The new ADS-B based aircraft avoidance system at the MLRO

D. Iacovone, G. Bianco
MLRO, Matera, Italy

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Intro

- The Matera Laser Ranging Observatory (MLRO) has been equipped since the beginning with a pulsed radar aircraft avoidance system.
- We have added redundancy in the safety subsystem by means of the integration of a new aircraft avoidance system based on the ADS-B technology.

ADS-B

Due to the difficulty in obtaining the position of aircrafts flying far from ground based pulsed radar systems, international air traffic control authorities are supporting the use of *virtual* radar systems with GPS-based technology.

The ADS-B (A*utomatic Dependent Surveillance – Broadcast*) technology allows for a continuous information transmission between aircraft and ground stations.

Advantages

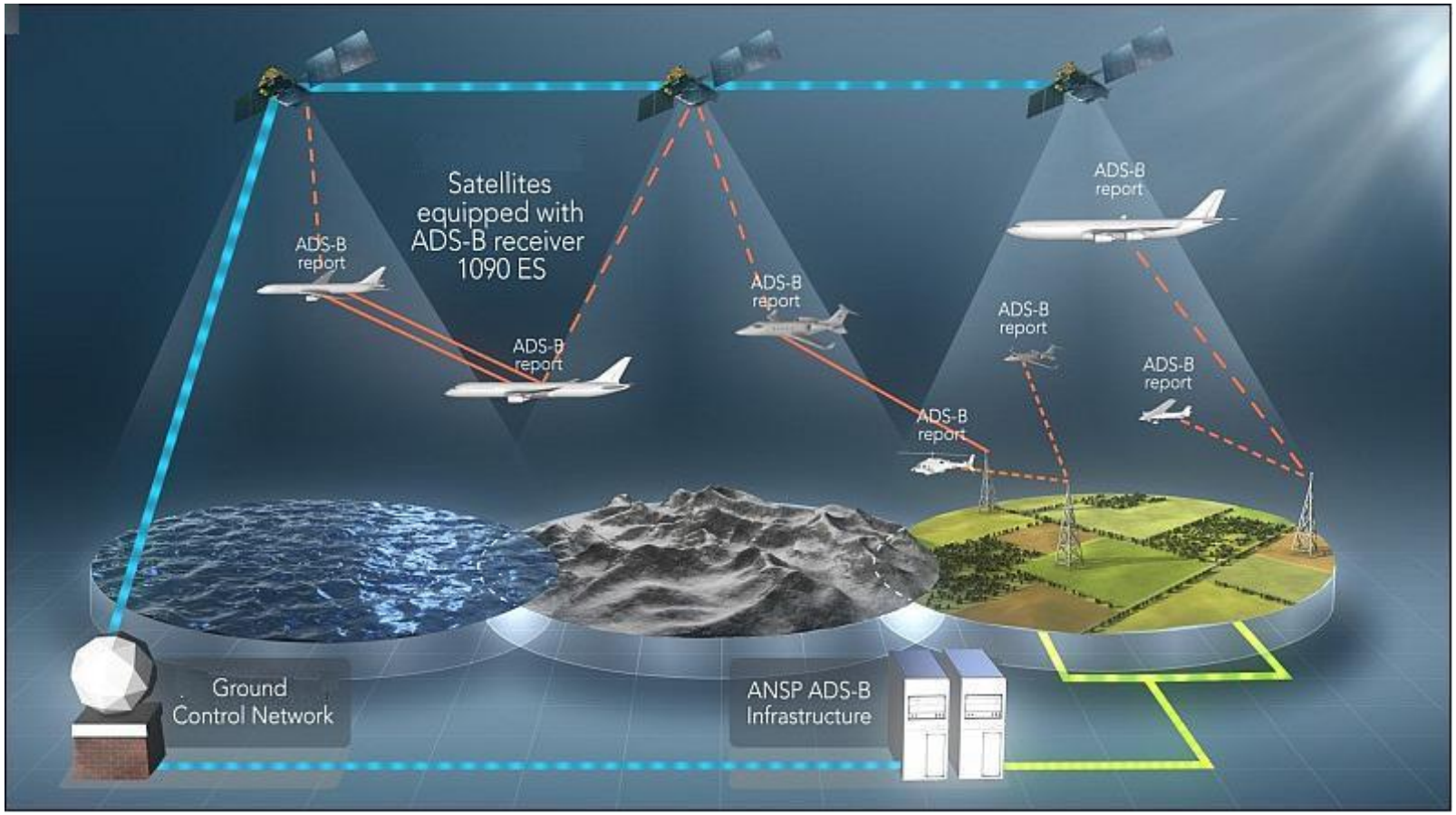
- Improved safety
  - Info available to pilots as well
  - Increased aircraft range
- New services
  - Meteo info
  - Maps
  - Pilots know their position relative to nearby aircraft
- Cheaper ground stations

Main international programs

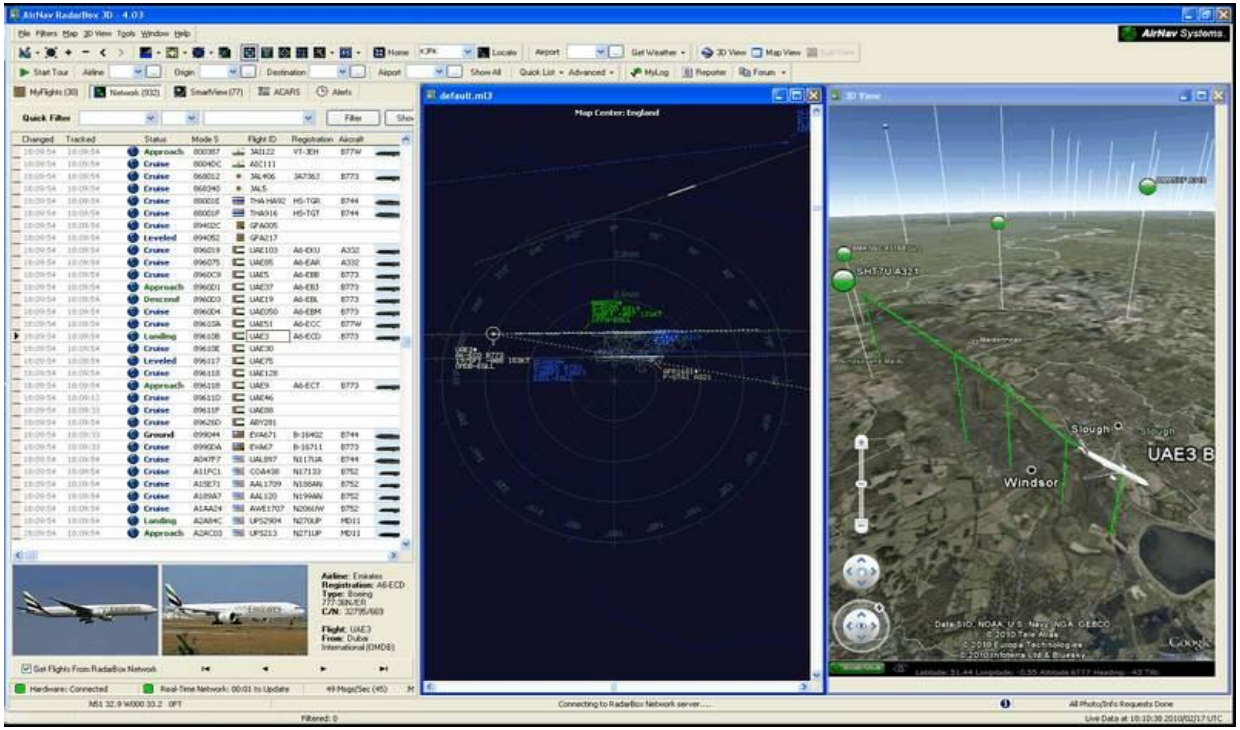
- **NextGen** (*Next Generation Air Transportation System*), FAA
- **SESAR** (*Single European Sky ATM Research*), Eurocontrol

Eurocontrol decided that all new aircrafts from January 2015 on shall carry a ADS-B based transmitter. Older aircraft shall comply from December 2017.

ADS-B communication system



RadarBox (AirNav Systems)



Antenna and amplifier

Antenna GP-1090	
Spec	**Value**
Bandwith	1070 -1110 MHz
Gain	5dB + / - 0.5 dB
Connector	N-type
Length	55 cm
Cable	RG58, 20 mt

Amplifier AS-1090	
Spec	**Vakue**
Bandwith	1030 -1090 MHz
Gain	12dB
NF	0.9 dB
Power supply	12 VDC
Current	100 mA
Max input level	+2dB
Connector	N-type
Size	74 x 93 x 45 mm

Risk scenarios

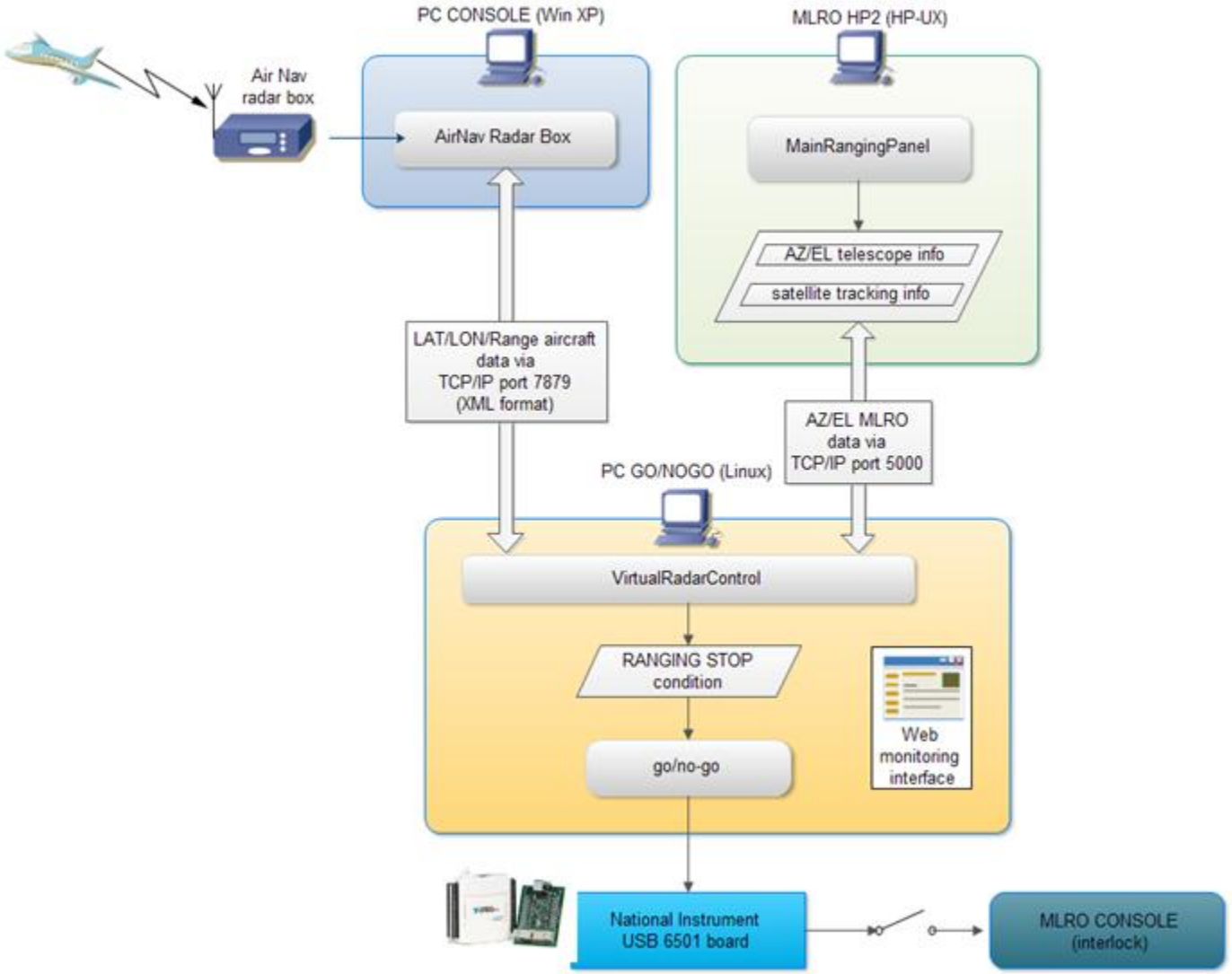
Aircraft	Best case	Worst case
Military	$V_{aereo} = 600 \ \frac{m}{s} \ @ 40 \ km$	$V_{aereo} = 600 \ \frac{m}{s} \ @ 300 \ m$
	$\omega_{aereo} = 0.86 \ ^{\circ}/_{s}$	$\omega_{aereo} = 63 \ ^{\circ}/_{s}$
Civilian	$V_{aereo} = 220 \ \frac{m}{s} \ @ 40 \ Km$	$V_{aereo} = 220 \ \frac{m}{s} \ @ 300 \ \mathrm{m}$
	$\omega_{aereo} = 0.32 \ ^{\circ}/_{s}$	$\omega_{aereo} = 36 \ ^{\circ}/_{s}$

In case of a low flying aircraft the RadarBox is not reliable due to the 1s period of its ≪Mode S≫ transmission; hence it cannot replace the pulsed radar (750 Hz pulse rate) but only complement it. Moreover, any aircraft flying over the MLRO area is not necessarily equipped with such a transmitter (such as Georg's glider ☺) so at this time it is not yet possible to get rid of the pulsed radar.

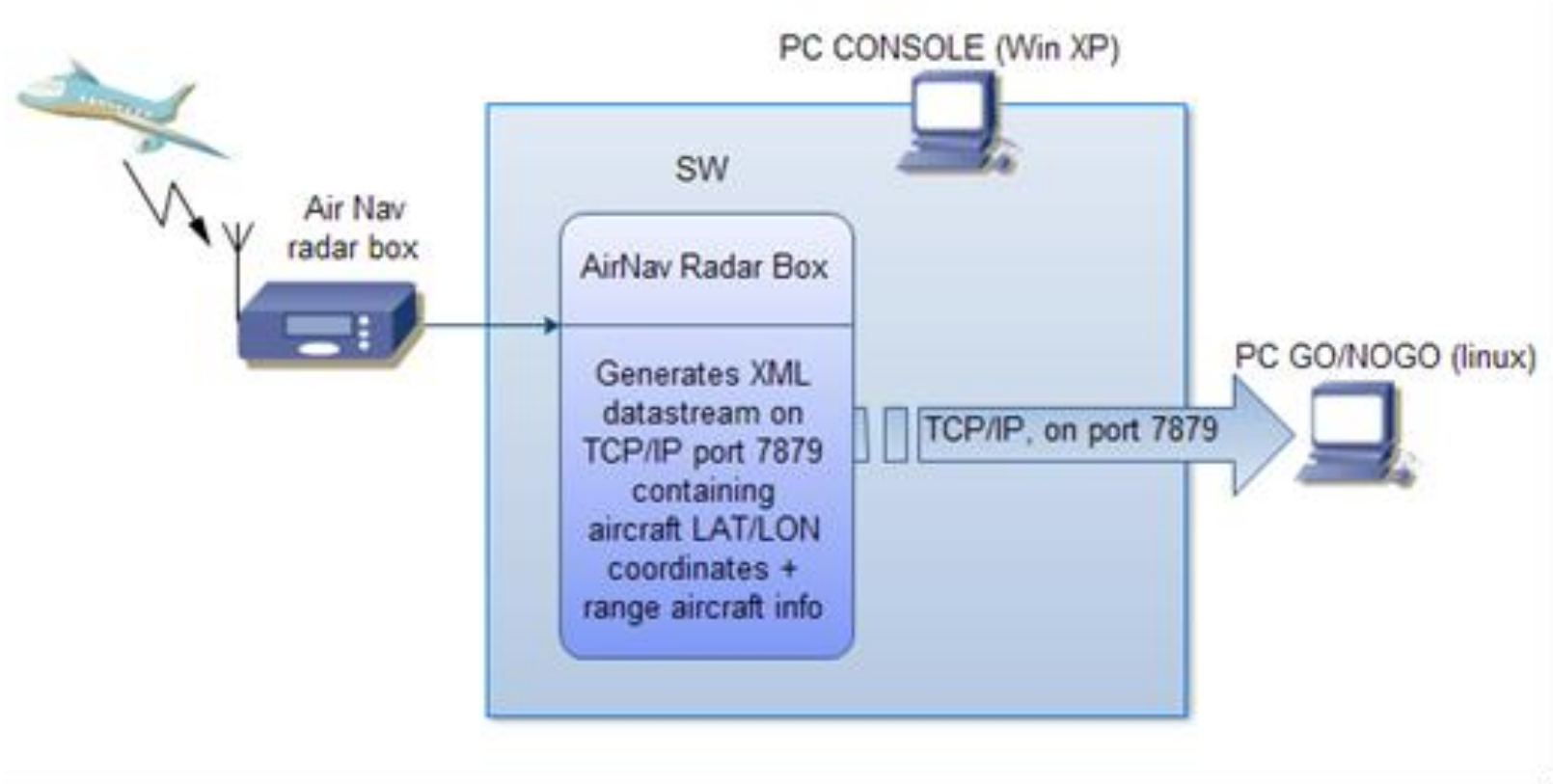
MLRO virtual radar specs

Parameter	Value
Azimuth	$(AZ_{MLRO} - 10°) \leq AZ_{aereo} \leq (AZ_{MLRO} + 10°)$
Elevation	$(EL_{MLRO} - 10°) \leq EL_{aereo} \leq (EL_{MLRO} + 10°)$
Range max	40 Km
Latency of aircraft position	5 sec
Latency of MLRO pointing	5 sec

SW Architecture



AirNavBox 3D SW



Mode-S data packet

<MODESMESSAGE>
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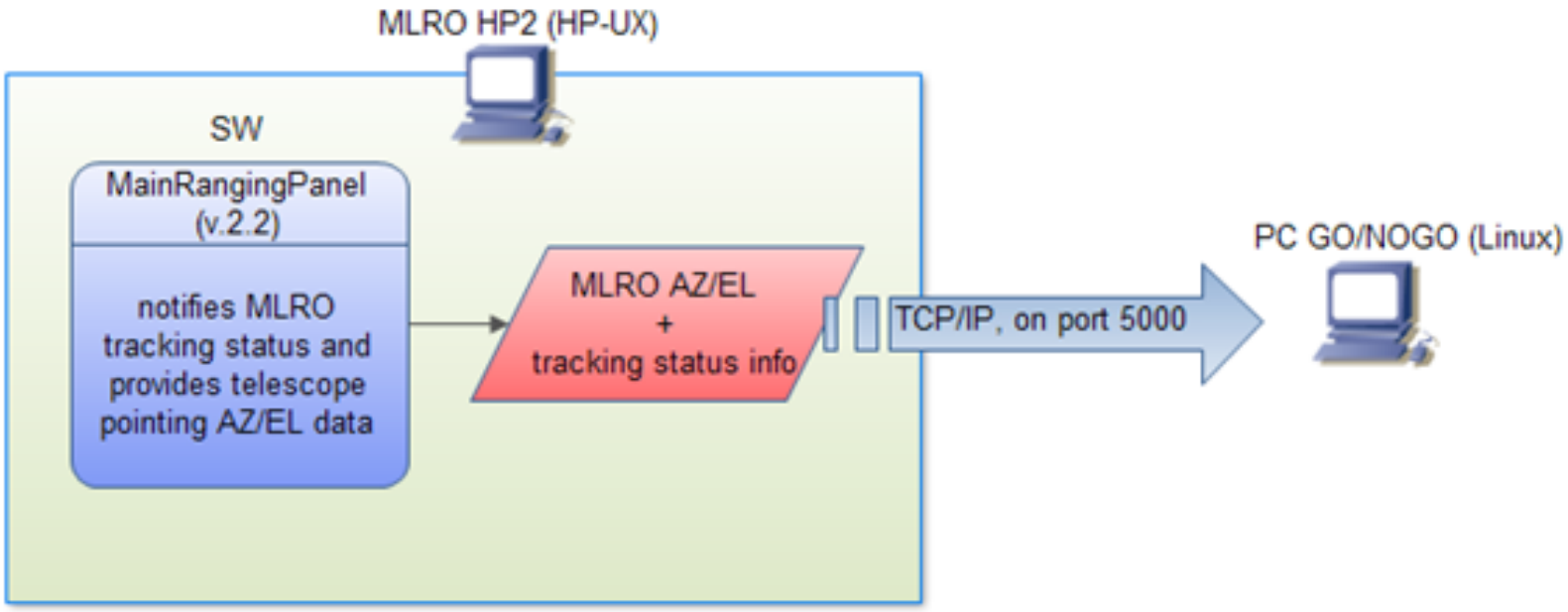
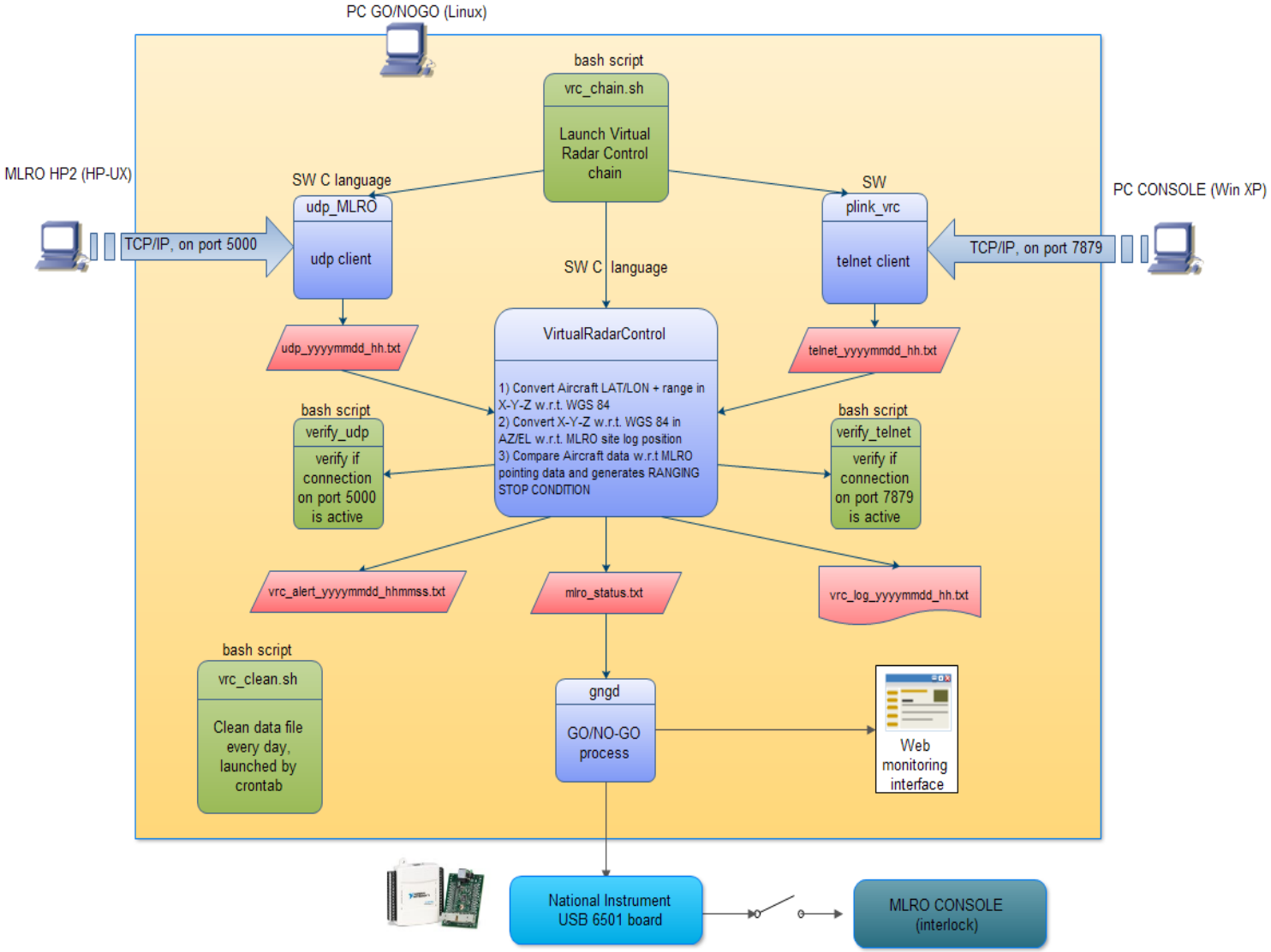
<MODES>390E31</MODES>
<CALLSIGN>AIZ271</CALLSIGN>
<ALTITUDE>36000</ALTITUDE>
<GROUNDSPEED>378</GROUNDSPEED>
<TRACK>285</TRACK>
<VRATE>0</VRATE>
<AIRSPEED>000</AIRSPEED>
<LATITUDE>40.5656</LATITUDE>
<LONGITUDE>16.4516</LONGITUDE>
<SQUAWK>3755</SQUAWK>
</MODESMESSAGE

MainRangingPanel 2.2 SW



VirtualRadarControl SW



Conclusions

- The new ADS-B based aircraft avoidance system has been designed, built and integrated into the MLRO system by e-Geos
- The new system is currently set up as a backup system in case of main radar system failure.

…ooops…!