What is EFF?

An introduction into the world of airline briefing

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Scope

This document explains the conventional airline briefing process and outlines the use of an Electronic Flight Folder (EFF) application hosted on an airline Electronic Flight Bag (EFB) platform.
The Flight Management System (FMS), developed twenty years ago, guides the pilot through the climb, cruise and descent phases of flight.
The EFF application does not replace the FMS, it will be used in addition to it, replacing today's paper clipboard . EFF can guide the pilot through the whole mission, from briefing to post-flight. Its connection to vital aircraft systems is very loose. In fact, it may not have a connection to the avionics at all. Therefore it can be allowed to have tight connections to the airline's ground-IT.

References

- ARINC 633 (www.arinc.com/aeec/projects/aoc)
- ARINC 763
- ARINC 821
- JAR OPS 1
- JAA TGL 16
- FAA 120-76A

Expected benefits

- Elimination of paper printing costs
- Elimination of paper handling costs
- Elimination of paper storage costs
- Potential safety increase due to the possibility to implement automatic cross checks of important flight data (such as actual fuel on board being larger than minimum fuel)
- Reduction of pilot workload due to automatic calculation of simple manual tasks (like adding elapsed times and take off times), due to hyperlinking information or due to search capabilities
- Cost reduction due to a higher automation in post-flight checking of en-route ATC charges
- Improvements in flight planning due to a feedback of actual flown routes into flight planning systems
- Improvements in in-flight optimization due to a more current briefing package
- Cost reduction due to a stabilization and simplification of the operation, e.g. less airline ramp or airport handling agent tasks, fewer delays due to missing briefing papers
- Fewer training costs. No more training of ramp agents in flight briefing matters
- Simplification. Implementation of a single world wide briefing procedure possible

Traditional lifecycle of paper briefing package

Pre-flight

In order to perform a flight, a flight needs to be planned. In order to plan a flight, information about the specifics of the route, the time, the aircraft, the payload and so on, have to be taken into account.
So, the basic steps of flight planning are:

1. Gathering of relevant information
2. Planning a flight based on the gathered information and writing this planning down as the *Operational Flight Plan (Flightplan).*
3. Inform the necessary entities (systems or people) about the specifics of the planned flight.

While the early aviators did all three steps themselves and pilots still learn to plan a flight during their initial training, in an airline the three steps are usually done by a dedicated person called *dispatcher* and/or an automatic process. The system used by a dispatcher or used to fully automatic plan a flight is usually called *a Flight Planning System (FPS)*.

If the pilots themselves do not perform the flight planning, they need to be informed about the specifics of the flight they are ordered to do. This information process is called *flight briefing*.

Because safety is involved, a number of laws and requirements regulate a flight briefing and need to be taken into account by the airline. Driven by the fact, that some of the information the pilot needs to absorb is highly dynamic, e.g. weather information, the flight briefing is usually performed on the day the flight takes place, typically - but not always - in the ground time that precedes the particular flight.

Until the early 1990s a flight briefing was typically a face to face meeting of the dispatcher with the pilots during which the dispatcher handed over the gathered flight relevant information, as well as the resulting *Flightplan*. This information is usually called briefing package or *Flight Folder (FF)*. Typically, the size of a FF increases with the flight time and varies between 5 to 20 pages for a domestic flight and 20 to 100 pages for an intercontinental flight. A FF may contain all kind of documents, including satellite photos, painted weather charts, data generated wind charts and plain text documents.

Since the 1990s, many airlines have replaced the face to face flight briefing by a briefing terminal, nowadays typically a web browser that allows the pilots either to …

a) retrieve a stored FF from the briefing server or
b) retrieve a stored *Flightplan,* while gathering the latest versions of highly dynamic data like weather, and generate a FF.
c) trigger a full flight planning process and generate a FF

Method a) is simple and secure. The dispatcher and/or the FPS have finalized the FF long before it is retrieved by the pilot. It is static and the dispatcher can keep an exact copy of what the pilot will see. Data integrity can be enhanced by cryptographic signatures. The FF can be forwarded by many ways to the pilot, including as email attachment or as polled fax. The disadvantage lies in the fact that highly dynamic information, e.g. the latest payload figures or actual weather reports, are usually outdated and may need to be treated separately.

Method b) requires bidirectional communication to the FPS (or at least subsystems of it like weather databases) which rule out some communication channels like fax machines and which make the use of some email-like protocols look odd. The FF is typically split in small packages, which may be an advantage when slow connections are used, but which may increase complexity to assure proper data security and integrity. The biggest advantage is that weather and other highly dynamic information is always up to date.
Method c) allows the best optimization of the *Flightplan* because the latest weather information can be used to calculate it. But this method has a number of disadvantages and it is therefore not used by most airlines: First of all, other systems and people (e.g. Air Traffic Control or Load Planning need *Flightplan* data before the pilot triggers its calculation. Also, data gathering and *Flightplan* calculation are done online, which may lead to unacceptable response times. And even a short FPS system outage would often lead to aircraft departure delay.

The retrieved FF is typically printed as a stack of paper pages. If no briefing terminal is available, e.g. at outstations or during transits where pilots do not leave the aircraft, this stack of paper is handed over to them by a ramp agent.

The briefing process consists of reading the FF and finalizing the fuel by adding an amount to the calculated minimum fuel of the *Flightplan*. In the USA, finalizing the fuel is often a joined decision between the dispatcher and the pilot, both have to agree to the fuel. In other parts of the world, it is often the sole decision of the pilot.
Many briefing terminals have the ability to slightly modify the *Flightplan*, e.g. by changing the chosen alternate airport out of a list of possible alternate airports. In some cases, these changes need to be fed back to other entities, e.g. Air Traffic Control, prior to the flight.
Many authorities and/or company procedures require the pilot in command, and sometimes also the dispatcher, to sign the *Flightplan* in order to make clear it has been accepted by him/them. Traditionally, this signature is done by hand writing and it is documented by leaving a signed copy of the *Flightplan* at the departure airport.

After the briefing process is finished, the pilots use the *Flightplan* to prepare the flight. Usually, the planned route needs to be typed into the aircraft's FMS. In some cases the route is automatically loaded via datalink (ACARS), but then the pilot need the *Flightplan* to manually verify that the route loaded into the FMS equals the route on the *Flightplan*.
Weight information, sometimes from the *Flightplan*, sometimes from other FF documents like the Load- and Trim Sheet (LTS), is used to do takeoff performance calculations.

In-flight

In-flight, the *Flightplan* is used to check the flight's actual progress against the planned values. This is typically done by writing down actual times and actual fuel figures with a ball pen on the *Flightplan* paper. Most authorities require these checks. Its importance usually increases with the length of the flight. It should be noted, that this manual fuel check procedure is always done on long flights, even if an additional automatic checking is performed by the FMS, which would trigger warnings to pilots in case of insufficient fuel. It seems to be important, that the pilots stay in the loop here.
Authorities also usually require that the *Flightplan* contains a written record of the actual flown route. That means, route or flight level changes need to be documented on the *Flightplan*.
Before starting the approach, the pilots may want to review destination information like NOTAMS. If a diversion becomes necessary, the pilots will probably need to review the weather and NOTAM documents for the chosen alternate.

Post-flight

Post-flight, the pilot is required to complete the *Flightplan* by documenting the remaining fuel, actual destination airport and landing times. The FF is finalized by placing some or all of its documents in a storage location, e.g. a paper back which is after the flight, or in certain intervals (typically once per week), taken from board and stored on the ground.
Which and how long FF documents are to be stored may vary. Presently JAR OPS 1 requires that the *Flightplan* and some other FF documents are stored for a minimum period of 3 months (Attachment 1 to JAR OPS 1.1065).

The use of an Electronic Flight Folder Application

The availability of COTS-like computers in the cockpit, usually referred to as Electronic Flight Bags (EFBs), raises the question whether or not a stack of paper is still the ideal media for flight briefing information.
For sure, paper has its advantages. It can be accessed without any tool. It can be accessed by all pilots and even outside the cockpit. An electronic replacement can not match it in all areas and therefore needs to overcome the paper weaknesses, just to get accepted by them.
The section "Expected benefits" at the beginning of this document, lists some of the hopes usually associated with the replacement of paper FF by Electronic FF (EFF).

The following text should give an overview about the typical use of an EFF:

Preflight

As usual, the flight is planned either fully automatic or by a dispatcher using a FPS. In its simplest form, the media *paper* is replaced by an electronic storage media, nowadays typically an *USB stick*. On airline bases, the pilot would still use a briefing terminal to retrieve the information, but - after finalizing the fuel - instead of printing paper he would download the package on a USB stick and carry it to the aircraft. At outstations or during transits, a ramp agent will hand over the preloaded stick to the pilot.
In the cockpit, the pilot plugs the stick into the EFB USB port and uploads the EFF data into the EFF application.
Of course, other ways might prove more efficient, such as wireless aircraft communication links, which eliminate the need for the ramp agent, and/or personal electronic devices (laptops) for pilots, which eliminate the need for airport briefing terminals. Downloading the EFF data package could, for instance, take place in the hotel or during transportation to the airport.
The EFF application validates the EFF data and gives other EFB applications access to key parameters.
If not done outside the cockpit, the pilot now performs the briefing (he/she reads the EFF data), finalizes the fuel and loads route and performance data into the FMS.
If the EFF is hosted on an EFB class 3 system, this data load can be done automatically.
If the EFF is hosted on an EFB class 1 or 2 system, the EFF can not write into the avionics and the pilot need to enter the data manually or trigger an ACARS uplink.

The time span between briefing and departure is usually 25 to 90 minutes. If the flight gets delayed, the time span will get longer, typically up to a few hours. During this time, some of the documents of an EFF need to be replaced by newer versions, e.g. the LTS, the NOtice TO Commander (NOTOC), slot and weather information, etc.
From an operational standpoint, some of these documents need to be pushed by ground personnel, some need to be polled by the pilot. It is clear, that the USB stick procedure described earlier has no advantage over paper in the highly dynamic environment just prior aircraft departure. Especially if an authority requires an airline to keep track of the documents that made it to the aircraft and which were used by the pilot, a bidirectional wireless link between aircraft EFF and ground server pays.
From a pilot perspective, it is important that revisions of documents are marked in such a way that important changes don't go by unnoticed. The typical conflict here is that the sender, let's say of an updated NOTOC, increases the integrity of his data (and thereby decreases his liability) by sending the whole package again, while the pilot simply has no time to reread everything to identify the changes.

As said before, some documents require to be signed and some authorities require that the operator keeps track of the documents being used.
How far should an EFF application support these workflows? Today, two or three other EFB applications manipulate EFF data and use signatures:

1. An airborne weight & balance application either generates a LTS or is being used to graphically present a ground calculated LTS
2. Sometimes, authorities require operators to keep track of takeoff performance data. In these cases a performance application may need to interact with the EFF application.
3. Some airlines may want to include the technical aircraft status, e.g. the list of known defects; into the EFF data package and they need to leave a captain's signature about the aircraft acceptance at the departure station.

The amount of interaction between the EFF and other EFB applications may vary. As a minimum, an EFF application should support the workflows related to the Flightplan, e.g. the finalizing and ordering of fuel, the documentation about this final fuel as well as the chosen alternate airports.
But airlines may expect more from an EFF application, e.g. the exchange with EFF data with a weight & balance, a performance, a navigational chart or a technical logbook application or the support to sign the dangerous goods part of a NOTOC electronically.
Airlines may also expect from an EFF application, that it replaces a part of the functionality of an ACARS AOC application, e.g. requesting, receiving and reporting all kind of flight related data, e.g. airport weather, SIGMETs, flightlogs and so on.

In-flight

In the paper scenario, the pilot wrote down actual figures of fuel and time on the *Flightplan.* paper document in order to stay in the loop. If an EFF is used, the *Flightplan*, or a part of it, needs to be presented somehow on the EFB display, so that the pilot can see the planned figures. And the EFF needs an inbound interface, so that the actual figures can be stored in the EFF data structure. For manual entry, the inbound interface could be a trackball, keyboard, touchscreen, virtual keyboard or line select (bezel) keys. In case of a class 2 or class 3 EFB, data could be supplied automatically from the avionics via a gateway system. AEEC document 821 calls such a gateway to the avionics world the Read Only Data System (RODS).
The *Flightplan* data could be presented as plain tabular text or graphically, e.g. as an overlay to the en-route navigation. When designing the user interface and when creating the procedures using it, it is important to assure, that the pilot is kept in the loop.
To fulfill authority requirements, entered data needs to be stored in the EFF data package.

Authorities usually require a written record of actual flown routes. How could this be done using the EFF?
A simple way would be to stream aircraft position and altitude data into the EFF and store it there. Another simple way would be to allow the pilot to paint on the presented *Flightplan*, e.g. with his fingers or a stick and make handwritten changes in an overlay bitmap to the *Flightplan*. The disadvantage of both possibilities is that it is hard to feed back this kind of data into the FPS and use it for route optimization and checking airway bills, a potential benefit listed at the beginning.
Besides position and altitude, the RODS should know the route waypoint the aircraft flies to, the *active waypoint*. When an aircraft flies the route programmed in the FMS, than its route can be presented as a chain of active waypoints. But that is not always the case as pilots may chose to fly non-programmed route segments, e. g. by the use of the heading select knob. A possibility to overwrite planned route segments in the *Flightplan* textually seems unavoidable.

Post-Flight

Remaining fuel, actual landing times and airport code can all be received from the RODS.
Like in the preflight phase, the airline may require the commander to sign the EFF data package. There may be the need to downlink some of the data prior to the next flight, e.g. the landing times and the remaining fuel.
As in the paper case, the data may also stay on board for a specified period of time, e.g. a week, before it is forwarded to the ground server.
Weekly intervals would allow the use of USB sticks, shorter intervals would make the use of wireless connections seem more efficient.
The ground EFF server may forward the data partly back to the FPS and other systems, to close feedback loops.

A few words about the EFF data structure

The airline wish to continue their use of existing FPS systems when introducing airborne EFF applications lead to the standardization of the EFF data structure through the AEEC AOC subcommittee in 2006. For the exact definition of the structure, see AEEC document 633 and its XML Schema descriptions.
The following paragraphs give a high level description and explain some requirements that lead to the XML Schema definition:

The EFF data package, when unpacked, contains a list of files. One of these files, eff.xml, contains a XML instance document identifying which of the files in the list contains documents of a certain *topic*. For example a document with filename="NOTAM2006-11-15.txt" and topic="NOTAM" should contain NOTAM information.

Beside a few administrative files like the eff.xml itself, all files found in the EFF data package contain documents of a certain topic. A weather topic document contains weather reports, a NOTAM topic document contains NOTAM reports. Airlines have different ideas how to present information to their pilots. XML gives them the freedom to choose the format of their choice, because only the structure of the document is standardized, not the format.

That freedom may even exist above the topic level:
Airline A may want to group weather reports and NOTAMs of an airport together, while airline B may want to keep weather reports and NOTAMs separately. The developers of the EFF Schemata defined topics for documents of equal contents. There is no predefined topic for a mixed weather/NOTAM document for instance.
But for some topics, XML schemas have been defined. The most important one is the *Flightplan* schema, which allows to identify individual parameters within a *Flightplan* document. At the time of writing, AEEC AOC Subcommittee has not finalized any other EFF topic schema. But even the most basic Weather or NOTAM schema will allow the identification of individual airport weather or airport NOTAM reports and therefore creates a possibility than an application regroups these reports. An application could, if wished, transform a weather and a separate NOTAM document into a single mixed weather/NOTAM document without the need of parsing.
Full blown XML schemas for wind charts, aviation weather reports, NOTAMs, etc, are complicated and should be defined by the appropriate organizations, not AEEC. However, their use would give all EFB applications access to contents to the briefing package in a machine readable form.

Through the use of a weather XML schema, the cryptic aviation weather or runway condition reports (e.g. SNOWTAMs, MOTNE, TAF Icing groups, etc) could easily be converted in plain language.

What does it take to switch from paper FF to EFF?

As a minimum, an airline needs a ground system that can produce an EFF data package and an EFF application that can be used in the aircraft. One of the goals of the AEEC AOC Subcommittee is, that these two pieces of software, can come from different vendors.

The ground system could be an upgrade to the airline's existing FPS, or it could be a dedicated EFF ground server attached to a classical FPS.

In the aircraft, a single EFF application on a single Class 1 EFB may be sufficient, if it is assured that the EFB power supply lasts long enough and if contingency procedures exist, for the case it breaks down. For full benefits, two Class 2 EFBs, one for each pilot, are recommended. Other applications, like performance, library or navigation charts, should also run on the same EFB platform.

For the distribution of the EFF data package by physical means (e.g. USB stick) or wireless (e.g. WLAN or UMTS) the appropriate infrastructure is needed.

There is no need for a printer in the cockpit.

Pictures

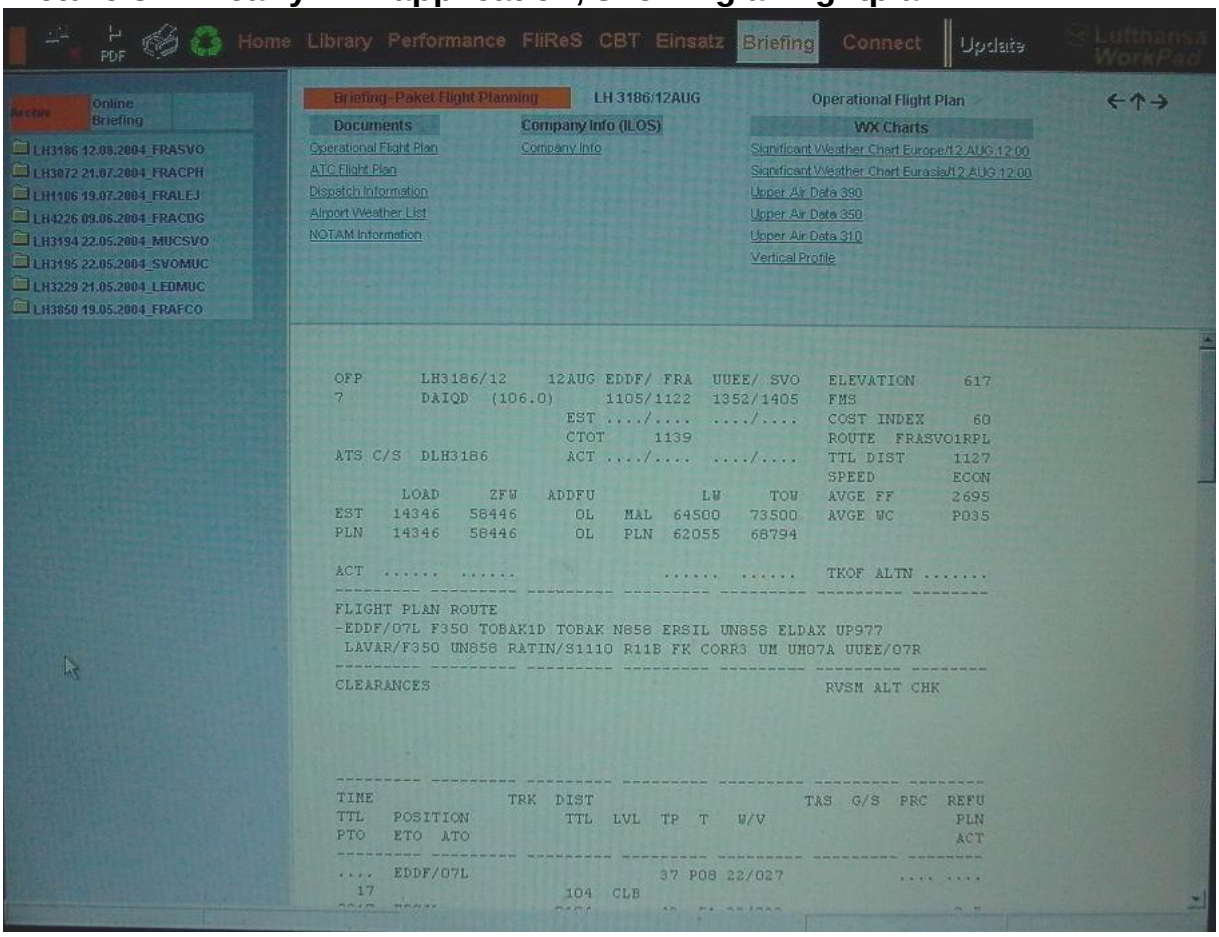
Picture 1: Inflight usage of a conventional paper Flightplan

Picture 1 shows a clipboard with the first page of a two page Flightplan. It starts with a Header, containing elementary flight information like departure and destination airports. Second comes a description of the ATS Flightplan, a route description by the use of airways and waypoints. The long tabular section of the Flightplan lists important waypoints like Top Of Descent (TOC) and waypoints where time and fuel checks can be made. The dots ("…") mark spots where ballpoint entries are expected.

Picture 2: Bag, used to store a paper FF after the flight

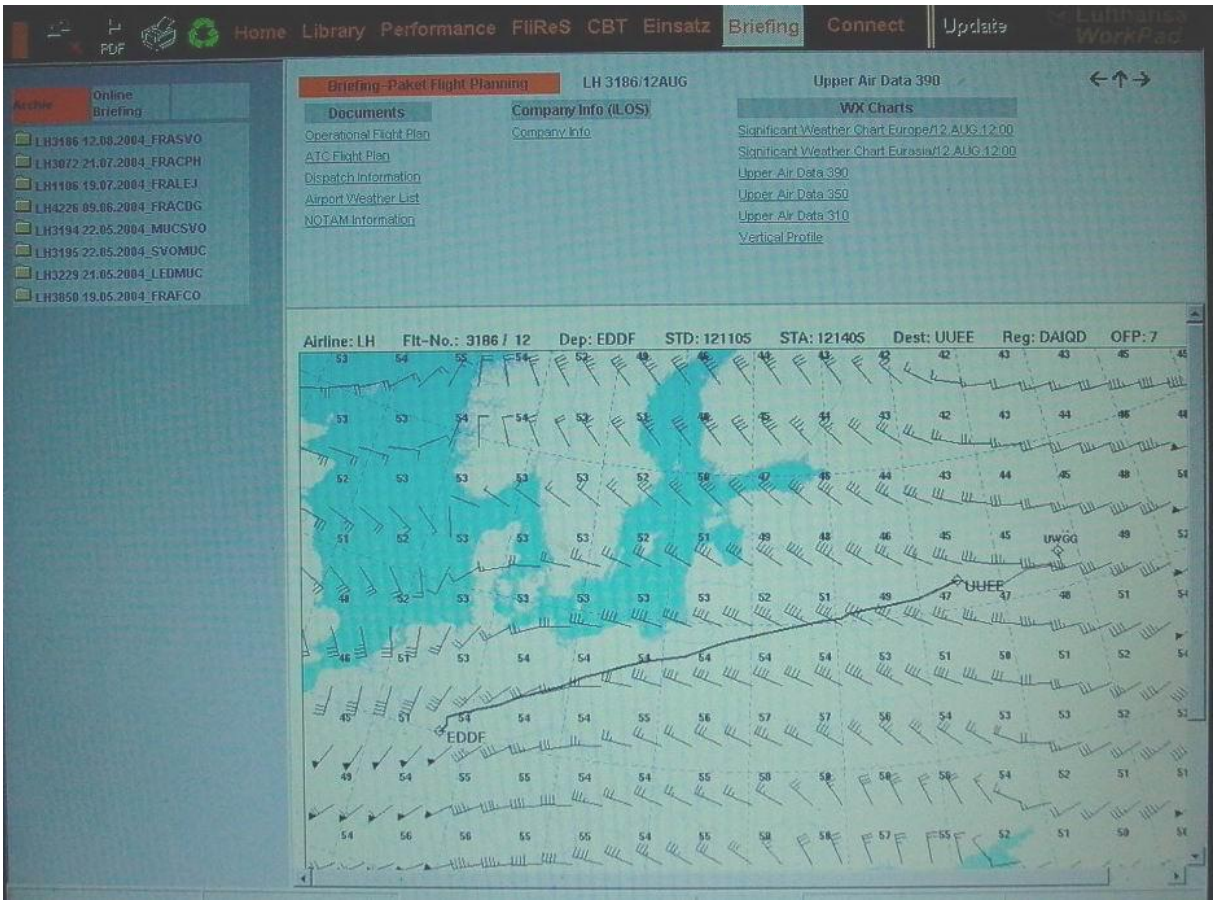
Picture 2 shows a bag to be picked up by someone for storage. It contains parts of multiple paper FF.

Picture 3: An early EFF application, showing a Flightplan



Picture 3 is a screenshot of an EFF-like application called "Briefing". With the navigation tree to the left, an EFF data package can be selected. The Links at the tops are used to select a document within a selected EFF data package. The main part of the screenshot shows the selected document, a Flightplan.

Picture 4: An early EFF application, showing a Wind Chart



Same application as in picture 3, now showing a data generated wind chart with a graphical representation of the planned route.