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# Introduction

ASTERIX Display & Sniffer is a C# /.NET application developed using Microsoft Visual Studio 2010. Initially, it started as a small test application intended to read and decode ASTERIX messages. However, over the time I also added a data display functionality that eventually became a full plot/tracker display providing filters, different map overlays, indication of “track in coast” state, moving labels, entering CLF (Cleared Flight Level) etc.. In addition to that it is also possible to:

1. Record and read in ASTERIX data in raw format. Up to 6 different data streams.
2. Export data in KML format in order to visualize it in Google Earth.
3. Export data in real time to Google Earth in order to use it as a data display. This is done via Google Earth Network Connection feature.
4. Use application to forward/transfer ASTERIX data between networks or to a different multicast address or port.

Note that the application also uses Visual Basic Power Pack, so in order to use full functionality of the application please make sure it is installed. You can get it at: <http://msdn.microsoft.com/en-us/vstudio/bb735936.aspx>

On my PC I have it installed at C:\Program Files\Reference Assemblies\Microsoft\VBPowerPacks\v10.0\Microsoft.VisualBasic.PowerPacks.Vs.dll. and referenced form VS2010.

Make sure that machine where software is running (WIN OS) localization is set to English U.S.

The software uses .NET libraries (ie. double.Parse) that depend on localization. In the case it is not set correctly the software is not able to correctly parse configuration files located in the C:\ASTERIX\ADAPTATION directory.

# Initial Setup

To run the application needs to be configured via several configuration files. These files have to be located in ***C:\ASTERIX\*** directory that itself contains the following directories and configuration files:

***C:\ASTERIX\ADAPTATION***

* ***DisplayAttributes.txt*** (Not to be manually modified)
  + Defines display attributes for the display maps. The application itself provides GUI for changing the attributes (see: Display Attributes for details).
* ***Main\_Settings.txt*** (Not to be manually modified)
  + - The system ***display origin point*** (LAT/LNG of the default center of the display map. The parameter is set to the center of Bosnia and Herzegovina but can be modified using application GUI. (See: Display Attributes for details).
    - Display ***background color***. The parameter is set to black, but can be modified using application GUI. (See: Display Attributes for details).
* ***Radars.txt*** (To be manually modified)
  + Defines radar positions (LAT/LNG). Please see the file for the proper syntax. If no file is provided then by default Sarajevo TWR and Jahorina radars are defined. ***All radars whose data is to be processed have to be defined in this file.***
* ***Sectors.txt*** (To be manually modified)
  + Defines sector borders. See the file for the proper syntax and modify it as needed.
* ***States.txt*** (To be manually modified)

* + Defines state borders. See the file for the proper syntax and modify it as needed. I got my data from <http://www.gadm.org/country>. Some manual modification is needed tough.
* ***Waypoints.txt*** (To be manually modified)
  + Defines system waypoints. See the file for the proper syntax and modify it as needed.
    - *NOTE: The last parameter is needed but does not have any impact at this moment. It is intended to flag the point as a COP (Coordination point) and is included for the future application growth.*
* ***LabelAttributes.txt***
  + Defines Track/Plot Label attributes. The file is not to be manually modified. Instead use provided GUI. Please see Label Attributes.

***C:\ASTERIX\IMAGES***

* ***radar.jpg*** (jpg image to be used for radar presentation on the display)
* ***waypoint.jpg*** (jpg image to be used for waypoint presentation on the display)

***C:\ASTERIX\GE***

* ***ac\_image.png*** *(an image that Google Earth uses for Track/Plot display when displaying in real time.*
* ***ASTX\_TO\_KML*** *(auto generated file that is used by Google Earth to display data in real time).*

# Main Windows and Functionality

Once started, the ***Main Screen*** opens up and, as you might assume, there are no any data displayed. To see some action the data either have to be imported from a raw ASTERIX recording or processed in real time from LAN.

To open up a recording just go to File -> Open Asterix Recording and browse to the file.

To read in live data the PC where ASTERIX Display & Sniffer is running has to be on the same network as the hardware which is providing the data so that application gets the ASTERIX data via known multicast IP and PORT number.

*In my case, for the testing purpose, I use a host WINDOWS machine and one virtual LINUX machine where an ASTERIX recorded data (I provide CAT48 data sample (****jahorinaJan\_cat.48****) that is re-played (****I use gengate provided by SkyGuide****) on the same network as my host machine, using the following setup:*

1. *Host PC: 192.168.5.104, 255.255.255.0*
2. *Virtual Linux ASTERIX replay (CentOS): 192.168.5.103, replaying data on 231.27.80.1, port 4001*

*Of course, if available you can connect* ASTERIX Display & Sniffer *to any live ASTERIX data provider or use other tools, such as* Bittwist (runs on Windows) to locally replay the radar data.

# Setting up a connection

To start, from the Main Screen (Figure 2) open up ***Settings -> Connection Settings or directly from the Main Screen under Connection*** (Figure 1), and enter required data. It is possible to enter several connections and save them in a file. Later on, you can open up the file and just activate one of the saved connections.

### C:\Users\bhdca\Desktop\Documentation\Connection Screen.jpg

### Figure 1: Connection Screen

# Start processing data

Once a connection is activated to start processing the data it is necessary to enable it from the Main Screen using the upper right button (***Stopped/Running***). Once the processing is activated the screen will start to populate in real time with the buffered data as shown in Figure 2 & 3.

### C:\Users\bhdca\Desktop\ScreenHunter_01 Oct. 02 13.48.jpg

### Figure 2: Main Display Window

### C:\Users\bhdca\Desktop\Capture\Main Capture.jpg

### Figure 3: Main Capture Window

Once some data is buffered stop the buffering and then you can analyze the data either by looking at the Main Screen or by one of the below listed options:

# Data Item Presence

This view will tell you what data items were detected for a given message category for the latest buffered data sample.

### C:\Users\bhdca\Desktop\Documentation\Data Item Presence.jpg

### Figure 4: Data Item presences

So far the data item presence for the following ASTERIX categories is implemented:

* CAT 001
* CAT 002
* CAT 008
* CAT 034
* CAT 048
* CAT 062
* CAT 063
* CAT 065

# Data Item View

This view will list you all the given data items in the order they were received for the given data sample. It does not filter the data so for CAT001 and CAT048 it is much better to use “View by SSR Code”.

### C:\Users\bhdca\Desktop\Documentation\Data Item View.jpg

### Figure 5: Data Item View

# View by Mode-A Code

This view provides the following data (CAT 001 or CAT048), filtered by Mode-A code in the order received:

1. ***Distance from the surveillance source***
2. ***Azimuth from the surveillance source***
3. ***Lat/Long from the surveillance source***
4. ***Mode C code Validated (TRUE/FALSE)***
5. ***Mode C code Garbled (TRUE/FALSE)***
6. ***Mode C code value***

### ScreenHunter_04 Jul. 24 21.37.jpg

### Figure 6: View data by SSR code

# Export

This option enables you to decode and export a data sample, filtered by a SSR code, to either Earth Plot or GE Path supported file formats that then can be used to export data into a KML file, used by Google Earth. The final result is possibility to display any track in the data sample as a 3D track in Google Earth, as shown in Figure X.

### C:\Users\bhdca\Desktop\Documentation\Plot Exporter by SSR Code.jpg

### Figure 7: Export to Earth Plot format by Mode-A code

### C:\Users\bhdca\Desktop\Documentation\3D Example of a test flight over BiH exported via ASTERIX SNIFFER.jpg

### Figure 8: 3D example in Google Earth of a real test flight over Bosnia and Herzegovina

# Live Display in Google Earth

It is possible to set up the application to auto-generate a .kmz file (every update cycle) that is then automatically processed by Google Earth. The final result is that Google Earth can be used as a 3D data display. If desired, a web server could be configured to provide the .kmz file so that data could be seen via a web browser (google maps) or any other web page with embedded google maps.

The live display in Google Earth is enabled by selecting display mode from Plot Display Tab.

# Local Plot/Track Display

Local Plot display functionality enables you to display received plots either in real time or buffered data. It provides filter capability (by Mode-A code and/or Flight Level) as well as to dynamically adjust update rate in order to match antenna time period of a specific radar in the case no North Mark message is available. If North Mark message is available it is recommended to use “Sync to NM” option.

Data display can be real time or passive. The passive display is an option to visualise all the buffered data (each recived target) including options to use one of the available filters (By Mode-A code or Flight Level Band ), as depicted in Figure XX. In addition to that it is possible to filter out PSR targets. The filters are applicable to passive and real time displays.

***Please note:*** Application uses WEB map providers (google, yahoo, etc..) so first time application is started it is necessary to be on the internet so application is able to cache the maps. While on the net zoom in so appropriate maps are downloaded. Later on maps will be cached and application can be used offline.

### *C:\Users\bhdca\Desktop\ScreenHunter_01 Oct. 02 13.48.jpg*

### Figure 9: Custom Map with only user defined data.

### *C:\Users\bhdca\Desktop\ScreenHunter_02 Oct. 02 13.51.jpg*

### Figure 10: Map with user defined and Google terrain overlay

### *C:\Users\bhdca\Desktop\ScreenHunter_03 Oct. 02 13.53.jpg*

### Figure 11: Passive display no filter

### *C:\Users\bhdca\Desktop\ScreenHunter_04 Oct. 02 13.54.jpg*

### Figure 12: Passive filter – by Mode-A code

While the application does provide GUI for re-centering and zoom in and zoom out functions, it is also possible to use mouse middle button for zoom and right button for moving the maps.

The following depicts a track that is in:

* Coast state (indicated by the down pointing arrow next to Mode A 6544
* AC is climbing (indicated by upper pointing arrow next to Mode C 334
* A track that has a CFL 600 entered (next to Mode C)
  + To enter a CFL right click over CFL field.

Please note that the label box is shown only when a mouse is over the label.

### C:\Users\bhdca\Desktop\Example1.jpg

### Figure 13: Label in coast, AC is climbing and entered CFL

# Display Attributes

Display attributes window is accessed either via the Main Window from ***Settings -> Display Attributes*** or by right button mouse click from the Display Window, that will then provide the option to open up the Display Attributes Window. This window is used to control various display attributes as shown below in the Figure 15

### C:\Users\bhdca\Desktop\ScreenHunter_06 Sep. 12 14.54.jpg

### Figure 14: Menu to Access Display configuration windows

To check/modify a specific display attribute first select ***Display Item***, and then modify an applicable attribute.

***NOTE: Although not all attributes are applicable to each Item all attributes are available for the implementation simplicity. Example: Line Attribute is not applicable to radar but is to State Border line.***

### C:\Users\bhdca\Desktop\ScreenHunter_05 Sep. 12 14.54.jpg

### Figure 15: Display Attributes

# Display Items

Display attributes window is accessed by right button mouse click from the Display Window that will then provide the option to open up the Display Item

Display Item is provides a simple way to enable/disable specific data item on the display. The selection gets saved between application sessions.

### C:\Users\bhdca\Desktop\ScreenHunter_07 Sep. 12 14.58.jpg

### Figure 16: Display Items

# Label Attributes

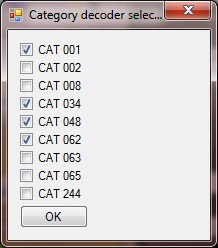
Label Attributes Window lets you configure Track/Plot Label attributes. The changes can be checked immediately by pressing “Update” button and then will be applied to the display. Once satisfied with the selection the settings can be saved using “Save” button so they remain same between sessions.

### C:\Users\bhdca\Desktop\ScreenHunter_08 Sep. 12 14.59.jpg

### Figure 17: Label Attributes Picker

# Choosing Category to Process

This option lets you choose what ASTERIX Category is to be processed. Usually, the one to be expected needs to be selected and in the case of using the application in order to display the data only category needed should be selected in order to improve performance. Choosing all available options lets you use the application to determine what categories/data items are present on the given interface.



### Figure 18: Category decoder selector

# ASTERIX Recording

Aaaaa

# ASTERIX forwarding

Aaaa

# Implemented Decoders (so far)

CAT01

020 Target Report Descriptor

040 Measured Position in Polar Coordinates

070 Mode-3/A Code in Octal Representation

090 Mode-C Code in Binary Representation

CAT02

000 Message Type

020 Sector Number

030 Time of Day

041 Antenna Rotation Period

CAT48

020 Target Report Descriptor

040 Measured Position in Slant Polar Coordinates

070 Mode-3/A Code in Octal Representation

090 Flight Level in Binary Representation

240 Aircraft Identification

CAT34

000 Message Type

030 Time-of-Day

020 Sector Number

041 Antenna Rotation Period

CAT62

015 Service Identification

105 Calculated Track Position (WGS-84)

060 Track Mode 3/A Code

040 Track Number

136 Measured Flight Level

380 Aircraft Derived Data

Subfield # 2: Target Identification

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