up to 18,000ft or more, using only a low cost mobile device and standard cellular mobile networks which are otherwise not useable in this environment.

SOLUTION

Priocept has been working with LiftedIndex to develop both the mobile and server-side components of their technology. This includes an Android app plus server-side infrastructure implemented entirely on Google Cloud.

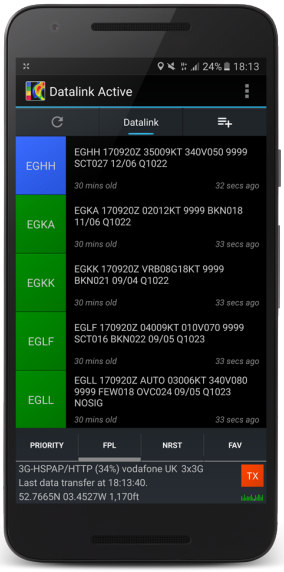
Using a combination of innovative software technology on both the mobile device and "cloud" based infrastructure, AirborneWeather is able to deliver internet connectivity where it would not otherwise be possible. This provides cost saving, utility and safety improvements to general aviation.

Core to the product is a proprietary, low-level, and highly efficient network protocol. Instead of the usual HTTP based "web services" approach to network connectivity, AirborneWeather uses a binary, connectionless UDP protocol. This ensures that weather data can be retrieved and displayed during periods of very poor network connectivity, requiring the transfer of only a single IP packet. This technology is typically an order of magnitude more efficient than web services protocols, allowing a mobile datalink to be maintained on 2G, 3G or 4G networks, at altitudes that would otherwise lead to a loss of service.

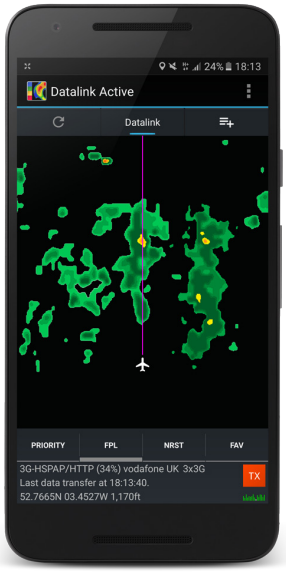
In addition, the datalink runs as a background service, so that intermittent periods of connectivity can be exploited even if the user is performing other tasks on their device. Weather retrieval is intelligently prioritized, so that short periods of connectivity are used to download the most important weather information for the current stage of flight.

The UDP datalink technology is built on Netty, a high performance, asynchronous network server best known for its use within Twitter and Facebook's infrastructure. Netty allowed Priocept to develop a proprietary low-level network protocol that provides high efficiency data transfer, while using only high level Java APIs.

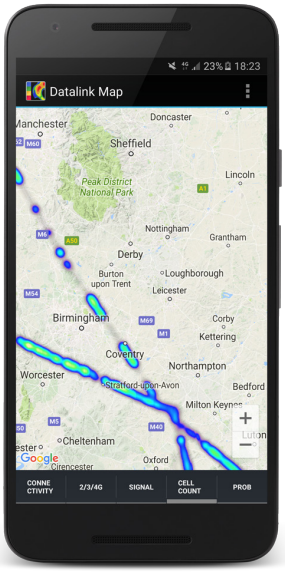
Behind the UDP datalink is a range of Google Cloud Platform based infrastructure that delivers weather data to the mobile app, while at the same time collecting "crowd sourced" data on datalink performance at any given location and altitude. This allows building of a three dimensional model of likely AirborneWeather connectivity on any given airborne route.



Airport weather display



Radar (rainfall) display



Datalink performance mapping

TECHNOLOGY PLATFORM

The AirborneWeather product uses the following technologies:

- **Android** – native mobile application for all Android based mobile devices, developed using Java and Android Studio. J2ObjC technology is used to ensure a portable code base in preparation for a future iOS product.
- **Netty** – provides the underlying infrastructure for the weather datalink layer over UDP, both on the client side (embedded within the Android app), and on the server side (running on Google Cloud Platform).
- **Google Compute Engine** – provides load balanced and redundant virtual machines running on Google Cloud Platform infrastructure, to ensure reliable and high performance hosting of the UDP service.
- **Google App Engine** – provides a highly reliable "serverless" HTTP based alternative to the UDP infrastructure. This is used as a backup to the UDP service, and for on-the-ground retrieval of less critical data, such as airport locations, which does not need to be updated while airborne.
- **Google Cloud Datastore** – provides server-side storage of weather data and imagery. Weather data is sourced from a number of providers including the National Oceanic and Atmospheric Administration (NOAA), but is then stored locally within Cloud Datastore, to provide a high performance cache of both current and historic data.
- **Google BigQuery** – provides "big data" and data warehousing infrastructure, with almost unlimited scalability, and is used for analytics and mapping of the large volumes of collected data, including analysis of datalink performance.
- **Google Cloud Endpoints** – provides a serverless framework for implementing web services endpoints, used by the mobile app for administrative tasks and datalink performance data submission.
- **Google Deployment Manager** – provides an "infrastructure as code" or "DevOps" solution to managing the server-side infrastructure, whereby all infrastructure is declared as code and can be instantly recreated or duplicated in a fully automated fashion.

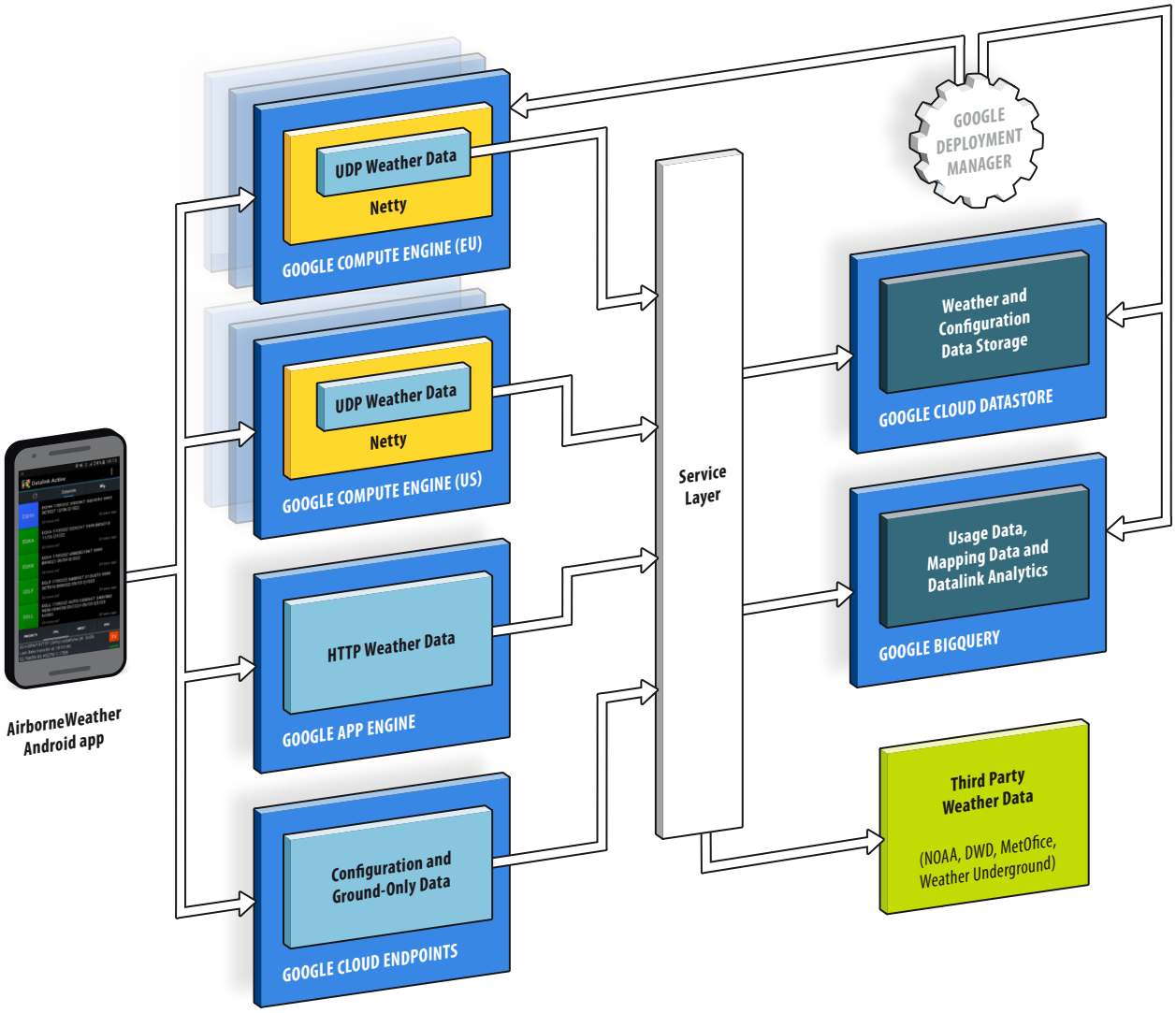


Figure 1 – AirborneWeather software architecture

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