

Monitoring activities of satellite data processing services in real-time with SDDS Live Monitor

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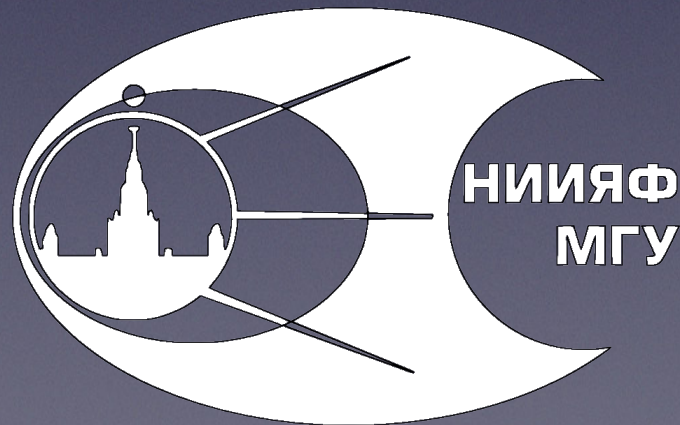
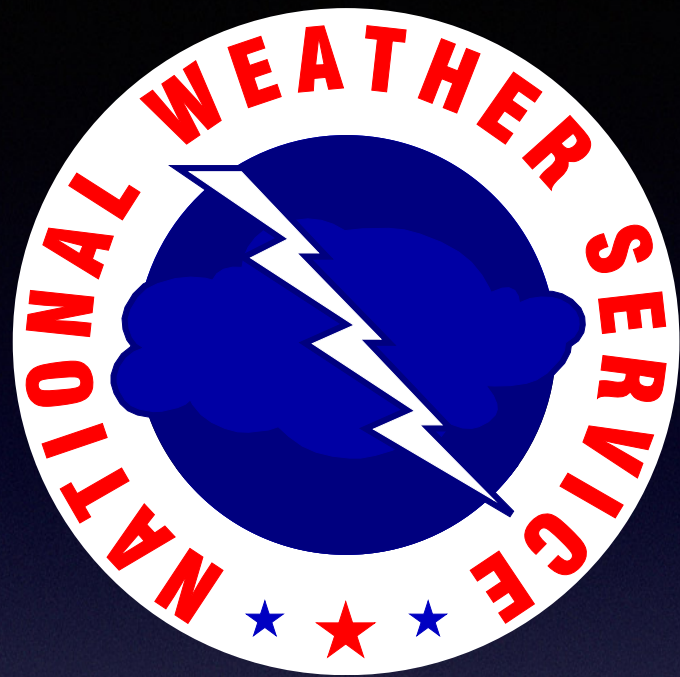
Satellites around the Earth

The screenshot displays the SpaceBook interface for viewing satellites. The central visualization shows Earth at the center, surrounded by a dense field of yellow and green dots representing satellites in various orbits. The interface includes several key components:

- Top Left:** SpaceBook logo.
- Left Panel:** A list of filterable attributes: Name, SSC Number, Status, Orbit, Mission, Owner, and Tracking (currently set to ComSpOC).
- Top Right:** Navigation icons for home, globe, and help, along with a legend for Mouse and Touch controls.
- Right Panel:** A detailed control menu with the following options:
 - Detail view:** Left click on any object for more info.
 - Pan view:** Left click + drag.
 - Zoom view:** Right click + drag, or Mouse wheel scroll.
 - Rotate view:** Middle click + drag, or CTRL + Left click + drag.
- Bottom Left:** A circular playback control showing a 1x speed, the current time (Jun 25 2017 23:47:12 UTC), and play/pause buttons.
- Bottom Center:** A timeline for the month of June 2017, with markers for Jun 22, 24, 26, 28, and 30 UTC.
- Bottom Right:** A status box indicating "Objects: 16832" and "Showing: 9503", with a note that "Orbits from public TLE data" are shown and a link for more information.



<http://apps.agi.com/SatelliteViewer/>



The unified data storage challenge

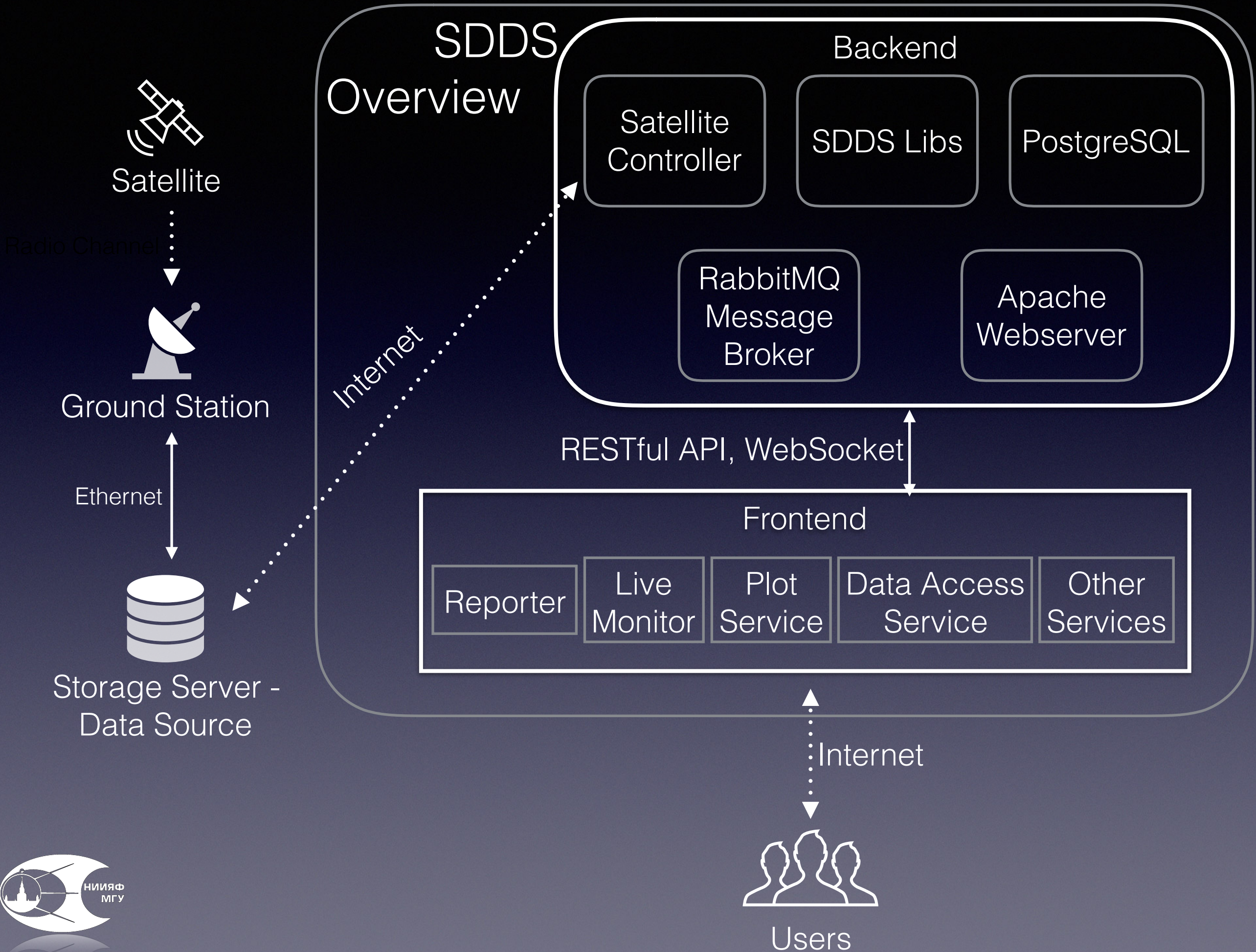
- Connections to data sources (HTTP(S), FTP(S), PPTP, IPSEC, IKEv2, etc.)
- Data formats (raw, txt, csv, XML, JSON, CDF3/4, HDF4/5, fits, png, jpeg, etc.)
- Hierarchy of onboard instruments and their data unit
- Data validation and correctness



A system to collect & process satellite data

- Fully automatic
- Satellite adding needs a minimum of coding
- Real-time monitoring and notification
- Data access UI for scientists
- API for developers





Live Monitor



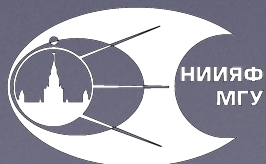
Goals

- Notifying of state changes and erroneous conditions of each system component (service)
- Creating reports of each run for each satellite
- Operator UI
- Customisable notification services for 3rd party applications

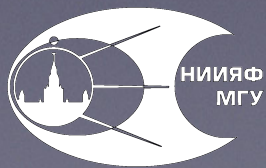
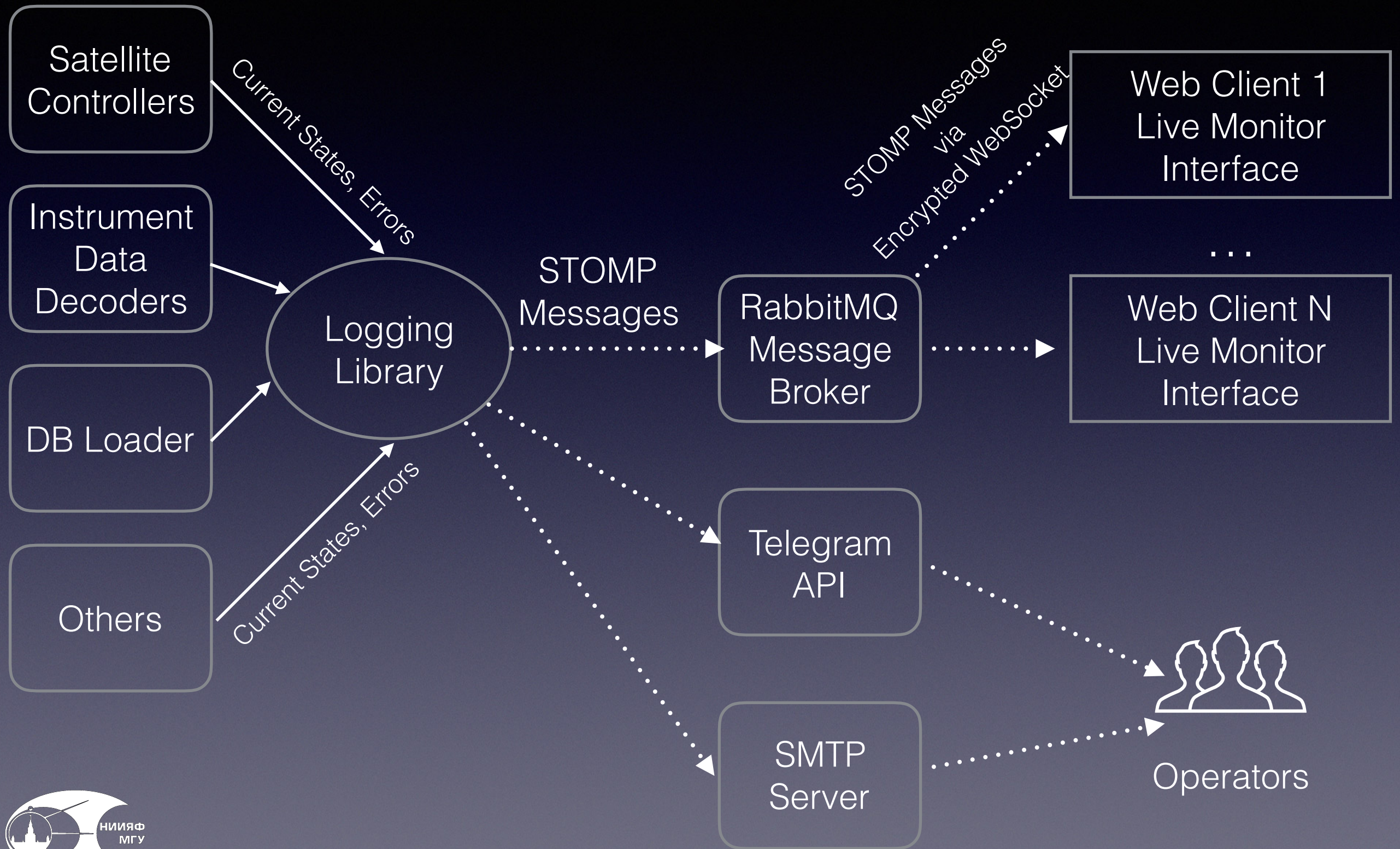


Existing solutions

- SAS products for banking and finance
- Nagios / Zabbix for IT infrastructure



Live Monitor Overview



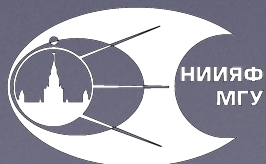
Software Stack

- Python, Javascript, JSON
- Apache, Django, RabbitMQ
- React, Websocket/SockJS, STOMP
- Telegram



Logging library

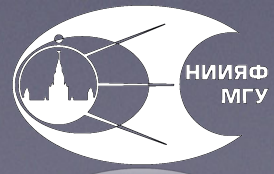
- Based on Python logging module
- 4 levels: DEBUG, INFO, WARNING, ERROR
- Supports: stdout, smtp, Telegram, websocket (via RabbitMQ)
- Format: [`<timestamp>`] [`<pid>`] `<module>`:
`<line_number>`: `<level>`: `<message>`




```

1 [2017-06-26 06:30:01] [11514] sd_downloader[ace]: 1230: INFO: Running sd_downloader.pyc in automatic mode, PID = 11514
2 [2017-06-26 06:30:01] [11514] sd_downloader[ace]: 763: INFO: Wrote process ID to /home/smdc/sdds/downloader/ace.pid
3 [2017-06-26 06:30:01] [11514] sd_downloader[ace]: 1290: INFO: Started #connect
4 [2017-06-26 06:30:01] [11514] sd_downloader[ace]: 255: INFO: Direct connection = True
5 [2017-06-26 06:30:03] [11514] sd_downloader[ace]: 233: INFO: Connected to URL http://legacy-www.swpc.noaa.gov/ftplib/lists/ace/
6 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 1337: INFO: Stopped #connect
7 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 1290: INFO: Started #download
8 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 521: INFO: Downloading file ace_swepam_1m.txt
9 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 530: INFO: Downloaded file and moved to /mnt/buffer/binary/ace_swepam_1m.txt
10 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 521: INFO: Downloading file ace_sis_5m.txt
11 [2017-06-26 06:30:05] [11514] sd_downloader[ace]: 530: INFO: Downloaded file and moved to /mnt/buffer/binary/ace_sis_5m.txt
12 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 521: INFO: Downloading file ace_mag_1m.txt
13 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 530: INFO: Downloaded file and moved to /mnt/buffer/binary/ace_mag_1m.txt
14 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 521: INFO: Downloading file ace_epam_5m.txt
15 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 530: INFO: Downloaded file and moved to /mnt/buffer/binary/ace_epam_5m.txt
16 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 1337: INFO: Stopped #download
17 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 1290: INFO: Started #extract
18 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 588: INFO: Cleaning all directories starting with ace_epam_5m
19 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 786: INFO: Moving files for instrument epam
20 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 815: INFO: Moving src = /mnt/buffer/binary/ace_epam_5m.txt to dst = /mnt/buffer/ace_epam_5m/epam/L0
21 [2017-06-26 06:30:06] [11514] sd_downloader[ace]: 588: INFO: Cleaning all directories starting with ace_mag_1m
22 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 786: INFO: Moving files for instrument mag
23 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 815: INFO: Moving src = /mnt/buffer/binary/ace_mag_1m.txt to dst = /mnt/buffer/ace_mag_1m/mag/L0
24 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 588: INFO: Cleaning all directories starting with ace_sis_5m
25 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 786: INFO: Moving files for instrument sis
26 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 815: INFO: Moving src = /mnt/buffer/binary/ace_sis_5m.txt to dst = /mnt/buffer/ace_sis_5m/sis/L0
27 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 588: INFO: Cleaning all directories starting with ace_swepam_1m
28 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 786: INFO: Moving files for instrument swepam
29 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 815: INFO: Moving src = /mnt/buffer/binary/ace_swepam_1m.txt to dst = /mnt/buffer/ace_swepam_1m/swepam/L0
30 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1337: INFO: Stopped #extract
31 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1290: INFO: Started #process
32 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1315: INFO: Started #epam
33 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 929: INFO: Running decoder for instrument epam
34 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1027: INFO: Finished running decoder epam
35 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1317: INFO: Stopped #epam
36 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1315: INFO: Started #mag
37 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 929: INFO: Running decoder for instrument mag
38 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1027: INFO: Finished running decoder mag
39 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1317: INFO: Stopped #mag
40 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1315: INFO: Started #sis
41 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 929: INFO: Running decoder for instrument sis
42 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1027: INFO: Finished running decoder sis
43 [2017-06-26 06:30:07] [11514] sd_downloader[ace]: 1317: INFO: Stopped #sis
44 [2017-06-26 06:30:08] [11514] sd_downloader[ace]: 1315: INFO: Started #swepam

```



RabbitMQ

- 1 message queue for each service
- Encrypted connection (TLS) with authentication
- Publish-subscribe scenario
- Simple (or Streaming) Text Oriented Message Protocol (STOMP)



Web UI - all satellites

SDDS

Home FTP Data Access GRB Catalog Exit

Satellite Data Downloading System

Satellite Name	Status	Log Messages
Lomonosov	Idle	Log messages:
Meteor-M2	Idle	Log messages:
Meteor-M1	Idle	Log messages:
ACE	Idle	Log messages:
Electro-L2	Running	Log messages: [2017-06-26 13:42:55] [22946]



Web UI - Electro-L2

downloader.sinp.msu.ru/downloader/41105/

SDDS Home FTP Data Access GRB Catalog Report Live Monitor QLook Telegrams Orientation Exit

Electro-L2 Live Monitor

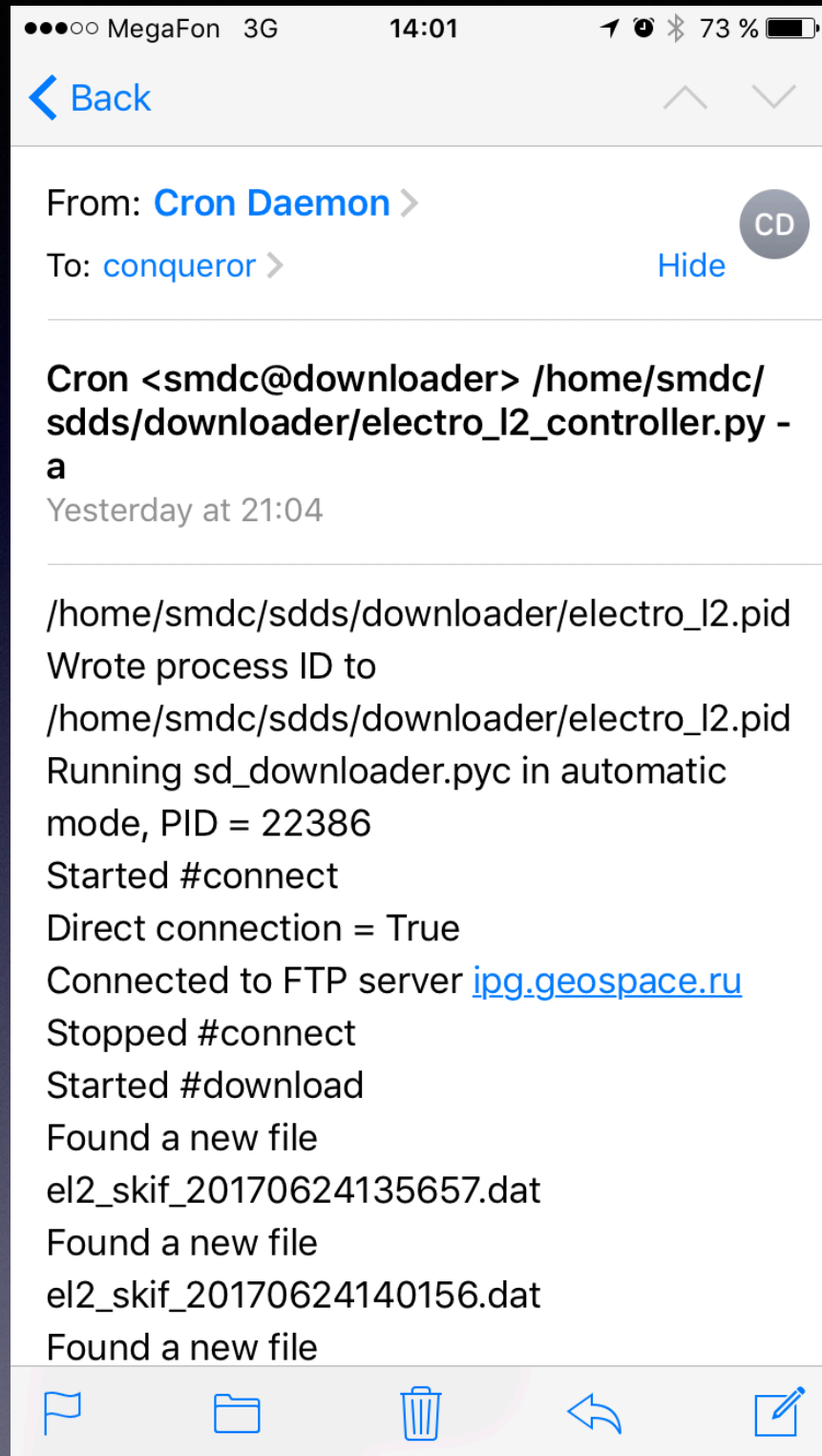
- connect Idle Log messages: Show
- download Idle Log messages: Show
- extract Idle Log messages: Show
- skl Idle Log messages: Show
- spectra_i Idle Log messages: Show
- spectra_e Idle Log messages: Show
- coordinates Idle Log messages: Show
- skif Idle Log messages: Show
- db Idle Log messages: Show
- storage Idle Log messages: Show

Web UI - Electro-L2

The screenshot shows a Safari browser window displaying the 'Electro-L2 Live Monitor' web interface. The browser's address bar shows the URL 'downloader.sinp.msu.ru/downloader/41105/'. The interface includes a navigation menu at the top with items like 'SDDS', 'Home', 'FTP', 'Data Access', 'GRB Catalog', 'Report', 'Live Monitor', 'QLook', 'Telegrams', 'Orientation', and 'Exit'. The main content area is titled 'Electro-L2 Live Monitor' and features a grid of service status cards. Each card displays the service name, its current status, and a 'Log messages' section with a 'Show' button. The 'db' card is highlighted in green and shows a 'Running' status with log messages from [2017-06-26 13:45:00] [24533]. Other cards include 'connect' (Idle), 'download' (Idle), 'extract' (Stopped), 'skl' (Idle), 'spectra_i' (Idle), 'spectra_e' (Idle), 'coordinates' (Idle), 'skif' (Stopped), and 'storage' (Idle). A settings gear icon is visible in the top right corner of the interface.

Service Name	Status	Log Messages
connect	Idle	Log messages: Show
download	Idle	Log messages: Show
extract	Stopped	Log messages: [2017-06-26 13:44:59] [24533] Show
skl	Idle	Log messages: Show
spectra_i	Idle	Log messages: Show
spectra_e	Idle	Log messages: Show
coordinates	Idle	Log messages: Show
skif	Stopped	Log messages: [2017-06-26 13:45:00] [24533] Show
db	Running	Log messages: [2017-06-26 13:45:00] [24533] Show
storage	Idle	Log messages: Show

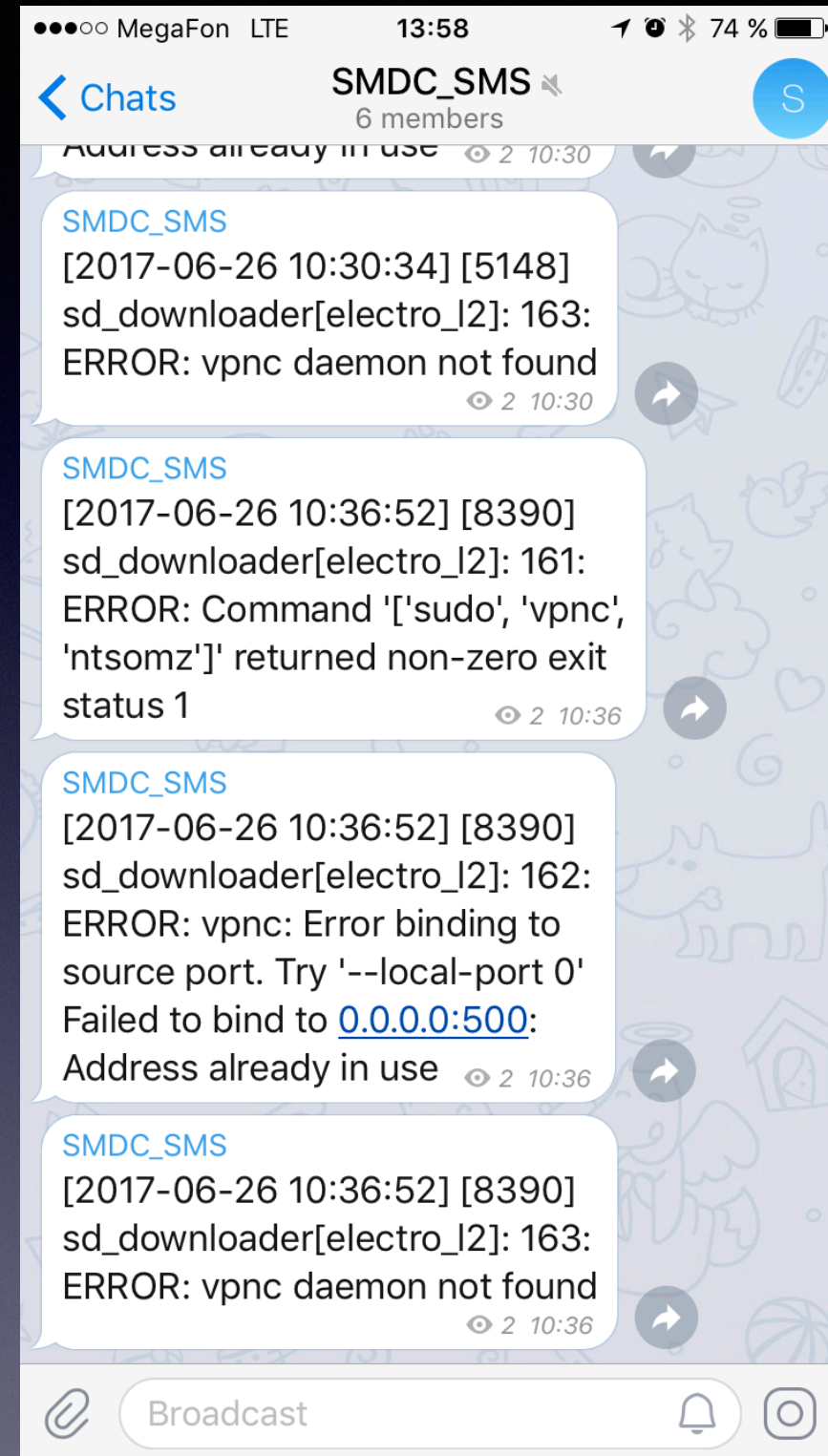
Notification - email & Telegram



From: Cron Daemon >
To: conqueror > Hide

Cron <smdc@downloader> /home/smdc/sdds/downloader/electro_l2_controller.py - a
Yesterday at 21:04

```
/home/smdc/sdds/downloader/electro_l2.pid  
Wrote process ID to  
/home/smdc/sdds/downloader/electro_l2.pid  
Running sd_downloader.pyc in automatic  
mode, PID = 22386  
Started #connect  
Direct connection = True  
Connected to FTP server ipg.geospace.ru  
Stopped #connect  
Started #download  
Found a new file  
el2_skif_20170624135657.dat  
Found a new file  
el2_skif_20170624140156.dat  
Found a new file
```



SMDC_SMS
6 members

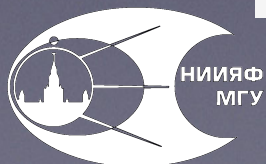
Address already in use 2 10:30

SMDC_SMS
[2017-06-26 10:30:34] [5148]
sd_downloader[electro_l2]: 163:
ERROR: vpnc daemon not found 2 10:30

SMDC_SMS
[2017-06-26 10:36:52] [8390]
sd_downloader[electro_l2]: 161:
ERROR: Command '['sudo', 'vpnc',
'ntsomz']' returned non-zero exit
status 1 2 10:36

SMDC_SMS
[2017-06-26 10:36:52] [8390]
sd_downloader[electro_l2]: 162:
ERROR: vpnc: Error binding to
source port. Try '--local-port 0'
Failed to bind to 0.0.0.0:500:
Address already in use 2 10:36

SMDC_SMS
[2017-06-26 10:36:52] [8390]
sd_downloader[electro_l2]: 163:
ERROR: vpnc daemon not found 2 10:36



Notification Management API

- Add a service to be monitored by Live Monitor
- Enable/Disable notification for the whole service
- Enable/Disable notification via Telegram
- Enable/Disable notification for each stage of a service(in future)
- Processing control via Telegram bot - stop a service when an error occurs (in future)



Current Status

- 1 year of operation
- >10 GB of raw data / day
- >12.3 TB of data (total)
- <100 msg/s, max - >10000 msg/s
(E5-2650 2.60GHz / 8GB / 1Gb
Ethernet)



Conclusion

- A system for near real-time satellite data processing
- A real-time monitoring framework
- UI for operators
- Notification via mails & Telegram messenger
- API for developers



“FAQ => nguyendmitri@gmail.com :)”

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