How pilots and controllers communicate digitally

News

Charlie Page

Sep 5, 2020

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“It’s good to talk”, so we were told by a 1990s advertising campaign by a telecoms company. Talking constitutes a large part of our communication with each other, but in a digital age, non-verbal communication its making up for an ever-increasing proportion of how we interact with each other. This is particularly true for pilots and Air Traffic Control (ATC).

The majority of interactions between pilots and ATC is still conducted by voice. It’s quick to send and is quick to receive a reply. In the fast-paced environment around the airport with multiple arriving and departing aircraft, the speed of communication is key. When ATC issues us with instruction, they need a rapid response.

CPDLC has multiple benefits for both pilots and controllers. (Photo by Charlie Page/The Points Guy)

However, when away from the frenetic lower altitudes, an instantaneous reply isn't quite as important. As airspace begins to get busier again, more aircraft are being handled by individual controllers. With more aircraft comes increased radio transmissions and the increased chance of mistakes being made.

One aircraft replying to the call meant for another aircraft, pilots missing a call meant for them and multiple transmissions being broadcast at the same time are all common events on a busy frequency. In addition, you may have a pilot and a controller from two different countries communicating in a language which isn't their first — English. Accents can sometimes be difficult to understand and mistakes can be made as a result.

The use of a text message-based system nullifies all these problems, not only increasing flight safety but ATC efficiency as well. It's known as controller pilot data link communications (CPDLC).

Benefits of datalink

The benefits of datalink communications continue to grow as technology advances. It relieves congestion on ATC frequencies and, as a result, reduces controller and pilot workload. This, in turn, increases the number of aircraft that can safely fly through a particular section of airspace.

It also increases the accuracy of communications, reducing the chance of heavily accented words being misunderstood. With clear, concise written instructions on a screen in front of pilots, the chance of errors reduces.

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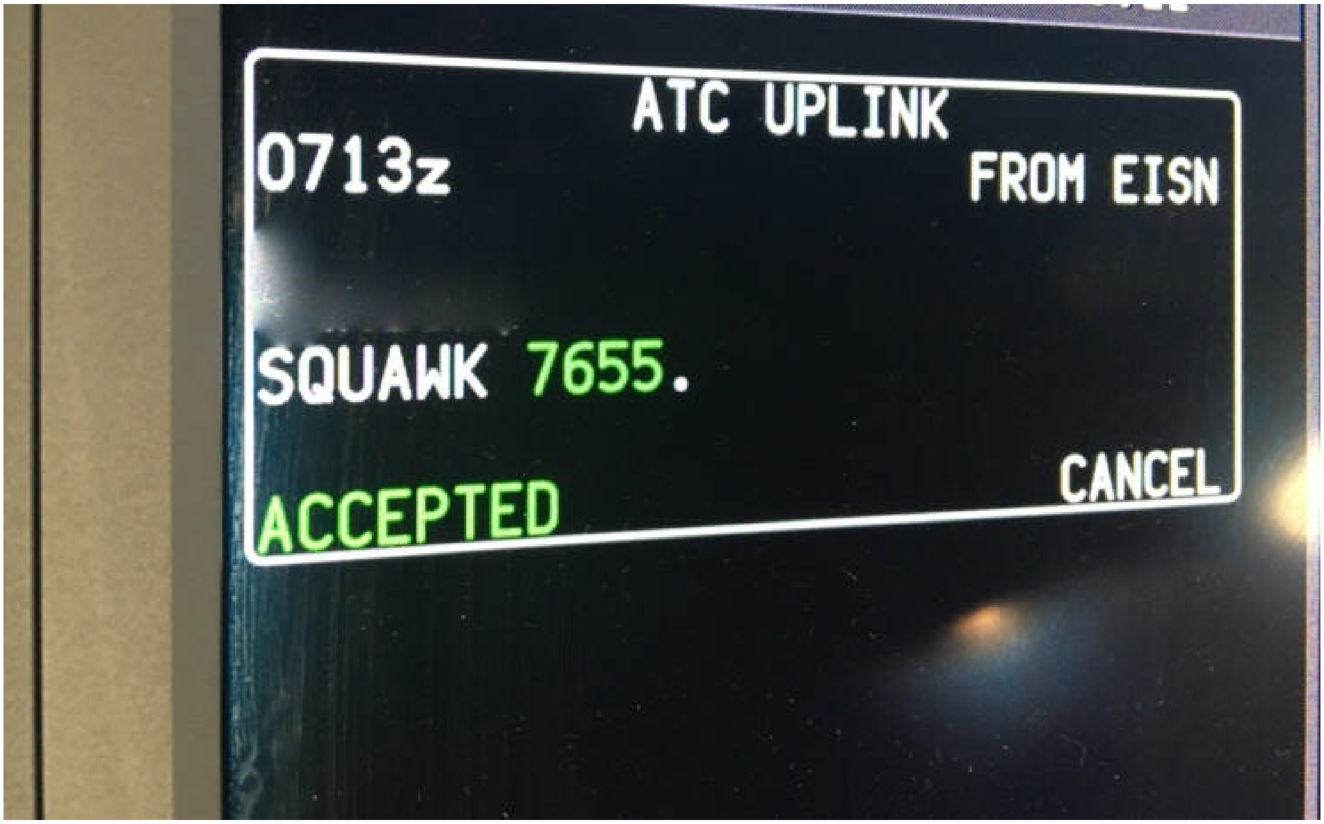

CPDLC gives clear, concise instructions. (Photo by Charlie Page/The Points Guy)

A certain type of datalink is also able to exchange data with the aircraft systems, without the need for pilot input. The aircraft is able to send regular accurate position information, allowing for reduced aircraft separation in areas not monitored by radar. This is particularly useful over the Atlantic, allowing more traffic to cross in a given time.

There are two types of datalink available — future air navigation system (FANS) and aeronautical telecommunications network (ATN).

Future air navigation system (FANS)

FANS was developed nearly 30 years ago by Boeing and later adopted by Airbus. It comprises of two main operational components, one for communicating and one for surveillance.

FANS is a globally used system that works well over long distances. As it uses satellites to create a network, it can be used beyond-line-of-sight communications such as very high frequency (VHF) radios.

However, it has a relatively slow rate of data transfer of just 2.4k bps, meaning that there can be some lag between messages being sent and received.

Controller pilot datalink communications (CPDLC)

The communication element of FANS, CPDLC connects the aircraft with ATC units on the ground. ATC can then use this to send us instructions relating to changes in our altitude, heading, speed and radio frequencies. We can also send requests to ATC should we wish to change altitude or change our course to deviate around thunderstorms.

Flying over the Atlantic, CPDLC is used as a primary means of communication with HF as a backup. When flying over land, it is used in conjunction with normal VHF communications.

The CPDLC system is designed for simplicity. To set the system up, we must first log on to the ATC unit we wish to connect to. Each unit has its own four-letter code, which we enter into the login page. For example, London is EGTT.

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The CPDLC control panel on the 787 Dreamliner. (Photo by Charlie Page/The Points Guy)

Once logged on, ATC is able to send us instructions via CPDLC messages instead of making a radio call.

When receiving a CPDLC message from ATC, for example, a clearance to climb to a higher altitude, it pops up on a screen to the right of the PFD. To reply to the message, we simply press one of the three buttons in the flight deck — accept, cancel or reject.

To send a message to ATC, we use one of the pre-set pages in the CPDLC menu.

When crossing the Atlantic, we must get clearance from the controllers on the ground. In days gone by, this exchange would have been done by voice over HF radio. However, with a lack in clarity of transmissions, this process is time-consuming and errors are easily made.

By using CPDLC, the exchange with ATC is much quicker and far less prone to mistakes. We simply fill in the boxes with the required information and hit the send button — very much like filling out a form on a web browser.

The simplicity of CPDLC is also of great benefit in emergency situations. Should the need to divert arise mid-Atlantic, getting hold of ATC on HF could be a laborious process. Instead, in seconds, we can send an emergency report to ATC with all the details they will need to know.

Automatic dependent surveillance — contract (ADS-C)

The other element of FANS goes on in the background without any obvious signs to the pilots. ADS-C allows ATC units to establish a connection with an aircraft and monitor various aspects of the flight progress. It is mainly used in areas where there is little or poor radar coverage.

When Malaysian flight MH370 went missing over the Indian Ocean, its position was relayed to ATC by a series of what were described by the media as "handshakes". The ADS-C system onboard the aircraft is what exchanged these "handshakes", giving ATC an accurate idea of the aircraft's position.

ATC is then able to create a number of "contracts" with the aircraft systems.

A "periodic contract" allows ATC to specify the time interval at which the aircraft sends a host of data to them and what data they would like. This could include GPS position, altitude, speed etc.

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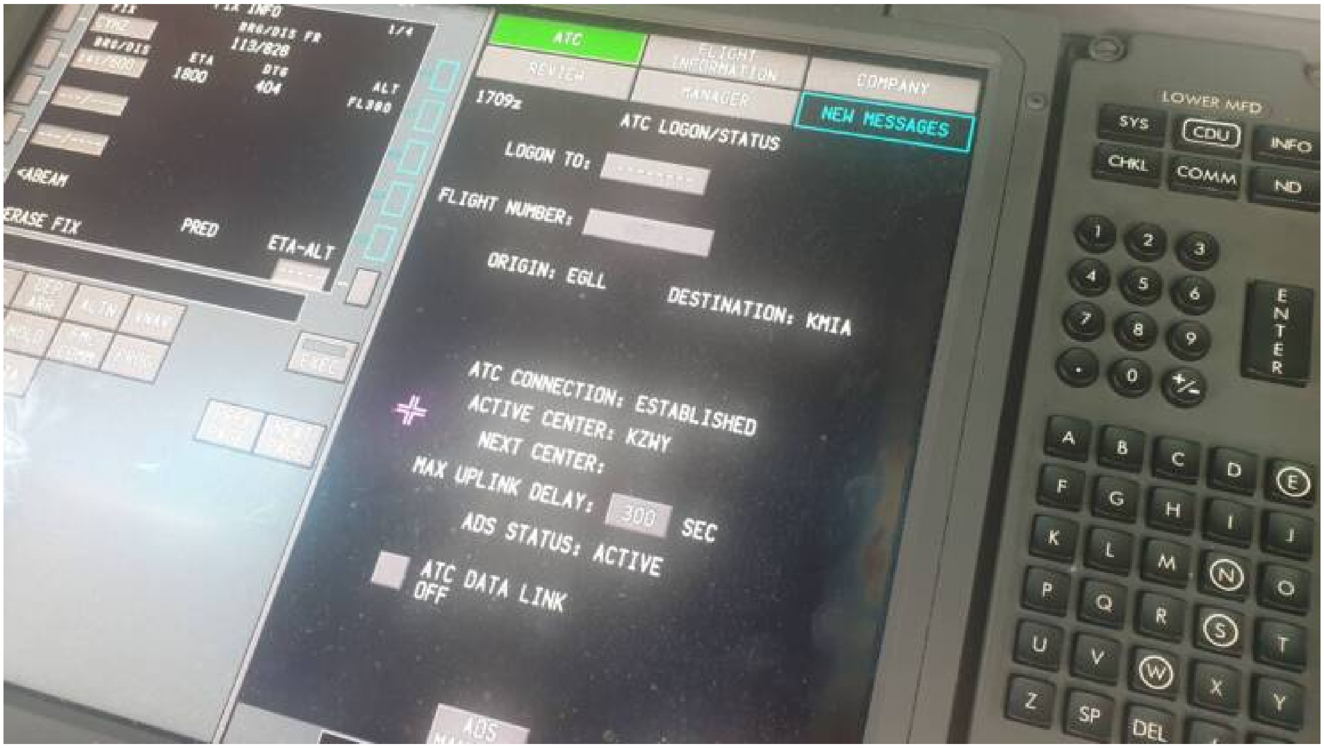


ADS STATUS: ACTIVE indicates that ADS-C is in use. (Photo by Charlie Page/The Points Guy)

This allows ATC to monitor an aircraft closely as it flies across busy traffic areas such as the North Atlantic. With such accurate position reports, it means that an aircraft could be cleared to a higher altitude more quickly, reducing fuel usage and reducing carbon emissions.

An “event contract” allows ATC to be notified should a particular event occur on a flight. This could include a deviation from the cleared altitude or a change to the waypoint which the aircraft is flying.

This may be an inadvertent action by the pilots or could be due to a technical problem with the aircraft. Whatever the cause, it makes ATC aware that something has changed and enables them to contact the pilots to query the change.

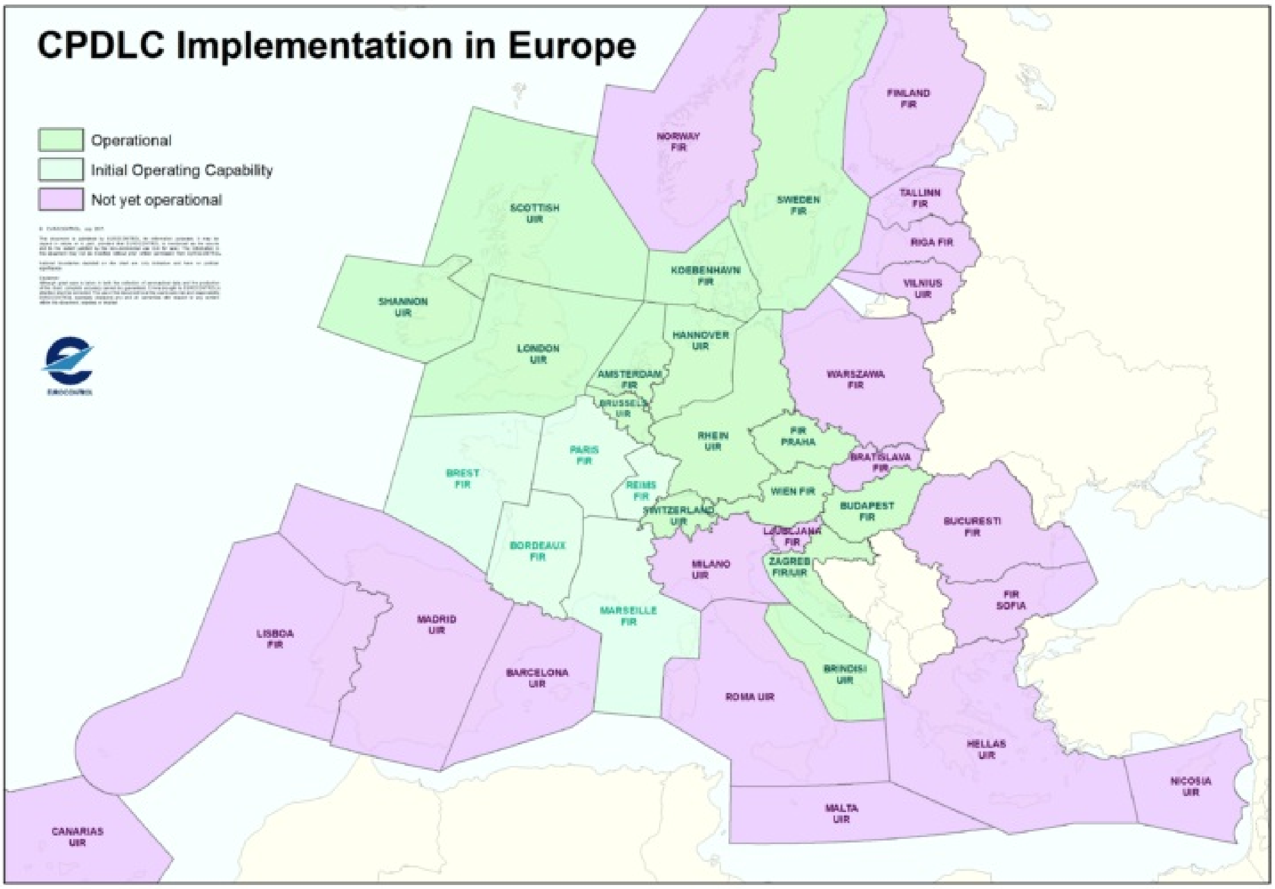
An “emergency report”, as mentioned above, also has an ADS-C element to it. When a crew send an emergency report, it gives ATC more regular updates of the accurate position. Should the worst happen, this will give a greater area of accuracy for any search and rescue mission.

Aeronautical telecommunications network (ATN)

Similar to FANS, ATN provides a CPDLC link between ATC and aircraft, however, the main difference is that there is no ADS-C capability. This may seem like an oversight for what is a newer technology but there is a reason for this.

ATN was developed by Eurocontrol and is in use over mainland Europe where good radar and VHF communications are available. As a result, the accurate position reporting facility of ADS-C is not required.

It uses a dedicated VHF transceiver on board the aircraft, known as VHF Datalink (VDL) Mode 2 for the transmission of messages. This gives a much faster connection speed of 31.5k bps compared to the sluggish FANS network and this enables a slightly different usage of CPDLC by controllers.



ATN coverage in Europe. (Image courtesy of Eurocontrol)

As mentioned before, the slow speed of FANS means that there could be a substantial delay between ATC sending the message and the pilots receiving it. Not ideal in the faced-paced environment of a busy ATC sector.

However, the increased speed of the ATN means that the speed of CPDLC messages between pilots and controllers is much faster. This means that ATC can issue time-critical instructions such as turns and headings. As a result, ATC is able to issue more instructions to aircraft in a shorter space of time, increase both flight safety and commercial efficiency.

How do we know who to connect to?

When connecting to CPDLC, we must first ensure that we are connecting to the correct ATC unit. In days gone by, a collection of paper charts were loaded on all aircraft which provided a whole host of information for our route. These days, the charts are all in electronic form as part of the aircraft's electronic flight bag.

Our route is shown on the map and by zooming in and tapping on the area which we need the information for, we can find out the four-letter code of the ATC unit. We then use this code to logon to the CPDLC.

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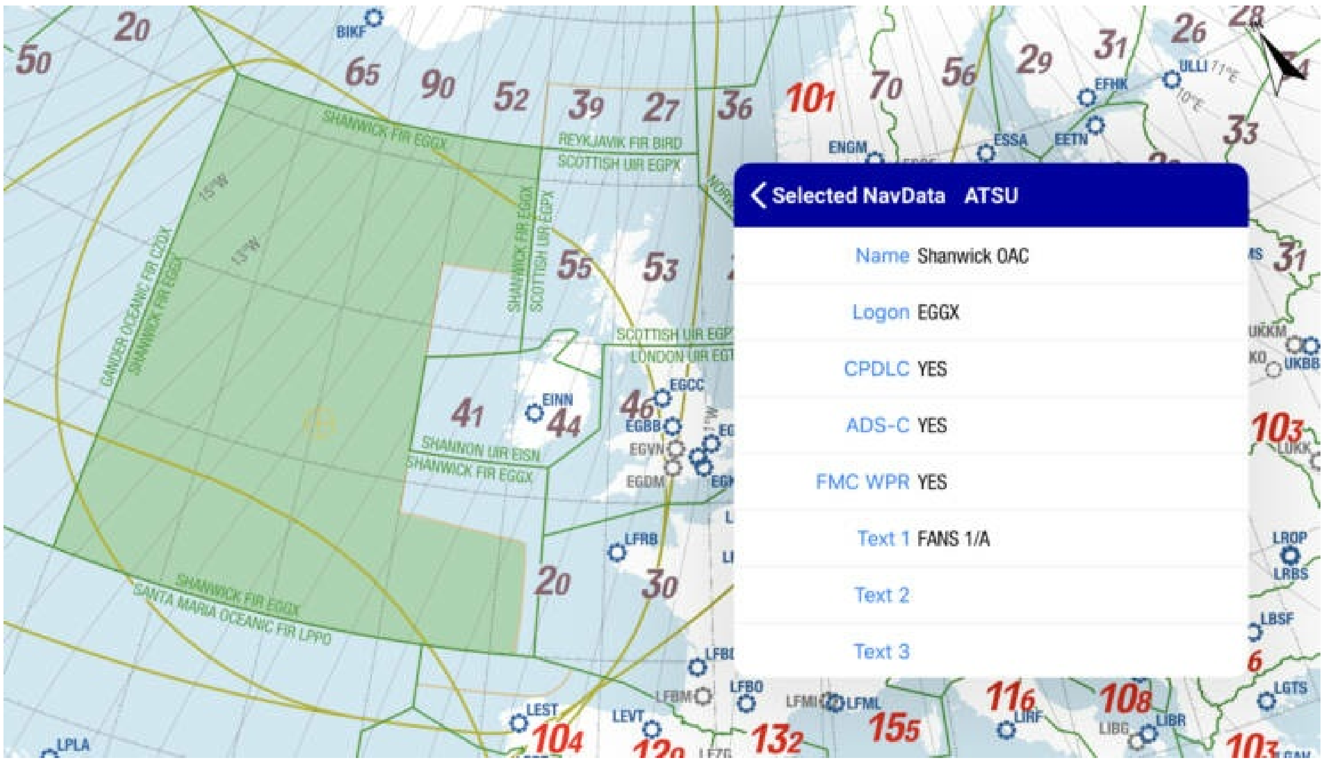

Information on CPDLC availability can be found in the en-route charts. (Image courtesy of Lido Pilot Solutions)

As most units around the world are FANS, a FANS connection is automatically made. Over Europe, as ATN is in use, an ATN connection is automatically established. However, in certain areas, such as over the U.K., we have a choice of which connection we would like to make.

When leaving London and connecting to London ATC CPDLC (EGTT), we are given the option if we'd like to connect via FANS. Whether we chose this depends on where we are going.

If we're heading west to North or South America, we'll be flying in a FANS region so we selected the FANS option. If we're heading out over Europe, we'll be in the ATN area so we'll want to make use of the faster ATN connection speeds and thus do not select the

FANS option.

Bottom line

The use of datalink communications makes life easier for both pilots and controllers. Not only does it improve flight safety, but it also increases the number of aircraft that can fly through a section of airspace in a given time.

The two types of connection have a marked speed difference, the fast ATN being able to issue time-critical instructions whereas the slower FANS uses ADS-C to give ATC accurate position reports in areas where there is limited radar coverage.

In certain areas of the world, CPDLC usage is mandatory. To use the busy airspace of the North Atlantic track system, aircraft must have operative CPDLC. A failure of the system requires the pilots to fly outside of this area, adding both time and cost to the flight.

Featured photo by Charlie Page/The Points Guy

Charlie Page Charlie Page is an airline pilot flying the Boeing 787 Dreamliner. Each Saturday he gives you a 'behind the cockpit door' insight to life in the flight deck.