McIDAS – XCD Replacement Update

2016 McIDAS Users' Group Meeting

Rewrite Team

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McIDAS XCD

McIDAS X

Conventional Data

Decoder

McIDAS-XCD files, decodes and indexes the NOAAPORT data stream into formats that can be served by McIDAS-X ADDE servers.

Output formats include McIDAS MD files, Text files, McIDAS GRID files, GRIB Version 1 and 2 files, NEXRAD files, and BUFR files.

NOAAPORT Data

- The NOAAPORT broadcast system provides a one-way broadcast communication of NOAA environmental data and information in near-real time to NOAA and external users. This broadcast service is implemented by a commercial provider of satellite communications utilizing C-band.

NOAAPORT Channels

The following NOAAPORT channels supply data to be decoded by McIDAS-XCD:

- **NCEP/NWSTG Channel (NWS Telecommunications Gateway)**
  - model output from the National Centers for Environmental Prediction (NCEP)
  - observations, forecasts, watches and warnings from NWS Forecast Offices
  - WSR-88D radar products
  - most observational data over North America
- **NCEP/NWSTG2 Channel**
  - supplements the NWSTG channel

NOAAPORT Data flow into SSEC

Users generally get NOAAPORT data in two ways:

1. Directly from DOMSAT (101° W)
2. Over the Internet via LDM

Why Replace -XCD?

- Installation is difficult
- Upgrades are difficult
- System is overly complex, large learning curve for operators, and very large learning curve for new programmer
- System was written for a mainframe then ported to UNIX
- A powerful system is needed to run -XCD, otherwise data can be lost
- A data format change can mean bad data, and a fix can be difficult to implement, and is only effective for future data

Goals

- Replace 4 parts of -XCD filing and decoding:
  - GRIB
  - NEXRAD
  - Text
  - POINT/MD serving
- Utilize LDM direct filing
- Reduce or eliminate compiled code
- Remove legacy mainframe complexity
- Utilize simple open-source database, SQLite
- Match or exceed current filing and serving performance on existing hardware

-XCD Replacement: GRIB Data

- LDM files GRIB messages to a temporary directory
- A GRIB daemon written in Python watches for data, extracts information and files metadata into a SQLite database
- SQLite databases are separated by model and date
- Volume of GRIB data has increased greatly over the last several years increasing the challenge

-XCD Replacement: NEXRAD Data

- LDM files NEXRAD files (WSR and TDWR) into a directory structure similar to the existing -XCD Decoder
- Data served by NEXRAD server

-XCD Replacement: Text Data

- LDM files data directly to disk
- A bash script running as a daemon watches for new data and files data into a daily *.XCD file as data comes in
- The bash script extracts metadata for insertion into a daily SQLite database
- Text servers (wxtgserv and obtgserv) query SQLite databases to find data and return information to client
- Commands: WXTLIST, WWLIST, WWDISP, *RPT

-XCD Replacement: Point Data

- RTPTSRC datasets
- Uses certain text data identified by WMO headers filed in the database (e.g. SA and SP for SFCHOURLY)
- No MD files are created, but structure created on the fly when serving via ADDE
- Commands such as PTLIST, PTDISP and PTCOPY get metadata from the SQLite database, then extract data from the *.XCD file created by the text filer
- At the start of each UTC day, a Station Database table (equivalent to STNDB.CORE) is created
- Station Database is retained for archived data

Point Data Improvements

- Replacement –XCD captures more surface hourly data than existing –XCD
- Existing –XCD: Hourly & 2 Specials

```
PTLIST RTPTSRC/SFCHOURLY SEL='ID KEKN;TIME 20;DAY 314' PARAM=DAY TIME HMS ID  T TD SPD DIR WX1 TYPE NUM=ALL
 DAY[CYD] TIME[HMS]  HMS[HMS]   ID      T[K]     TD[K]  SPD[MPS]  DIR[DEG]  WX1      TYPE
--------- --------- --------- ---- --------- --------- --------- --------- ---- ---------
  2016314    200000    195100 KEKN    280.96    279.86       4.1       310 R-F          0
  2016314    200000    203600 KEKN    281.16    280.16       5.7       310 R-F          1
  2016314    200000    203800 KEKN    281.16    280.16       4.6       310 RF           2
Number of matches found = 3
PTLIST: Done
```

- Replacement –XCD: Hourly & All Specials

```
PTLIST RTPTSRC/SFCHOURLY SEL='ID KEKN;TIME 20;DAY 314' PARAM=DAY TIME HMS ID  T TD SPD DIR WX1 TYPE NUM=ALL
 DAY[CYD] TIME[HMS]  HMS[HMS]   ID      T[K]     TD[K]  SPD[MPS]  DIR[DEG]  WX1      TYPE
--------- --------- --------- ---- --------- --------- --------- --------- ---- ---------
  2016314    200000    194700 KEKN    281.16    280.16       5.1       310 R-F          1
  2016314    200000    195100 KEKN    280.96    279.86       4.1       310 R-F          0
  2016314    200000    201600 KEKN    280.96    279.86       4.6       320 RF           1
  2016314    200000    202400 KEKN    280.96    279.86       4.6       320 RF           1
  2016314    200000    203000 KEKN    280.96    279.86       4.1       310 R+F          1
  2016314    200000    203600 KEKN    280.96    279.86       5.7       310 R-F          1
  2016314    200000    203800 KEKN    280.96    279.86       4.6       310 RF           1
Number of matches found = 7
```

Point Data Improvements

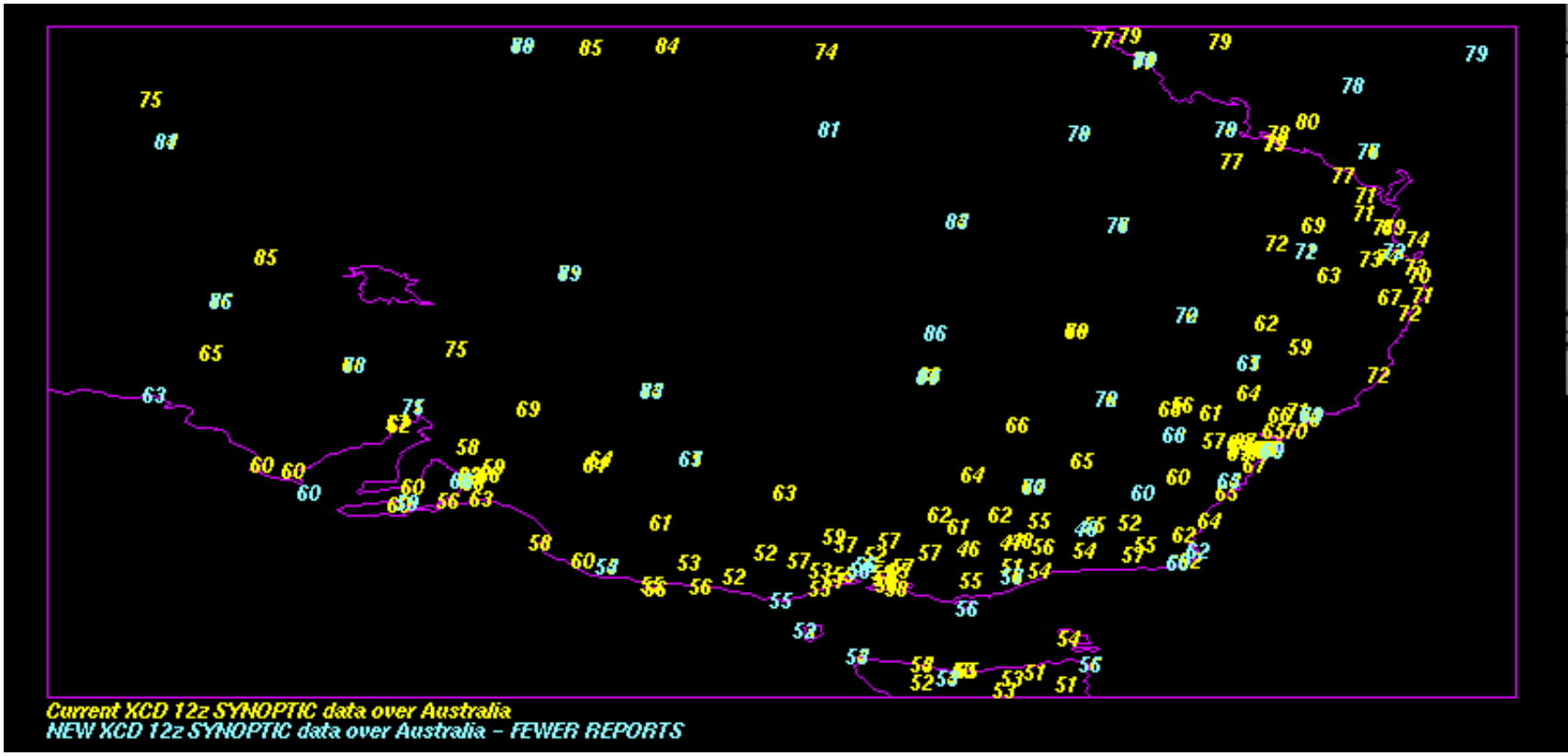
- Synoptic Data in current –XCD is stored every 3 hours

```
PTLIST RTPTSRC/SYNOPTIC SEL='CO AU; IDN 94102' PAR= DAY TIME IDN T TD DIR SPD NUM=ALL
 DAY[CYD] TIME[HMS]        IDN       T[K]      TD[K]  DIR[DEG]  SPD[MPS]
--------- --------- --------- --------- --------- --------- ---------
  2016315         0     94102    305.36    297.96       250       8.2
  2016315     30000     94102    305.96    297.96       260       7.7
  2016315     60000     94102    305.56    298.36       260       9.7
  2016315     90000     94102    303.06    297.96       260      10.8
  2016315    120000     94102    302.76    297.86       250      11.3
  2016315    150000     94102    302.46    297.56       250      10.8
  2016315    180000     94102    302.16    296.56       250       9.7
  2016315    210000     94102    303.06    296.76       230       8.2
Number of matches found = 8
PTLIST: Done
```

- Replacement –XCD can store every hour

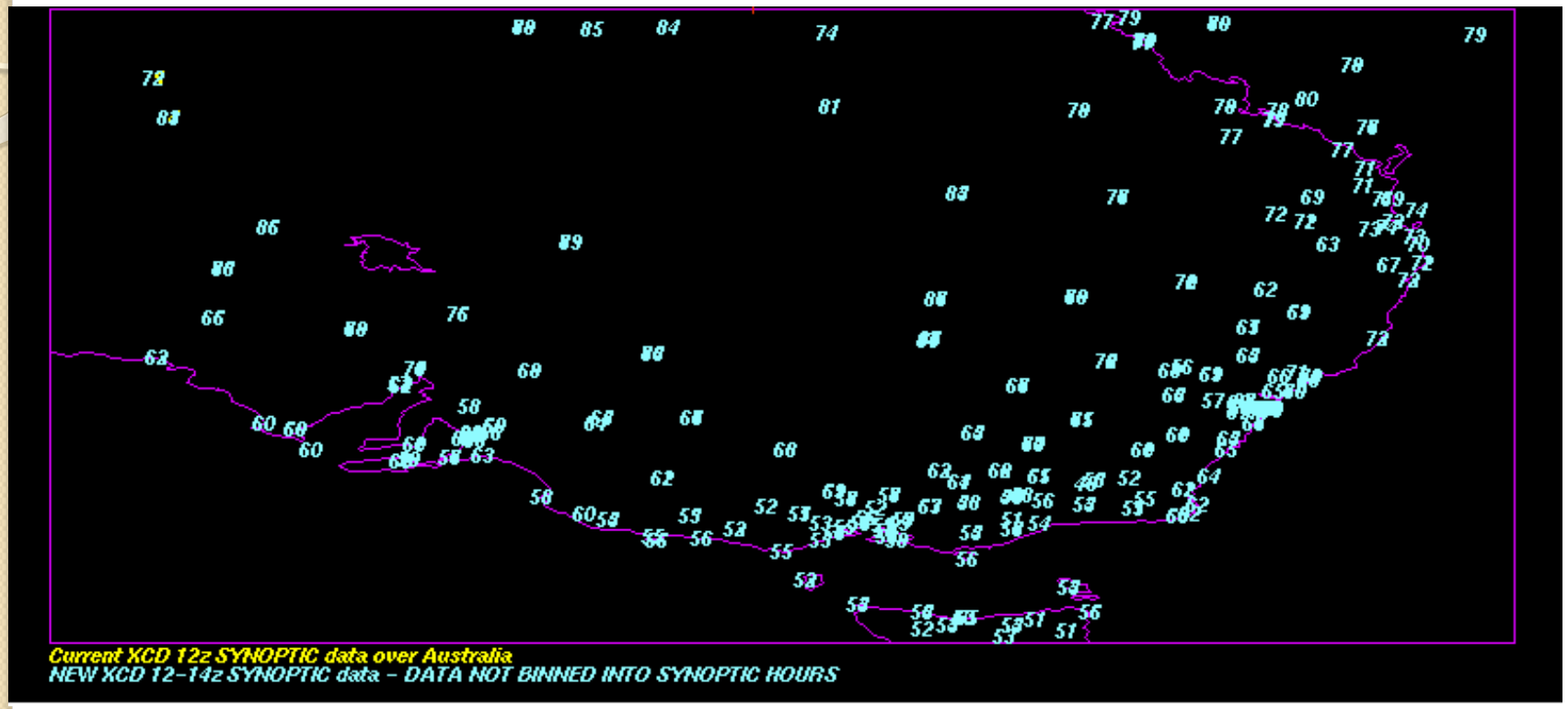
```
PTLIST RTPTLITE/SYNOPTIC SEL='CO AU; IDN 94102' PAR= DAY TIME IDN T TD DIR SPD NUM=ALL
 DAY[CYD] TIME[HMS]        IDN       T[K]      TD[K]  DIR[DEG]  SPD[MPS]
--------- --------- --------- --------- --------- --------- ---------
  2016315         0     94102    304.96    298.06       260       6.6
  2016315     10000     94102    305.36    297.96       250       8.2
  2016315     30000     94102    306.16    297.86       250       7.7
  2016315     40000     94102    305.96    297.96       260       7.7
  2016315     60000     94102    305.56    298.16       270       9.7
  2016315     70000     94102    305.56    298.36       260       9.7
  2016315     90000     94102    303.66    297.76       260      10.8
  2016315    100000     94102    303.06    297.96       260      10.8
  2016315    120000     94102    302.86    297.96       250      11.8
  2016315    130000     94102    302.76    297.86       250      11.3
  2016315    150000     94102    302.36    297.66       250      10.8
  2016315    160000     94102    302.46    297.56       250      10.8
  2016315    180000     94102    302.36    297.46       240      10.2
  2016315    190000     94102    302.16    296.56       250       9.7
  2016315    210000     94102    302.56    297.46       240       8.7
  2016315    220000     94102    303.06    296.76       230       8.2
Number of matches found = 16
PTLIST: Done
```

Point Data Case: Synoptic over Australia



- PTDISP RTPTSRC/SYNOPTIC.ALL PAR=T[F] FORMAT=I2 SEL='TIME 12;DAY 2016316' DEC=NO
  PTDISP RTPTLITE/SYNOPTIC.ALL PAR=T[F] FORMAT=I2 SEL='TIME 12;DAY 2016316' DEC=NO COL=2

Point Data Case: Synoptic Over Australia



- PTDISP RTPTSRC/SYNOPTIC.ALL PAR=T[F] FORMAT=I2 SEL='TIME 12;DAY 2016316' DEC=NO
  PTDISP RTPTLITE/SYNOPTIC.ALL PAR=T[F] FORMAT=I2 SEL='TIME 12 14;DAY 2016316' DEC=NO COL=2

Point Data Issues

- Number of hourly records of PTCOPY for SFCHOURLY data needs to be increased
  - Up to 10 specials per hour?
- Number of possible records of PTCOPY for SYNOPTIC data needs to account for the hourly availability

BUFR Data (Binary Universal FoRmat)

- Filed directly using LDM
- No operational McIDAS-X server exists
- A prototype server was created but has not been updated in several years
- Individual files can be loaded into McIDAS-V if they follow the standard BUFR tables
- We aim to be ready as BUFR implementation proceeds

Local Data

- A couple -XCD sites have local (non-NOAAport) feeds of data
- We have contacted those sites in the past
  - So far, no core -XCD decoder dependencies are known i.e. sites have written their own decoders
- If there is local data that do depend on -XCD libraries, sites will be able to continue to use -XCD libraries, or may link to McIDAS-X libraries as needed. Contact Jerry Robaidek or Becky Schaffer if you have concerns.

Hardware Specs

- Development hardware (~$4K in 2013)
  - 2- AMD Opteron 4180 CPUs - 6 core each
  - 32 GB ram
  - 7.2k rpm SAS disks
- Briefly tested GRIB on a sub $1K desktop
  - Intel i5-3570 3.4 GHz (quad core)
  - 16 GB memory
  - 7.2k rpm SATA drives (6 Gb/s)

Serving performance (Text)

- TEXT lists
  - WXTLIST (no parameters)
    - Current -XCD: fastest=.092 s slowest=.105 s
    - New -XCD : fastest=.014 s slowest=.35 s
  - WXTLIST WMO=SA
    - Current -XCD : fastest=.019 s slowest=.259 s
    - New -XCD : fastest= 1.654 s slowest= 1.890 s

Serving performance (SFCRPT)

- SFCRPT
  - SFCRPT KGRB 9 (Current –XCD)
    - Fastest : ~.021 s
    - Slowest : ~.419 s
  - SFCRPT KGRB 9 (New –XCD)
    - Fastest : ~.017 s
    - Slowest : ~.122 s

Serving performance (PTLIST)

- PTLIST
  - PTLIST RTPTSRC/SFCHOURLY SEL="DAY 2016312; TIME 12; ID KMSN"
    - Current –XCD: fastest=.022 s slowest=.074 s
    - New –XCD: fastest=.023 s slowest=.167 s
  - Remove ID: PTLIST RTPTSRC/SFCHOURLY SEL="DAY 2016312; TIME 12"
    - New –XCD slows to : ~0.3 s
  - Remove ID and Time: PTLIST RTPTSRC/SFCHOURLY SEL="DAY 2016312"
    - New –XCD slows to : ~3.8 s

Server performance (GRID)

- GRID lists (GRDLIST)
  - RTGRIDS/GFS-USLC DAY=2016312 TIME=6:00 PAR=U NUM=10
    - Current -XCD : ~.45 s
    - New -XCD : ~.07 s
- GRID display (GRDDISP)
  - RTGRIDS/GFS-USLC DAY=2016312 TIME=6:00 PAR=U FHOUR=12 LEV=500
    - Current -XCD: ~.185 s
    - New -XCD : ~.105 s
- GRID copy (GRDCOPY)
  - RTGRIDS/NAM-USPS G/G.5700 DAY=2016312 TIME=0:00 PAR=T FHOUR=9 LEV=500
    - Current -XCD: ~.125 s
    - New -XCD: ~.052 s

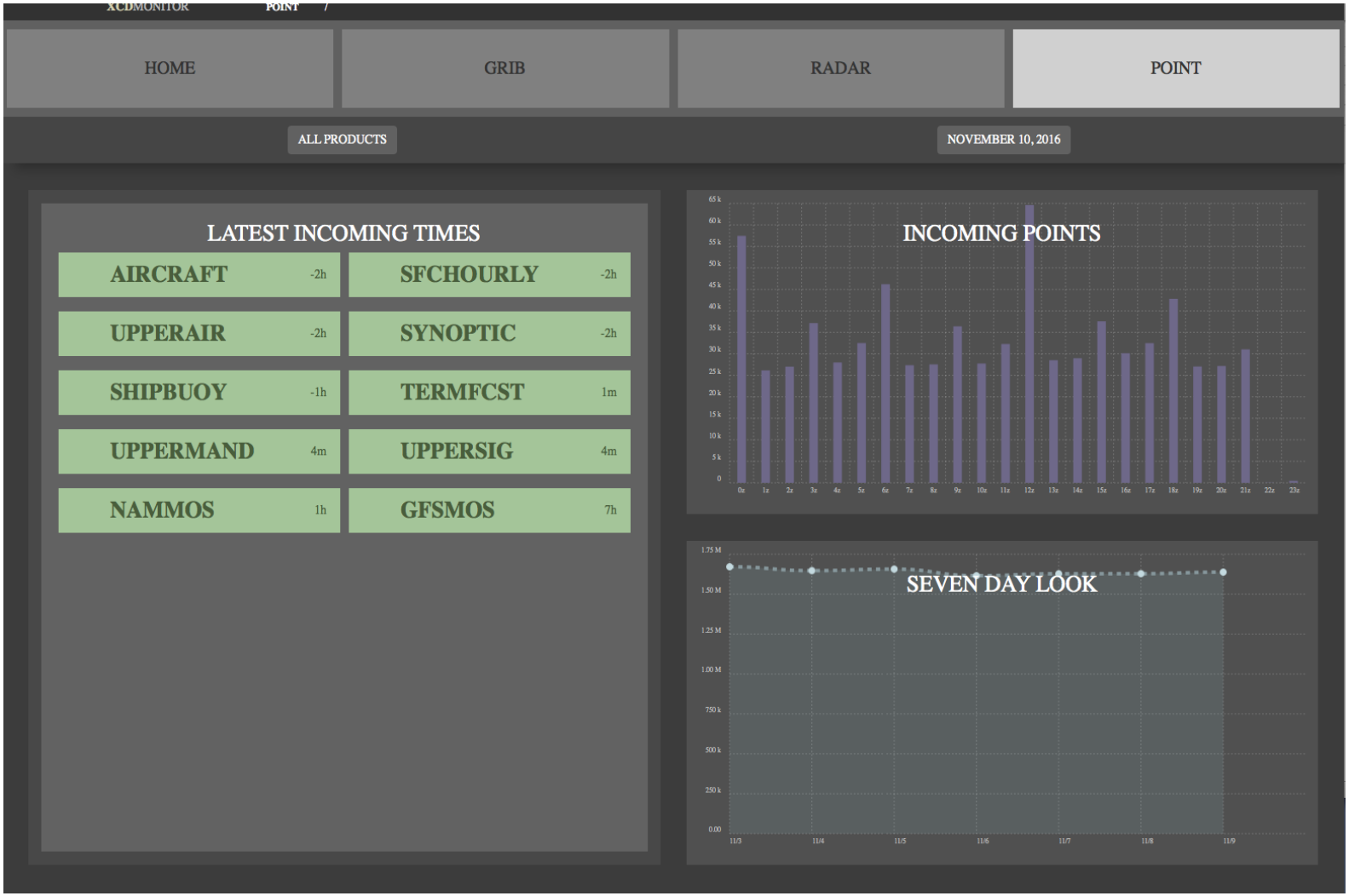
Monitoring

- Command line
  - ldmadmin watch
  - gribadmin
- Graphical
  - HTML based
  - Does not require apache to be installed

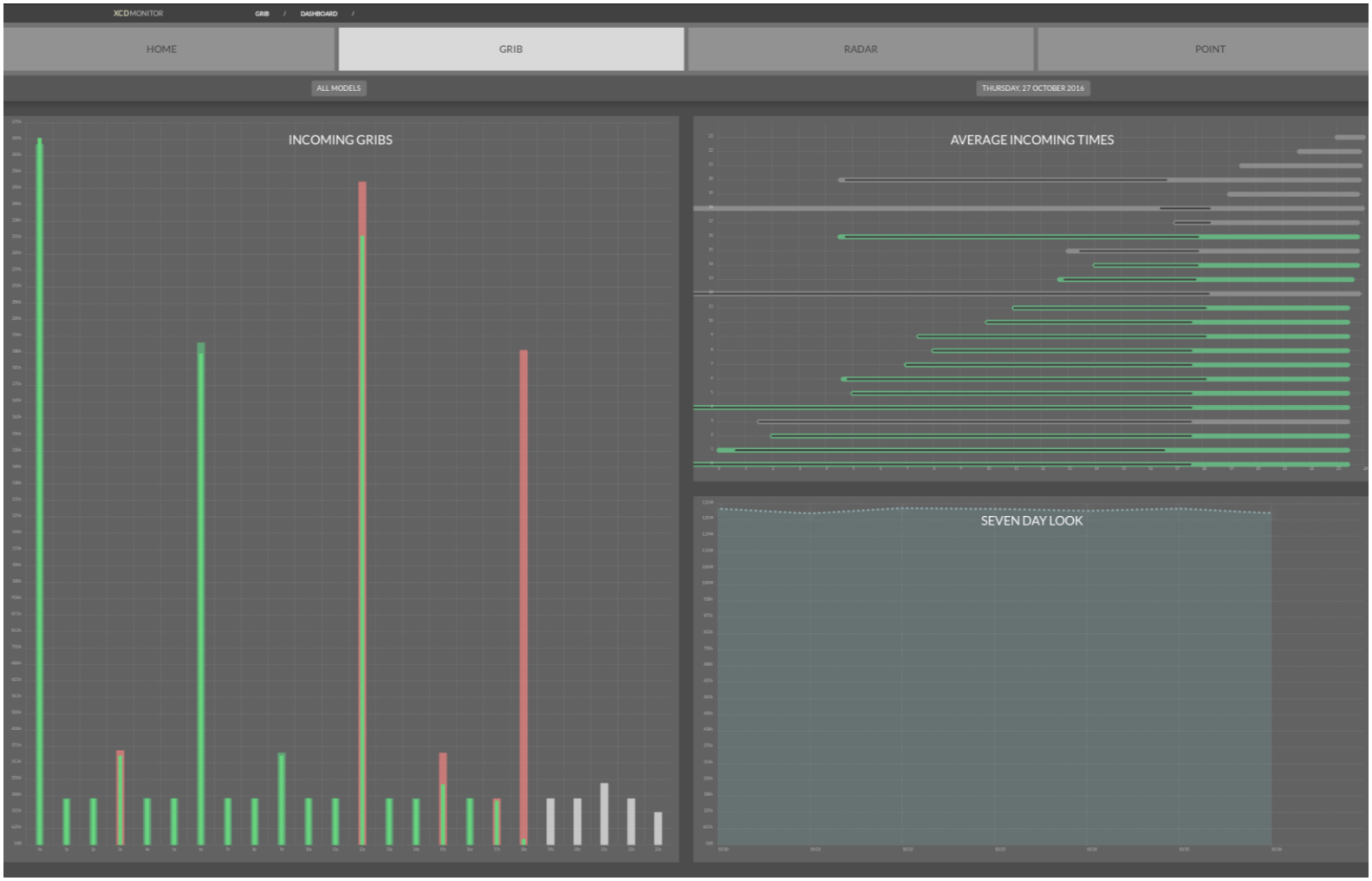
Monitoring


XCDMONITOR
HOME
HOME
GRIB
RADAR
POINT
ALL MODELS
NOVEMBER 10, 2016
1,178,404 GRIBS
PAST 24 HOURS
1,685,589 RADAR FILES
PAST 24 HOURS
816,834 POINT FILES
PAST 24 HOURS
23,356 GRIBS
PAST HOUR
110,404 RADAR FILES
PAST HOUR
58,214 POINT FILES
PAST HOUR
21:38 23m
MOST RECENT DATA
21:46 15m
MOST RECENT DATA
23:59 -1h
MOST RECENT DATA
GRIB
RADAR
POINT

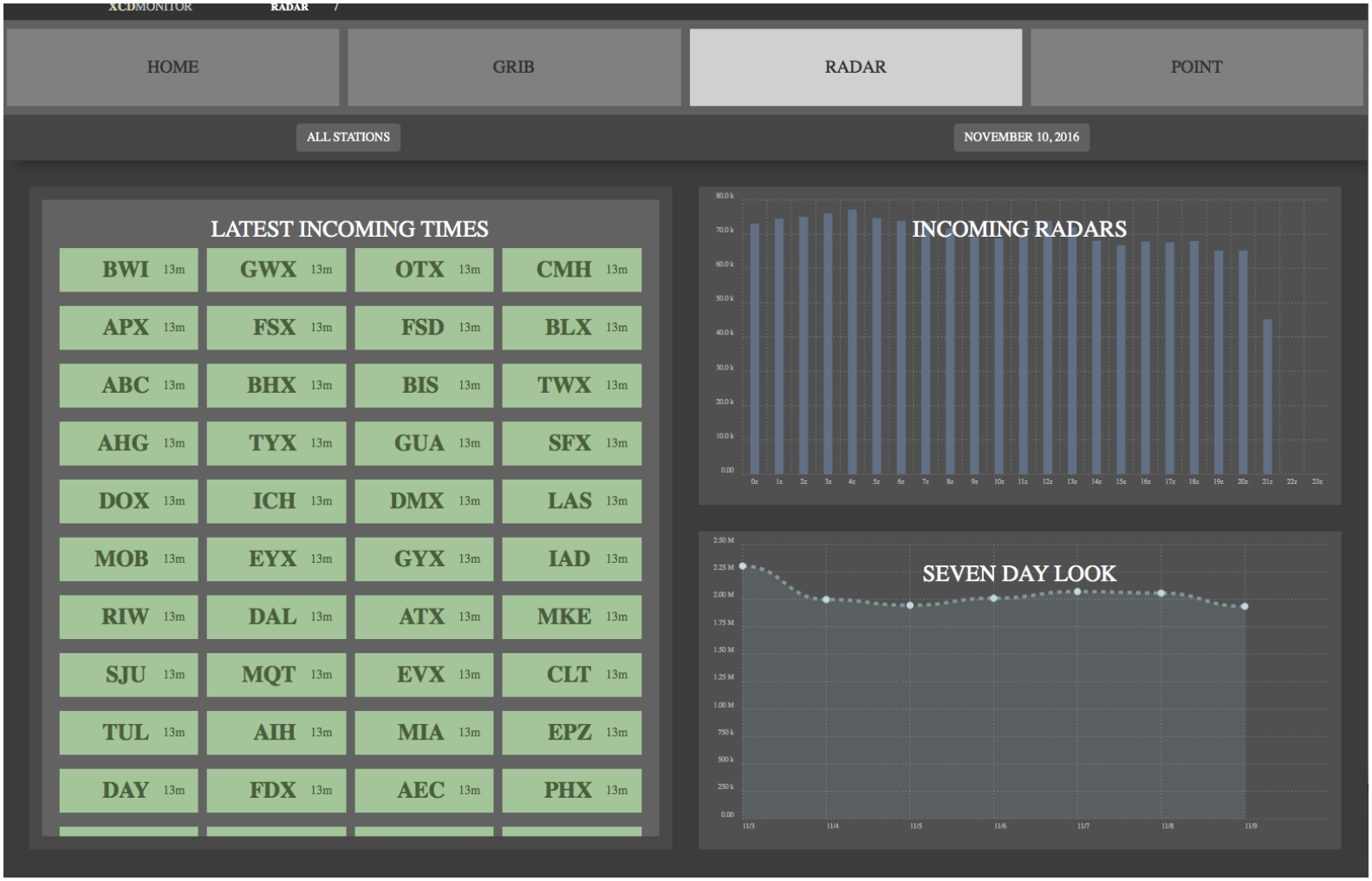
Point Monitoring



GRIB Monitoring



Radar Monitoring



Packaging and installation

- Existing servers and decoders (compiled code) will be migrated into McIDAS-X
- We plan to have -XCD replacement beta GRIB software (Python) and text software (bash) packaged as Linux containers using Docker
- Docker will simplify the process of building, running, and upgrading the containers
- Docker is a relatively new platform and we are working through issues
- Goal is to simplify the installation process for system administrators

Schedule

- All ingest and serving components are in testing
- Monitoring development and testing in progress
- Operations testing in progress
- Beta release early 2017
- Version 1.0 of the -XCD replacement will be packaged with McIDAS-XCD 2017.1