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# PRATHAM - DATA MANAGEMENT

| | Function | First name Last name | Date |
|---|---|---|---|
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## ACRONYMS

| | |
|---|---|
| IITB | Indian Institute of technology - Bombay |
| IPGP | Institute de Physique du Globe de Paris |
| GS | Ground Station |
| DG | Data Generator |
| TLE | Two Line Elements |
| S - TEC | Slant Total Electron Count |
| V - TEC | Vertical Total Electron Count |
| TBD | To be decided |
| TBC | To be confirmed |

**Table 0-1 Acronyms**

# REFERENCE DOCUMENTS

| | | |
|---|---|---|
| **RD1** | CDR Payload Sub-System | November 2010 |
| **RD2** | Telemetry and Telecommand Document | August 2010 |
| | | |
| | | |
| | | |
| | | |
| | | |
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| | | |

**Table 0-2 Reference documents**

## TO BE DECIDED/CONFIRMED

| Sr no. | TBD |
|---|---|
| 1) | Auxiliary data file content |
| 2) | Telemetry data file format |
| 3) | **Station IDs** of all ground stations |
| 4) | Fixed time of day for mirroring between IITB and IPGP servers |
| 5) | Method to intimate the IITB server and update the ground station's characteristic file in case of any changes made to the corresponding GS |
| 6) | Validation #3 : Automated/Manual |
| 7) | Telemetry file format |
| 8) | Details of all ground stations on the website |
| 9) | Example of CHAR file |

**Table 0-3 TBD**

| Sr no. | TBC |
|---|---|
| 1) | Method to generate the rotor orientation data |
| 2) | Online plotting tools/Online archive of plots of all data |
| 3) | MySQL database for website data maintenance |

**Table 0-4 TBC**

# 1. SCOPE AND APPLICABILITY

## 1.1 Scope

This document describes the detailed concepts for implementing the data management system for Pratham mission data at all the ground stations and the main server. It also describes the file formats of all the primary and processed data.

## 1.2 Purpose

This document describes the implementation of the entire data management system for Pratham mission data. The chief aspects of the document are :

1) Data acquisition at IITB(main server) and IPGP.
2) Data storage at all the ground stations and the main server.
3) Data processing and validation at main server.
4) File formats of all primary and processed data.
5) Website maintenance.

## 2. PREFACE

After Pratham satellite will be successfully in operation from its final orbit, it will transmit two linearly polarized signals when flying over India and France regions. Crossing the Earth ionosphere these signals will be rotated by the Faraday effect (**RD1**). Stations located in India and France will record the signals and the angle of polarization of the received signals, thus allowing the computation of Total Electron Content of the ionosphere along the line of sight of the satellite-receiver. The downlink data of Pratham will be collected by all the ground stations and managed by the main server. A very simplified flow diagram looks as follows :

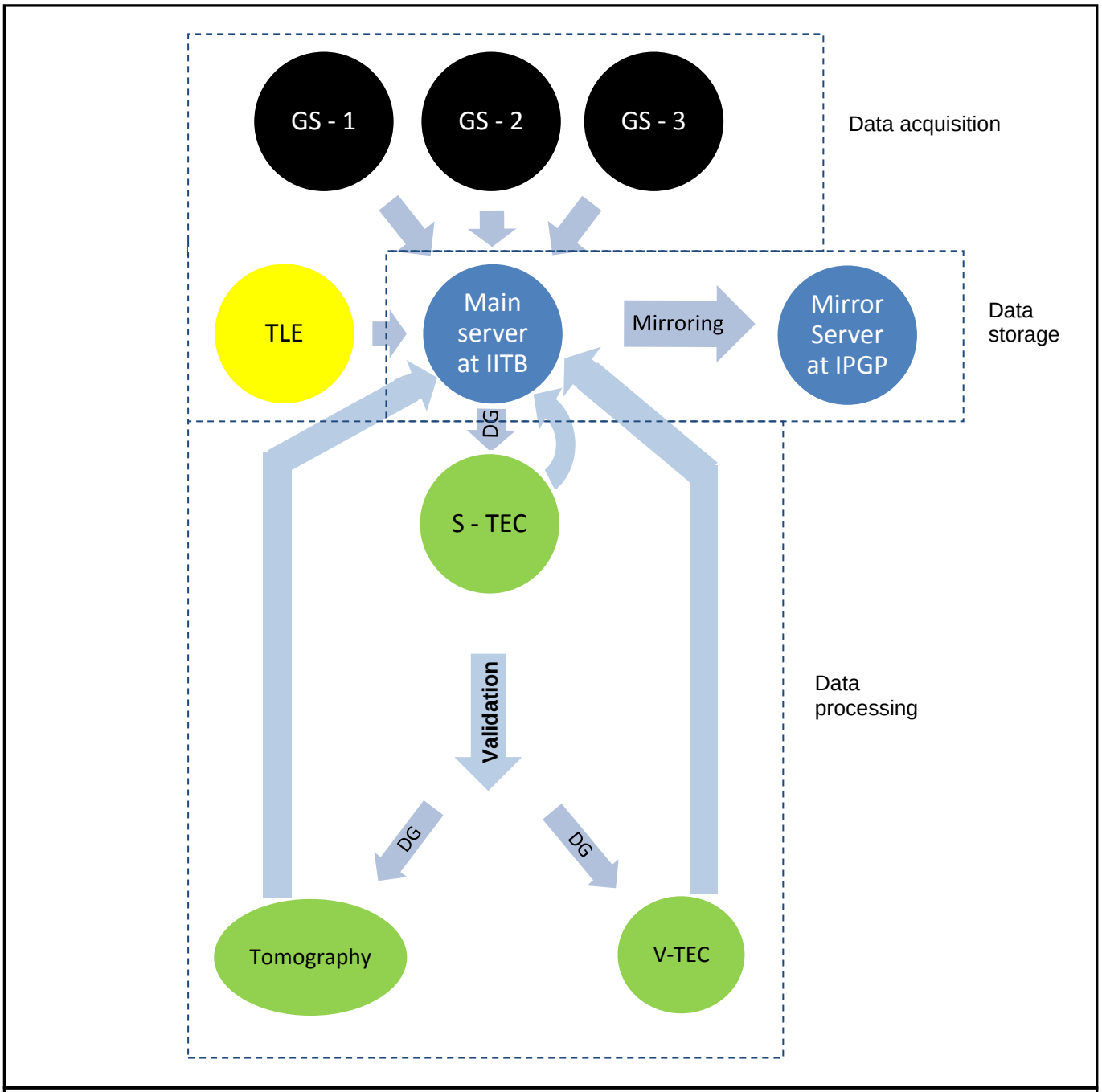


**Figure 2-1 PROCESS FLOW**

# 3. DATA ACQUISITION

This is the first block in the process. **Data acquisition here doesn't imply "Raw data acquisition from the hardware interfaces to the computer". It means the data acquisition from all the ground stations to the main server.**

## 3.1 Files to be sent from a GS to the server

The following files are the files to be sent by every GS to the main server :

1) **RAW_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt** (Raw data)
2) **OREF_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt** (Orientation data) [TBC]
3) **AUX_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt** (Auxiliary data) [TBD]
4) **TEL_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt** (Telemetry data). [Format TBD]

## 3.2 Elements of the acquisition block

There are three important elements of the acquisition block.

1) IITB server
2) IPGP server
3) All ground stations (including IITB and IPGP)

The data acquisition will be managed by an ftp server at IITB. Another ftp server will be at IPGP. The other ground stations do not need to create an ftp server. But each GS should maintain its own data until the end of the mission. All data upload and download will be automated, using scripts. All ground stations including IITB and IPGP, will upload their data files to IITB server. Additionally, IPGP server will act as a mirror to the IITB server.

### 3.2.1. IITB server

- This is the main server for Pratham data. All files sent by all the ground stations including IITB will be received and stored in the database at IITB..
- A small basic verification process needs to be implemented at IITB to check if all files have been correctly and completely uploaded before storing them in the specified location. This is in order to prevent data corruption at later stages.
- A verification message signalling successful completion has to be sent by both the remote servers to each other every time data transfer occurs between them.

On time of server : Continuous (24x7)

### 3.2.2. IPGP server

- This is the secondary server for Pratham. It will maintain its own data in its database.
- Additionally, it will act as a mirror of the IITB server. So this server will not receive the data directly from all the ground stations.
- It will receive the raw and processed data of all the ground stations from IITB server as a single package. i.e. the IITB database will be mirrored online on the IPGP server daily.

On time of server : Continuous (24x7)

#### 3.2.3. All ground stations (including IITB and IPGP)

- All ground stations will store their own data. They will send their data to the IITB server after every satellite pass.
- They will request the IITB server at the time of sending the data.
- All ground stations send the data to the main server only after the complete data has been retrieved.

### 3.3 Concepts for database maintenance

**Access :**

- All ground stations have download access to all the data present in both IITB and IPGP servers.
- All ground stations have permission to upload their **own** primary data on IITB server.
- No server or GS has permissions to edit any primary data.
- IPGP server has permissions to mirror the IITB server.
- All primary and processed data have public read-only access.

**Mirroring :**

- The mirroring from IITB to IPGP will be a daily 1-step process.
- Mirroring will occur at a fixed time of the day. (TBD yet).

All data uploading and mirroring will be exclusively automated.

# 4. DATA STORAGE

The data storage occurs in two stages.
1) At the GS (including IITB and IPGP).
2) At IITB and IPGP servers.

The primary data are first stored in the ground station's own database. This also includes IITB and IPGP ground stations. Then these data are sent to and stored in the IITB server which is in turn mirrored by IPGP server.

Let this data be split into 2 parts :

**Primary data :** These are the basic data, directly collected by the GS during satellite pass.

1) `RAW_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (Raw data)
2) `OREF_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (Orientation data)
3) `AUX_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (Auxiliary data)
4) `TEL_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (Telemetry data)

**Processed data :** These are the secondary data and comes after processing and validation.

1) `STEC_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (S-TEC)
2) `VTEC_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (V-TEC)
3) `TOM_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt` (Tomography)

**Characteristic data :** These are the data relate to the physical characteristics of the ground station.
1) `CHAR_PRAT_SSSS.txt` (Characteristic data)

**Logging data :** This is the daily log of the data received and processed by the IITB server.
1) `LOG_PRAT_SSSS_REC.txt` (Received files log)
2) `LOG_PRAT_SSSS_V1.txt` (Verification 1 results log)
3) `LOG_PRAT_SSSS_STEC.txt` (S-TEC generation log)
4) `LOG_PRAT_SSSS_VTEC.txt` (V-TEC generation log)
5) `LOG_PRAT_SSSS_TOM.txt` (Tomography data generation log)

## 4.1 Database structure

### 4.1.1 IITB and IPGP SERVERS

- All data will be stored in a folder named “PRATHAM”.
- This folder will have sub-folders :
  - CHAR : This folder will contain text files corresponding to each GS with information about that ground station’s characteristics.
  - LOG : This folder will be contain further sub-folders corresponding to every GS.
    - Each of these folders will contain 5 log files corresponding to the 5 log entries elaborated further in this document.
  - TEMP : This folder will hold the incoming data from every GS and act as a buffer. All primary data will first be verified in this folder before sending to the intended location. Once verified and sent, that data will be deleted from this folder.
  - DATA : This folder will hold all the downlink data of Pratham.
    - The data folder will have more sub-folders with names as “yyyy”, specifying the year of the start of that particular data acquisition.
      - All such folders will have further sub-folders with their names as “ddd” specifying the day of that year.
        Eg) Acquisition with a starting date of 1st Jan will be stored in a folder named “001”.
        - Each of these folders will have 2 sub-folders “PRIM” and “PROC”.
        - “PRIM” will contain the primary data of all ground stations for that day.
        - “PROC” will contain the processed data of all ground stations for that day.

Following is the block diagram of the data structure for IITB and IPGP servers :

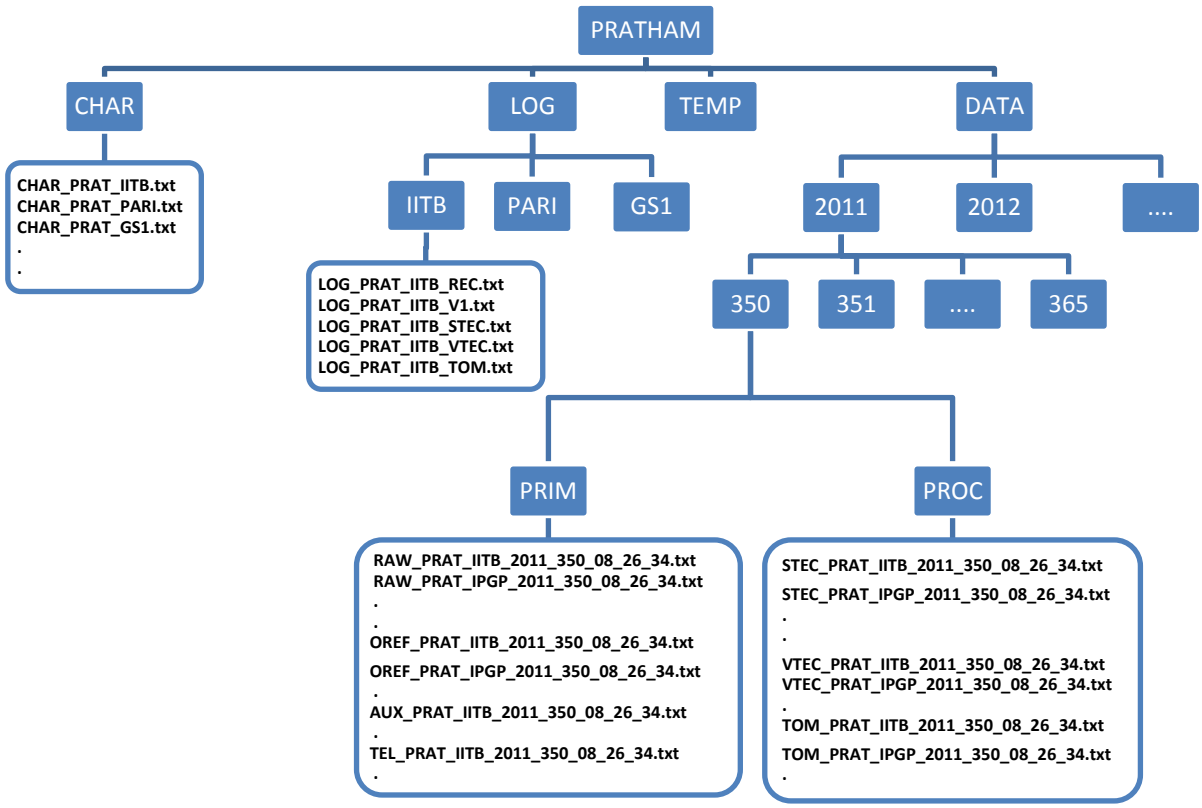


**Figure 4-1 IITB/IPGP server structure**

*The blue blocks denote folders and the white ones their file contents.*

### 4.1.2 GS database

- The basic structure of the GS database is similar to the IITB/IPGP server structure.
- Any updates made to the GS characteristics file will have to be intimated to IITB (How? – TBD) for making corresponding changes in the file of the main server.

This is the block diagram for the database at other GSs :

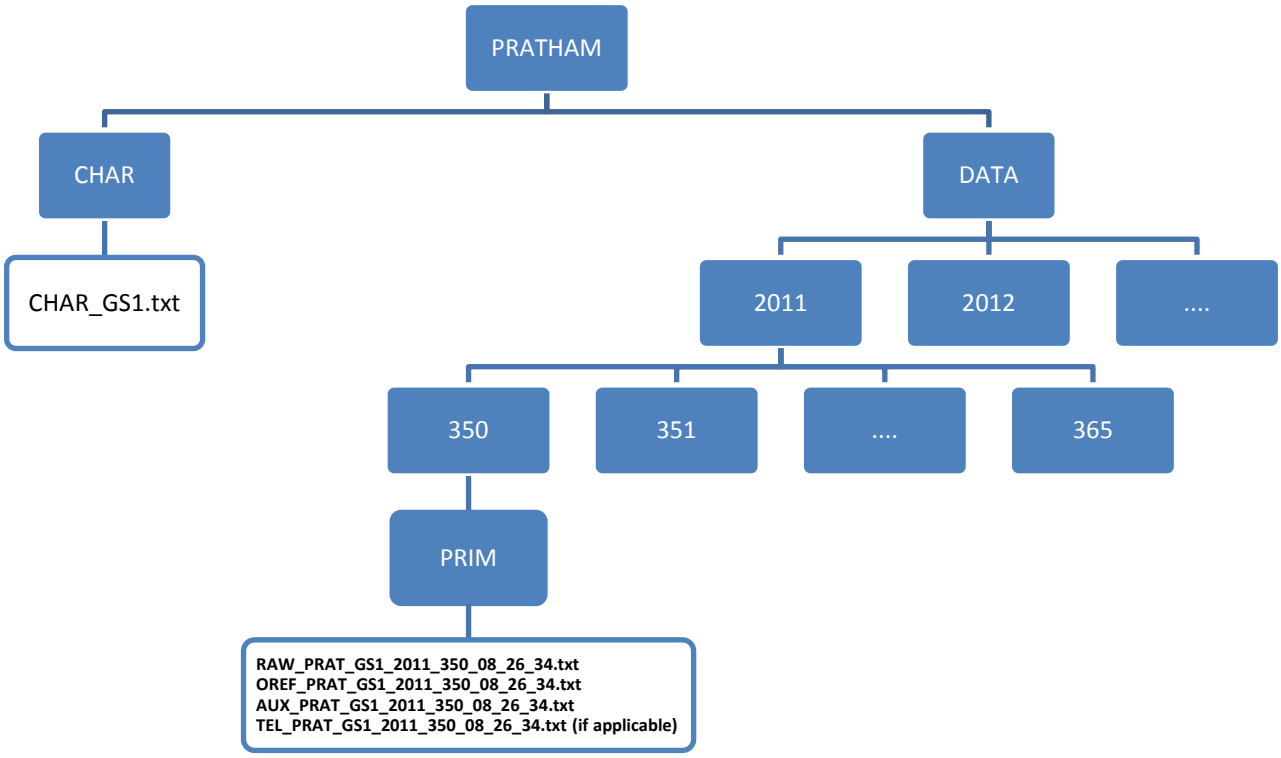


**Figure 4-2 All GS database structure**

*The blue blocks denote folders and the white ones their file contents.*

## 4.2 Specifications

- All data are stored in ASCII text files.
- The date “ddd” in the folder name is the date at the start time of the data acquisition. It is independent of the end time date. So even if the last data element acquired at the time of the satellite pass, is taken on a date other than the starting date, there is no ambiguity in the data storage.
- New folders will be created daily only on the day particular to those folders.

# 5. DATA PROCESSING

The data processing at the main server can be divided into three levels. The first level includes basic verification of the incoming data from all ground stations. The second level generates the S-TEC from the raw data. The third level validates and filters the S-TEC data and generates the final products : V-TEC/Tomography.

## 5.1 Level 1 (Primary validation)

- The incoming primary data files from a GS initially stored in the "TEMP" folder are validated. This validation includes :
  1) File count.
  2) Header line count for each file.
  3) Data column count for each file.
- If the file count is incorrect, the client GS will be requested to resend the data maximum 5 times after which logging will be done.
- After validation, if **all** the files sent by the GS are correct, they will be sent to their intended location.
- If the files are partially/completely incorrect, the files will be maintained in the temp folder.
- The correct files once sent to the intended location will be deleted from the TEMP folder.

## 5.2 Level 2 (S-TEC)

- The raw data files contain voltage values at pins VMAG and VPHS of the AD8302. These values being related to the intensity ratio and phase respectively can be used to calculate the S-TEC and phase difference between the two signals.
- The raw data will pass through the Data Generator software #1 and S-TEC will be generated.
- These S-TEC files will pass through the second stage of validation. This validation will check if :
  - S-TEC generation is possible
  - the generated S-TEC is erroneous (basic verification)
- A quality flag based on the results of the validation will be attached to every S-TEC data file.

| Condition | Q - Flag |
|---|---|
| If generation is impossible | 0 |
| If S-TEC is generated but not reliable (-ve/out of range) | 1 |
| If S-TEC is properly generated | 2 |

**Table 5-1 Q-Flag**

- The S-TEC values if generated will be stored in the S-TEC file with the corresponding time stamps and satellite coordinates.
- The S-TEC files with the quality flag, with or without the S-TEC values will be stored in "PROC" folder.

## 5.3 Level 3 (V-TEC/Tomography)

- The generated and validated S-TEC data can now be used to generate the secondary data, the final products. V-TEC & Tomography.
- But before that, the S-TEC files undergo a third set of validation automated/manual(TBD). After this validation, only the S-TEC files with appropriate S-TEC data will be sent to the next stage of processing for V-TEC and tomography generation.
- V-TEC/Tomography will be generated from the S-TEC file and stored in a separate file.
- The V-TEC/Tomography file will contain the V-TEC/Tomography values along with the time stamps satellite coordinates and piercing point coordinates.
- The file will be stored in the “PROC” folder.

## 5.4 Logging

Logging of the data management at the main server will be automatically made at 5 stages for every set of files (daily data from every GS). The 5 stages of logging are :

1. Data received from a GS (Number of files received).
2. First level validation results. (Names of erroneous files and type of error “head” or “data”)
3. Quality flag of the S-TEC generated (0/1/2)
4. V-TEC generated (Boolean –0/1)
5. Tomography generated (Boolean –0/1)

The 5 log files in that GS’s log folder will be updated every day with the corresponding log entries.

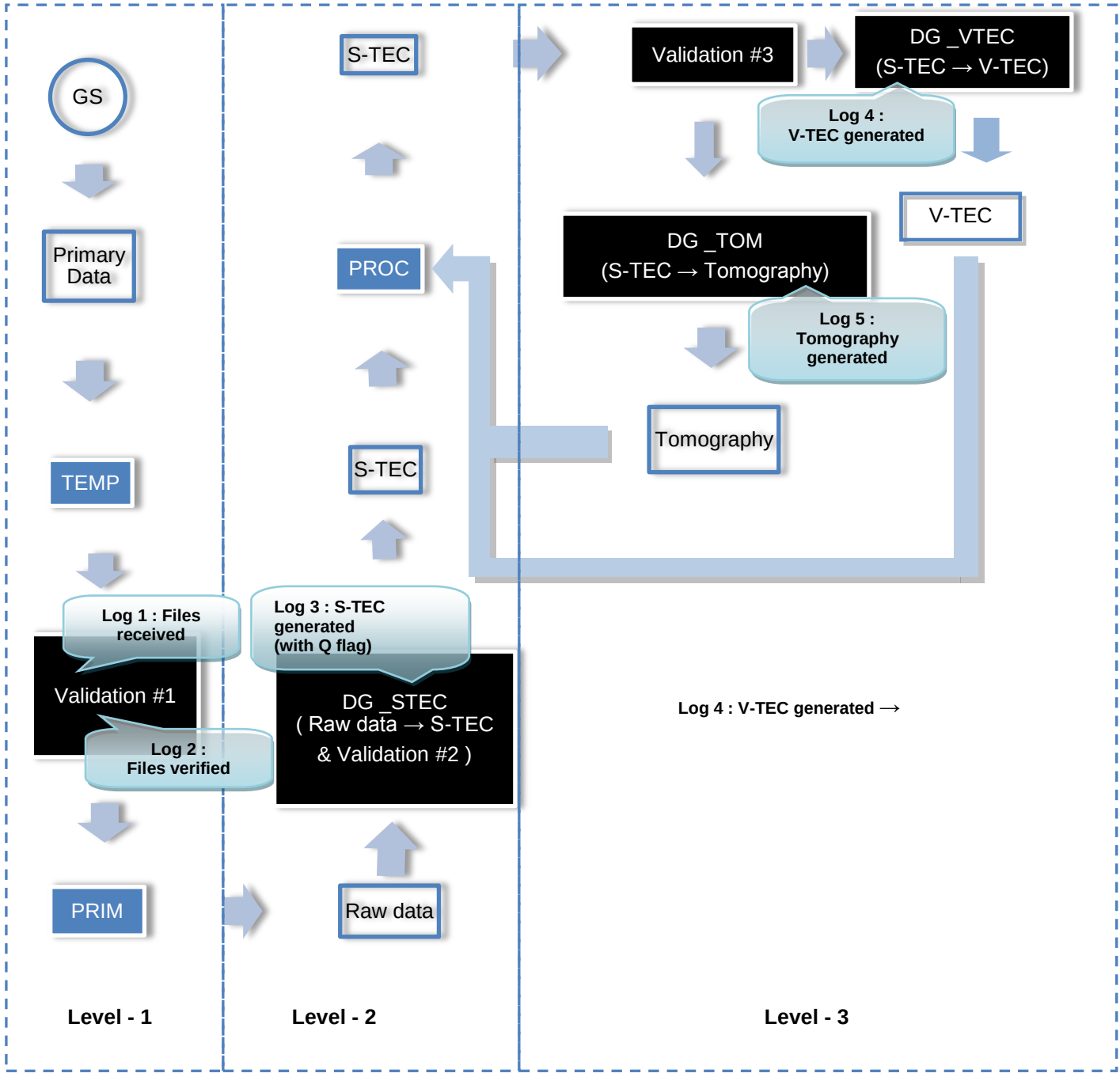


**Figure 5-1 Data Flow**

The blue blocks denote folders, white blocks denote data and black ones denote programs for data processing and verification

# 6. FILE FORMATS

Abbreviations used:

| Abbreviation | Meaning | Example |
|---|---|---|
| ssss | Station ID | IITB |
| yyyy | Year of acquisition | 2011 |
| ddd | Day of the year with 1st Jan as 1 & 31st Dec as 365/366 | 050 |
| hh | Hours UT (24) | 08 |
| mm | Minutes UT (60) | 26 |
| ss | Seconds UT (60) | 34 |
| Start_time_UT | Universal Time at the moment of first data acquired<br>*(This should be the same as the time in the file name)* | 2011-050T08:26:34Z |
| End_time_UT | Universal time at the last data acquisition.<br>*(This is the same as the last time stamp in the file)* | 2011-050T08:26:34Z |

**Table 6-1 File name abbreviations**

| Station ID | City | Country | Lon (E) | Lat (N) | H (m) | Institute |
|---|---|---|---|---|---|---|
| IITB | Mumbai | India | | | | IITB |
| PARI | Paris | France | | | | IPGP |
| | | | | | | |
| | | | | | | |
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**Table 6-2 Station IDs**

## 6.1. Calibration info and station characteristics

**NAME : `CHAR_PRAT_SSSS.txt`**

This file will contain the following information :
a) Position of antenna measured by GPS (Lat/Long/Alt)
b) Reception function of Antenna 145, including cross-talk with 437 :
The 3dB bandwidth of the antenna along with the F/B ratio.
c) Reception function of Antenna 437, including cross-talk with 145 :
The 3dB bandwidth of the antenna along with the F/B ratio.
d) Automation mechanism :
Use of rotor or any other hardware mechanism.
Other devices and hardware involved in the acquisition chain with a brief description of the chain.
The tracking and automation software used.
e) Type of data acquisition according to one of the following configurations :

| Type of data acquisition | Phase measured | Intensity measured | Tangent measured | Co tangent measured | Beacon decoded | Telemetry decoded |
|---|---|---|---|---|---|---|
| 1 | Yes | Yes | Yes | Yes | Yes | Yes |
| 2 | Yes | Yes | Yes | No | Yes | Yes |
| 3 | No | Yes | Yes | No | Yes | Yes |
| 4 | Yes | Yes | Yes | No | Yes | No |
| 5 | Yes | Yes | Yes | No | No | No |
| 6 | No | Yes | Yes | No | No | No |
| 7 | Yes | Yes | Yes | No | Yes | No |
| 8 | Yes | Yes | Yes | Yes | No | No |
| 9 | Yes | Yes | Yes | Yes | Yes | No |

**Table 6-3 Acquisition type**

**FORMAT :**

| | | |
|---|---|---|
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| 3db_bandwidth_145 | 1 word: [Hz] | 3db bandwidth of the 145MHz antenna |
| F-B_ratio_145 | 1 word: | Front to back ratio for the 145 MHz |
| 3db_bandwidth_437 | 1 word: [Hz] | 3db bandwidth of the 437MHz antenna |
| F-B_ratio_437 | 1 word: | Front to back ratio for the 437 MHz |
| Acquisition_type | 1 word | **The type of acquisition** |
| List of devices and their significance in the acquisition chain. | | |
| A brief formal description of the acquisition chain. | | |
| Name of tracking software with a link to its webpage. | | |

**EXAMPLE :**

## 6.2. Log files

The log file will contain the daily log entries of the data management process starting from the the data retrieval from a GS to generation of the final products. The log files corresponding to every GS will be updated after every satellite pass.

### 6.2.1. Data received Log:

**NAME : `LOG_PRAT_SSSS_REC.txt`**

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Station_ID<br>S | 4 characters | Station code |
| t<br>Location<br>a<br>t | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID<br>o | 1 word: PRATHAM | Satellite tracked |
| n<br>Variable_list<br>f<br>i | 3 word: | Time(iso)<br>Files_received(int)<br>Files_not_received (string) |

Files_received = number of files received
Files_not_received = names of files not received

| File | Abbreviation used in the log file |
|---|---|
| Raw data file | RAW |
| Orientation data file | OREF |
| Auxiliary data file | AUX |
| Telemetry data file | TEL |

**Table 6-4 Log file name abbreviations**

**Data :**

| Field name | Time(iso) | Files_received(int) | Files_not_received(string) |
|---|---|---|---|
| Description | Start time of the acquisition in iso_8601 format | Number of files received | File name abbreviations as in Table 6-4 Log file name abbreviations Log file name abbreviations as a string with file names separated by commas |

**EXAMPLE :**

**`LOG_PRAT_IITB_REC.txt`**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Time(iso) Files_received(int) Files_not_received(string)
2011-050T08:26:34Z 2 OREF,AUX
2011-051T08:25:11Z 4
2011-052T08:25:33Z 1 RAW
      ...          .    ..
      ...          .    ..
      ...          .    ..
```

### 6.2.2. Verification 1 Log:

**NAME : `LOG_PRAT_SSSS_V1.txt`**

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking_ID | 1 word: PRATHAM | Satellite tracked |
| Variable_list | 3 word: | Time(iso)<br>Erroneous_files(int)<br>Error(string) |

### 6.2.3.

| | |
|---|---|
| head | If the error is in the header |
| Data | If the error is in the data |

**Data :**

| Field name | Time(iso) | Erroneous_file(int) | Error(string) |
|---|---|---|---|
| Description | Start time of the acquisition in iso_8601 format | Number of erroneous files received | File name abbreviation as in Table 6-4 Log file name abbreviations Log file name abbreviations followed by type of error as a string with fields separated by commas |

**EXAMPLE :**

**`LOG_PRAT_IITB_V1.txt`**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Time(iso) Erroneous_files(int) Error(string)
2011-050T08:26:34Z 2 RAW, head, AUX, data
2011-051T08:25:11Z 0
2011-052T08:26:33Z 1 AUX, data
      ...          .         ...
      ...          .         ...
```

### 6.2.3. S-TEC Log:

**NAME : `LOG_PRAT_SSSS_STEC.txt`**

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Variable_list | 2 word: | Time(iso)<br>STEC_Flag(int) |

**Data :**

| Field name | Time(iso) | STEC_Flag(int) |
|---|---|---|
| Description | Start time of the acquisition in iso_8601 format | The S-TEC flag **[0/1/2]** generated by the program |

### 6.2.4.

**EXAMPLE :**

**`LOG_PRAT_IITB_STEC.txt`**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Time(iso) STEC_Flag(int)
2011-050T08:26:34Z 2
2011-051T08:25:33Z 1
2011-052T08:26:11Z 2
       ...          .
       ...          .
```

### 6.2.4. V-TEC Log:

**NAME : `LOG_PRAT_SSSS_VTEC.txt`**

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Variable_list | 2 word: | Time(iso)<br>VTEC_gen(int) |

**Data :**

| | | |
|---|---|---|
| **Field name** | Time(iso) | VTEC_gen(int) |
| **Description** | Start time of the acquisition in iso_8601 format | 1 if V-TEC is generated<br>0 otherwise |

**EXAMPLE :**

**`LOG_PRAT_IITB_STEC.txt`**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Time(iso) VTEC_gen(int)
2011-050T08:26:34Z 1
2011-051T08:25:33Z 1
2011-052T08:26:11Z 0
      ...          .
      ...          .
```

### 6.2.5. Tomography Log:

**NAME : `LOG_PRAT_SSSS_TOM.txt`**

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Variable_list | 2 word: | Time(iso)<br>TOM_gen(int) |

**Data :**

| Field name | Time(iso) | TOM_gen(int) |
|---|---|---|
| Description | Start time of the acquisition in iso_8601 format | 1 if tomography is generated<br>0 otherwise |

**EXAMPLE :**

**`LOG_PRAT_IITB_STEC.txt`**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Time(iso) TOM_gen(int)
2011-050T08:26:34Z 1
2011-051T08:25:33Z 1
2011-052T08:26:11Z 0
      ...          .
      ...          .
```

## 6.3. Raw data

**NAME : `RAW_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt`**
This file will contain the raw downlink data in the form of voltage values from the AD8302.

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Header_lines | 1 integer | Number of lines in the file header |
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking_ID | 1 word: PRATHAM | Satellite tracked |
| Start_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | Start time of acquisition |
| End_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | End time of acquisition |
| Sampling_rate[Hz] | (1 word) | Sampling rate of acquisition [Hz] |
| Data_points | 1 word | Number of data acquisition (number |
| Acquisition_type | 1 word | Column names according to the **Table 6-3** Acquisition type |
| Variable_list | N words | List of variables |

**Data :**

| Field name | Time (sec) | 145_VMAG1 (V) | 145_VMAG2 (V) | 145_VPHS1 (V) | 145_VPHS2 (V) | 437_VMAG1 (V) | 437_VMAG2 (V) | 437_VPHS1 (V) | 437_VPHS2 (V) |
|---|---|---|---|---|---|---|---|---|---|
| Description | Time from start of acquisition in seconds with the starting time assumed at t = 0. | Voltage output for the intensity ratios at the two perpendicular elements of the 145MHz antenna | Voltage output for intensity ratios of the 145MHz antenna but with the elements under consideration interchanged | Phase difference between the two signals on the perpendicular elements of the 145MHz antenna | Phase difference with the elements interchanged | Voltage output for the intensity ratios at the two perpendicular elements of the 437MHz antenna | Voltage output for intensity ratios of the 437MHz antenna but with the elements under consideration interchanged | Phase difference between the two signals on the perpendicular elements of the 437MHz antenna | Phase difference with the elements interchanged |

```
Columns of data.
...   ...   ...   ...   ...   ...
...   ...   ...   ...   ...   ...
```

**EXAMPLE :**

**RAW_PRAT_IITB_2011_050_08_26_34.txt**

```
9
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Start_time_UT 2011-050T08:26:34Z
End_time_UT 2011-050T08:33:55Z
Sampling_rate 10000
Data_points 123456
Acquisition_type 1
Time(sec) 145_VMAG1(V) 145_VPHS1(V) 145_VMAG2(V) 145_VPHS2(V) 437_VMAG1(V)
437_VPHS1(V) 437_VMAG2(V) 437_VPHS2(V)
0.0000 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
0.0123 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
0.0345 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
0.0567 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
0.0789 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
0.0901 2.3 1.75 0.47 0.035 2.54 1.72 0.42 0.04
 ...   ...  ...  ...  ...  ...  ...  ...  ...
 ...   ...  ...  ...  ...  ...  ...  ...  ...
```

## 6.4. Orientation data

**NAME : OREF_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt**

This file will maintain the orientation(azimuth/elevation) details of the rotor at the time of satellite pass.

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Header_lines | 1 integer | Number of lines in the file header |
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking_ID | 1 word: PRATHAM | Satellite tracked |
| Start_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | Start time of acquisition |
| End_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | End time of acquisition |
| Sampling_rate[Hz] | (1 word) | Sampling rate of acquisition [Hz] |
| Data_points | 1 word | Number of data acquisitions (number of data lines) in the |
| Acquisition_type | 1 word | **The type of acquisition** |
| Variable_list | 3 words | Time(sec) Azimuth(deg:min:sec) Elevation(deg:min:sec) |

**Data:**

| Field name | Time(sec) | Azimuth(deg:min:sec) | Elevation(deg:min:sec) |
|---|---|---|---|
| Description | Start time of the acquisition in seconds with starting time taken as t = 0 | Azimuth of the antenna | Elevation of the antenna. |

**EXAMPLE :**

**OREF_PRAT_IITB_2011_050_08_26_34.txt**

```
8
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Start_time_UT 2011:050T08:26:34Z
End_time_UT 2011:050T08:33:55Z
Sampling_rate 10000
Data_points 123456
Time(sec) Azimuth(deg:min:sec) Elevation(deg:min:sec)
0.0000 40:20:10 40:30:45
0.0123 40:23:45 41:35:23
  ...    ...      ...
  ...    ...      ...
```

## 6.5. Auxiliary data

**NAME : AUX_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt**
This file contains the auxiliary data(temperature, humidity, etc) at the GS during the satellite pass.

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Header_lines | 1 integer | Number of lines in the file header |
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Start_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | Start time of acquisition |
| End_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | End time of acquisition |
| Sampling_rate[Hz] | (1 word) | Sampling rate of acquisition [Hz] |
| Data_points | 1 word | Number of data acquisitions (number of data |
| Variable_list | N words | Time Temperature Humidity (etc TBD) |

**Data:**

| Field name | Time(sec) | Temperature(deg) | Humidity(%) |
|---|---|---|---|
| Description | Start time of the acquisition in seconds with starting time taken as t = 0 | Ambient temperature near the antenna | Humidity near the antenna |

**EXAMPLE:**

**AUX_PRAT_IITB_2011_050_08_26_34.txt**

```
8
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Start_time_UT 2011-050T08:26:34Z
End_time_UT 2011-050T08:33:55Z
Sampling_rate TBD
Data_points TBD
Temperature Humidity
31.5 74
 ... ..
 ... ..
```

## 6.6. Telemetry file

**NAME : TEL_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt**
This file will contain the health monitoring data sent by the satellite and GPS co-ordinates of the satellite during the pass. (**RD2**)

**FORMAT :**
(TBD)

**EXAMPLE :**

## 6.7. S-TEC

**NAME : `STEC_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt`**
This file will contain the S-TEC generated by the DG #1 from the raw data.

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Header_lines | 1 integer | Number of lines in the file header |
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Start_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | Start time of acquisition |
| End_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | End time of acquisition |
| Data_points | 1 word | Number of data acquisitions (number of data |
| Q_Flag | 1 word | 0/1/2 |
| DG#1_version | 1 word | Version of the data generator-1 which has generated the corresponding S-TEC data |
| Variable_list | 4 words | Time S-TEC sat_lat sat_long sat_alt |

**Data:**

| Field name | Time(sec) | S_TEC(TECU) | Sat_lat(deg:min:sec) | Sat_long(deg:min:sec) | Sat_alt(m) |
|---|---|---|---|---|---|
| Description | Start time of the acquisition in seconds with starting time taken as t = 0 | Slant TEC | Latitude of the satellite position | Longitude of the satellite position | Altitude of the satellite position |

**EXAMPLE:**

```
STEC_PRAT_IITB_2011_050_08_26_34.txt
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Start_time_UT 2011-050T08:26:34Z
End_time_UT 2011-050T08:33:55Z
Sampling_rate 10000
Data_points 123456
Q_Flag 2
DG#1_version 2.2
Time(sec) S_TEC(TECU) Sat_lat(deg:min:sec) Sat_long(deg:min:sec)
Sat_alt(m)
0.0000 53.2 40:20:10 40:30:45 800
 ...    ..    ...      ...    ..
 ...    ..    ...      ...    ..
```

## 6.8. V-TEC

**NAME : `VTEC_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt`**
This file will contain the V-TEC generated by the DG #2 from the S-TEC data.
Specific abbreviations :

**FORMAT :**

**Header :**

| | | |
|---|---|---|
| Header_lines | 1 integer | Number of lines in the file header |
| Station_ID | 4 characters | Station code |
| Location | 3 words:[deg:min:sec][deg:min:sec][m] | Station location: latitude, longitude, altitude |
| Satellite_Tracking _ID | 1 word: PRATHAM | Satellite tracked |
| Start_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | Start time of acquisition |
| End_time_UT | 1 word: [yyyy-dddThh:mm:ssZ] | End time of acquisition |
| Data_points | 1 word | Number of data acquisitions (number of data |
| DG#2_version | 1 word | Version of the data generator-2 which has generated the corresponding V-TEC data |
| Shell_height | 1 word [m] | Shell height in m |
| Variable_list | 4 words | Time V-TEC sat_lat sat_long sat_alt pp_lat pp_long |

**Data:**

| Field name | Time(sec) | V_TEC (TECU) | Sat_lat (deg:min:sec) | Sat_long (deg:min:sec) | Sat_alt (m) | PP_lat (deg:min:sec) | PP_long (deg:min:sec) |
|---|---|---|---|---|---|---|---|
| Description | Start time of the acquisition in seconds with starting time taken as t = 0 | Vertical TEC | Latitude of the satellite position | Longitude of the satellite position | Altitude of the satellite position | Latitude of the **piercing point** for calculating the V-TEC from the S-TEC | Longitude of the **piercing point** for calculating the V-TEC from the S-TEC |

**EXAMPLE:**

**VTEC_PRAT_IITB_2011_050_08_26_34.txt**

```
Station_ID IITB
Location 19:08:1.09 72:54:55.29 100
Satellite_Tracking_ID PRATHAM
Start_time_UT 2011-050T08:26:34Z
End_time_UT 2011-050T08:33:55Z
Sampling_rate 10000
Data_points 123456
DG#1_version 1.3
Shell_height 500000
Time(sec) V_TEC(TECU) Sat_lat(deg:min:sec) Sat_long(deg:min:sec) Sat_alt(m)
PP_lat(deg:min:sec) PP_long(deg:min:sec)
0.0000 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
0.0123 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
0.0345 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
0.0567 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
0.0789 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
0.0910 47.3 40:20:10 40:30:45 800000 54:32:12 62:53:45
 ...    ..    ...      ...      ...      ...     ...
 ...    ..    ...      ...      ...      ...     ...
```

## 6.9. Tomography

**NAME : TOM_PRAT_SSSS_yyyy_ddd_hh_mm_ss.txt**

This file will contain the tomography data generated by the DG #3 from the S-TEC data.

**FORMAT :**
(TBD)

**EXAMPLE :**

# 7. WEBSITE

The website of PRATHAM (http://www.aero.iitb.ac.in/pratham/) will host the collected downlink data. An online dynamic archive will be maintained on the website and updated daily. This archive will universally make available the processed numerical data of all ground stations. Additionally the website will hold online tools to plot and visualize the available numerical data.(TBC)

## 7.1 Website contents

### 7.1.1. Details of all ground stations

This will contain all the details of the involved ground stations. The contents include the information in the GS characteristic files, pictures of GS, small summary and general information, daily log of progress with the data collection, *more details TBD*.

### 7.1.2. Daily processed data

- The daily processed numerical data of all ground stations in the FTP server will be uploaded to the website database (MySQL database – TBC) at a fixed time of the day(TBD).
- Online interfaces will be setup to enable viewing of this data as data tables.
- Online tools will be setup to graphically visualise the required numerical data.
- A map of TEC will be generated daily from the collected data and updated with inflow of new data.

### 7.1.3. Current status of satellite

A dynamic graphical interface showing the current health, location – lat/long and graphically on the map, etc(TBD) will be available online.

# APPENDIX A: TITLE