A Note for Global Meteor Data Base

12/Nov/2007 SonotaCo

Introduction

An online meteor database which contains all data from the world is expected.
Geert Barentsen posted a design of Virtual Meteor Observatory (VMO) and Meteor Modelling Language (MML) to the Meteor Orbit Determination Group (MODWG) on 31/Oct/2007.
While, SonotaCo has been designing an online RDB for the SonotaCo Network in Japan. It is called Meteor Database for Online Laboratory (It is not impremented yet).
There are serious differences between two designs.

I added some features in Geert's design to mine.
Here I open a basic design of Global Meteor DataBase (GMDB) that might unify both.

Contents

GMDB design policy

My opinions

- On the design of database, the most important matter is its life time.
  - Life time is limited by the changes of procedures and key data.
  - Life time of rigid DB is very short.
  - We should make allowance for the possible future changes.
    - On the analysis of meteors, the method or procedures are not fixed yet.
      - We should accept a new method as one of multiple methods when it appears.
      - To research the differences between methods, it is needed that DB can contain multiple results from multiple methods simultaneously.
      - We should minimize the effect of partial changes to avoid the re-construction of all records.
        - We should divide the whole procedure to several sections, and make the section data independent from methods.
        - Modularity of data reduces the scope of procedures and will encourage the study of methods.
        - Procedure model is needed.

    - Shower catalogues are not fixed. It is natural that they are changing every year.
        - Correspondence between shower and other records should be flexible.
        - Multiple relation should be allowed for the research of showers and shower catalogs.

    - Relation between a meteor and an observation cannot be decided easily.
        - Relation should be flexible.
          - Meteor info should not be included in observation records.

    - There will be many meteors that is observed by more than 2 stations.
        - Multiple pairs will be generated.
          - Multiple orbits for one meteor should be kept at one time for comparing or unifying.
        - A new combine process that handles more than 2 observations at a time is expected.

    - Multiple orbits reduced by multiple methods should be allowed to exist simultaneously.

    - Raw observation data should be kept for the future researches.

  - MML should be discussed after the RDB scheme is fixed.

Matters that I think important.

- human readability
- dataset simplicity
- data independency from methods
- enhancement possibility
- partial data update possibility
- life time of database

Matters that I don't think so important.

- data base size
- processing speed
- normality (concentration of same data) of RDB

Matters that are considered in my design.

- re-process by multiple methods (improvement/comparison)
  - multiple position measurement methods
  - multiple linearity correction methods
  - multiple orbit computation methods
  - multiple orbit qualifying methods
  - multiple shower classification methods
- multiple shower catalogs/updates of catalog
- multiple mount type (eq-guide,az-ev-guide,fixed)
- de-interlaced analysis
- multiple simultaneous object
- radiant-vg estimation from single station observation
- observation_id local creation
- researches
  - statical processes on meteors or orbits
  - detail trajectory analysis by 3D position sequence
  - meteoroids drop position analysis
  - light curve, mass estimation
  - new shower analysis and update of shower catalogues
  - HR/ZHR computation (period)
  - comparison of methods on every stage

Possible extends.

- covariance
- multi-band camera
- specter measurement system
- synchronized camera network

Model of meteor data processing

Modeling and layering is effective methods used in many fields.
It brings data independency from methods, and compatibility of procedures (It allows joined process also).

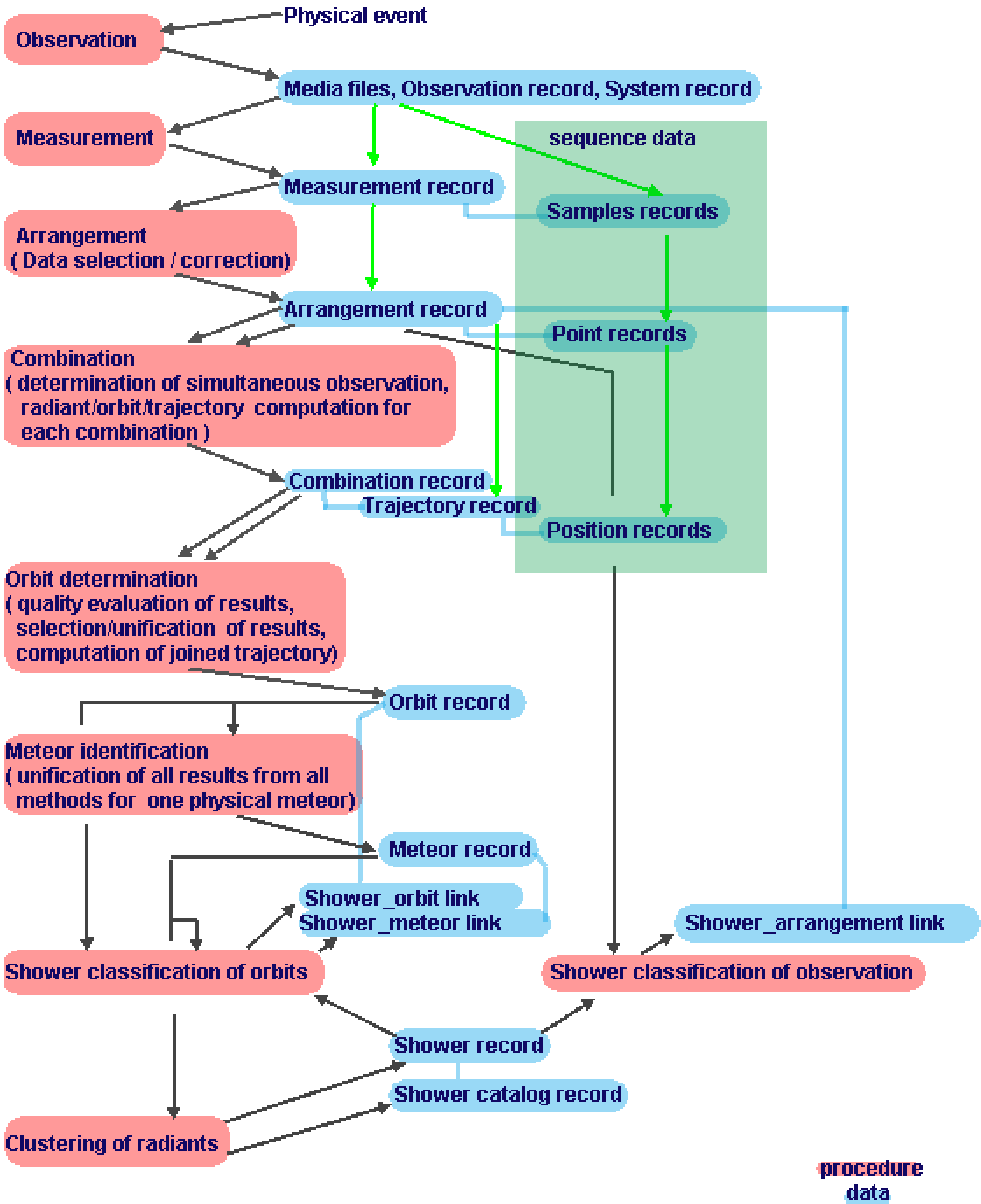
Tables and a figure below shows the model of meteor data processing that I made from our experience.

Process models

observation	creates media file records from a actual event
measurement	convert media file records to numerical values(raw data)
arrangement	correct position of raw data and makes more accurate series of data (I call this process as "arrangement" but I think there may be more preferable names)
combination	calculate one radiant/orbit from multiple simultaneous arrangements (usually from two) and decide the positions
orbit determination	calculate one radiant/orbit from multiple combinations (usually 1 to ～30) of one actual meteor
meteor identification	make relation from one actual event to many results reduced by multiple methods.
shower determination for observations	estimation of possible radiant on the single station observation result(on arrangement)
shower determination for orbits	determination of the shower of a meteor using observed radiant/orbit information
clustering of radiants	make a new shower data or shower catalogs

Data models that corresponds to major tables.

system	defined by location, observer, and equipments
observation	one event of single station observation
measurement	measured result of observation (raw data)
samples	series of measured direction and magnitude data of one shutter time (raw data)
arrangement	corrected or modified data of measurement (data that should be used for further computation)
points	series of corrected or modified direction and magnitude data
combination	one radiant direction that is decided by a pair or a set of multiple simultaneous observations
trajectory	one trajectory and orbital elements that is decided by one combination and one arrangement (this may be a part of long trajectory).
positions	series of geographical positions and absolute magnitude in one trajectory.
orbit	one joined geographical information and orbital elements form multiple combinations of one actual event by one method.
meteor	one actual meteor
observation period	time span that is used for the computation of ZHR
proc	processing id of software



Data Processing Model of Meteor Analysis

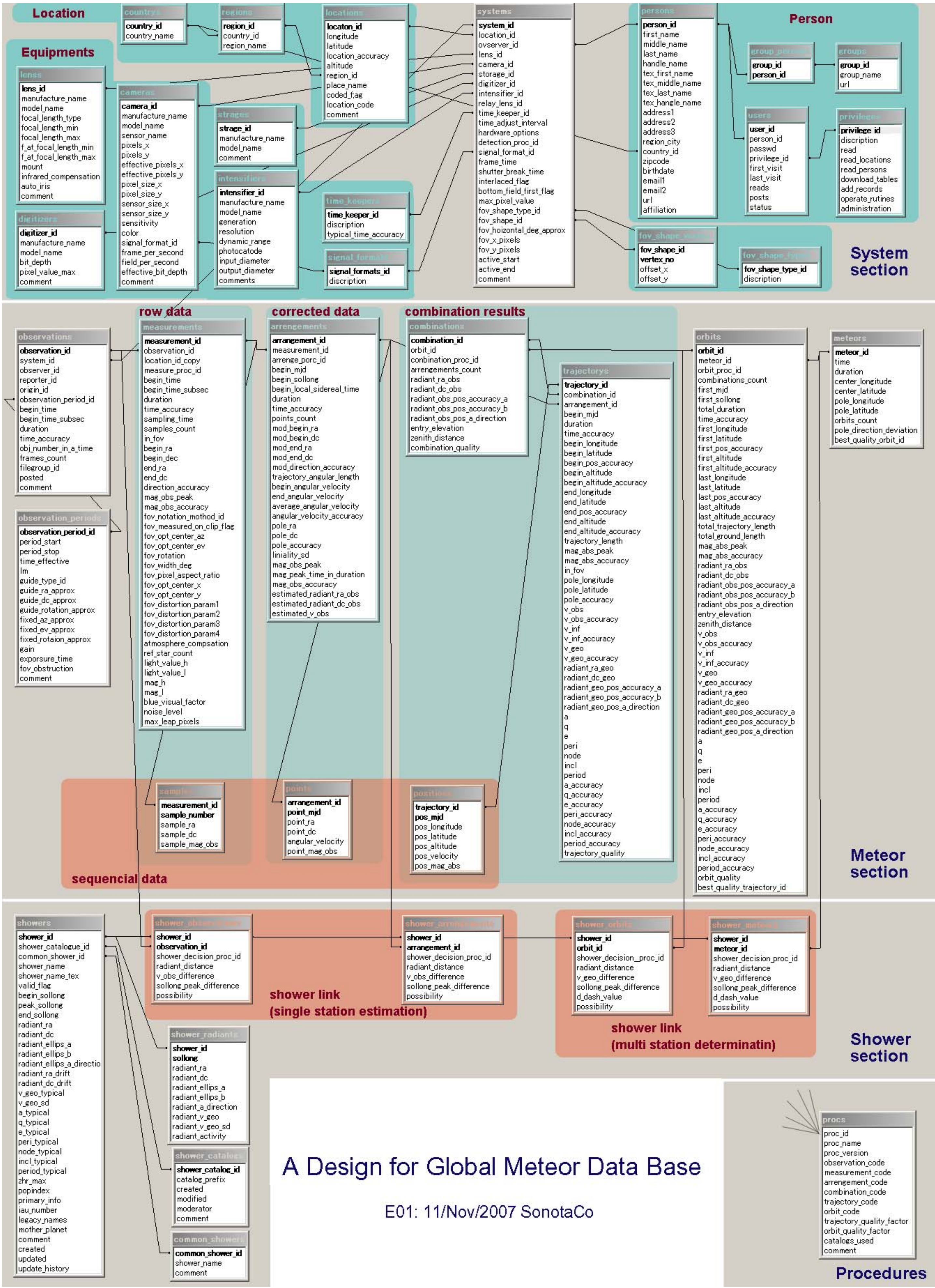
Outlook of GMDB

GMDB has 3 sections

1. System section
   contains information that is fixed for each camera.
2. Meteor section
   contains all information of observation/computation results and conditions except media files.
3. Shower section
   contains shower catalogs , shower information and shower to instance links

Notes:

- All tables has only one directional links along with the processing steps or data inheritance. This is the key feature for partial data updates.
- Procs table contains all procedure information. It should be treated as one of System section tables. It has many relation links to tables which hold computation results, but the relation line is not displayed in figures.
- Observation_periods table might not be needed. It holds data for conventional ZHR computation. But there may appear more accurate ZHR estimation methods which suit for automated observation.
- Shower to Combination link may be worth to add
- Shower to Observation link might not be needed
- All tables except links should have timestamps of created and modified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Meteor section

Meter section contains 11 tables.

Observations

Information of one single site observation of one event.

Observation_priods

Time span of single station observations for conventional ZHR computation.

Measurements

Raw data of measurement result of media files.

This table should contain enough information for the re-measurement of media files. Such as set of fov reduction parameters must be here.

Samples

Raw sequence data of observed direction and magnitude.

Arrangements

Corrected or selected data of measurements.

There are many methods of correction, future improvement is also expected.

This table makes it possible to compare many methods and to keep raw data as it is.

Points

Corrected or selected trajectory direction and magnitude.

Combinations

One pair or combination data.

This table contains one radiant direction that is computed from the combination.

More than 2 observations will be used for one combination in near future.

Trajectorys

One geographical trajectory computed from one combination and one arrangement.

(It should be written as “Trajectories”. But it is required on some RDB systems that the table name is primary key name + ‘s’).

Positions

Sequence of geographical positions and absolute magnitude in one trajectory.

Orbits

One orbit from multiple combinations by one method.

Joined trajectory information should be included here.

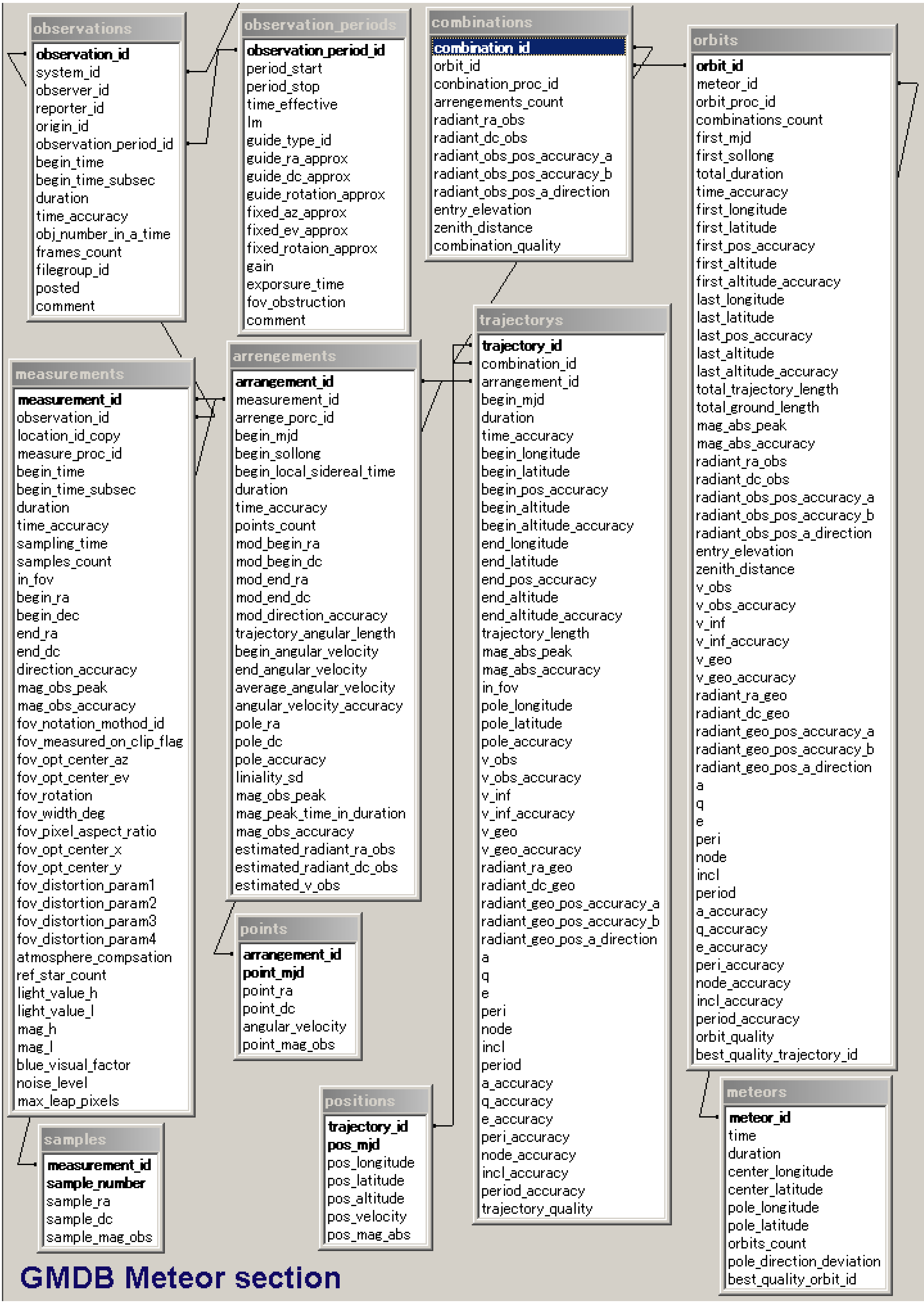
Meteors

One key that correspond to one actual meteor.

This is prepared for the existence of results by multiple computation methods.

This table contains information of geographical approximate position of the event. It helps identification of multiple observations. Especially geocentric pole longitude and latitude of the trajectory is very useful for precise determination of true simultaneous events.

Note: Many tables contains mjd (Modified Julian Day) as the time value. It is obvious that subsecond of time will be able to use and is very useful in the future. Double precision mjd can express under milliseconds by single term. I strongly recommend it.



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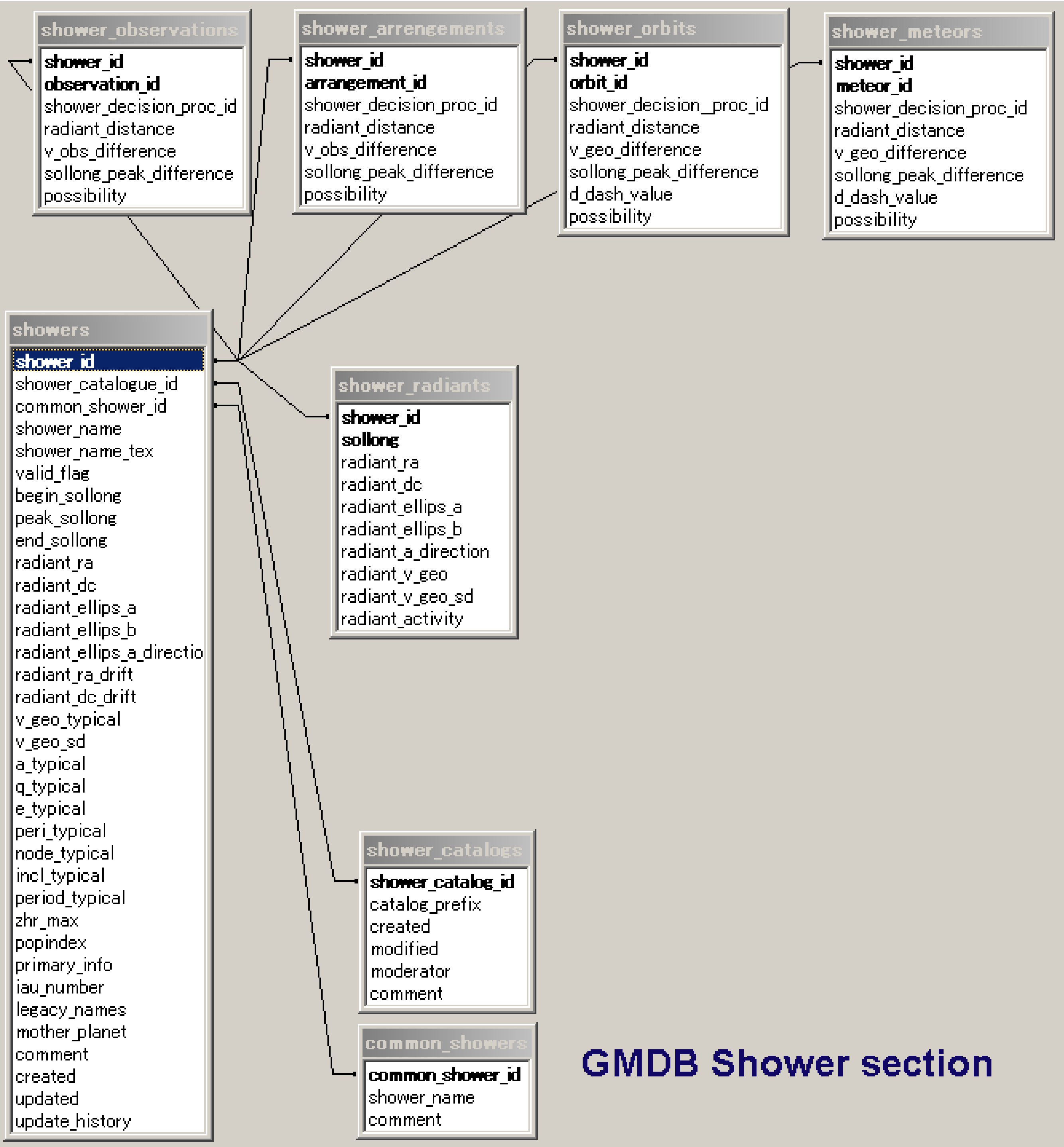
GMDB Meteor section

Shower section

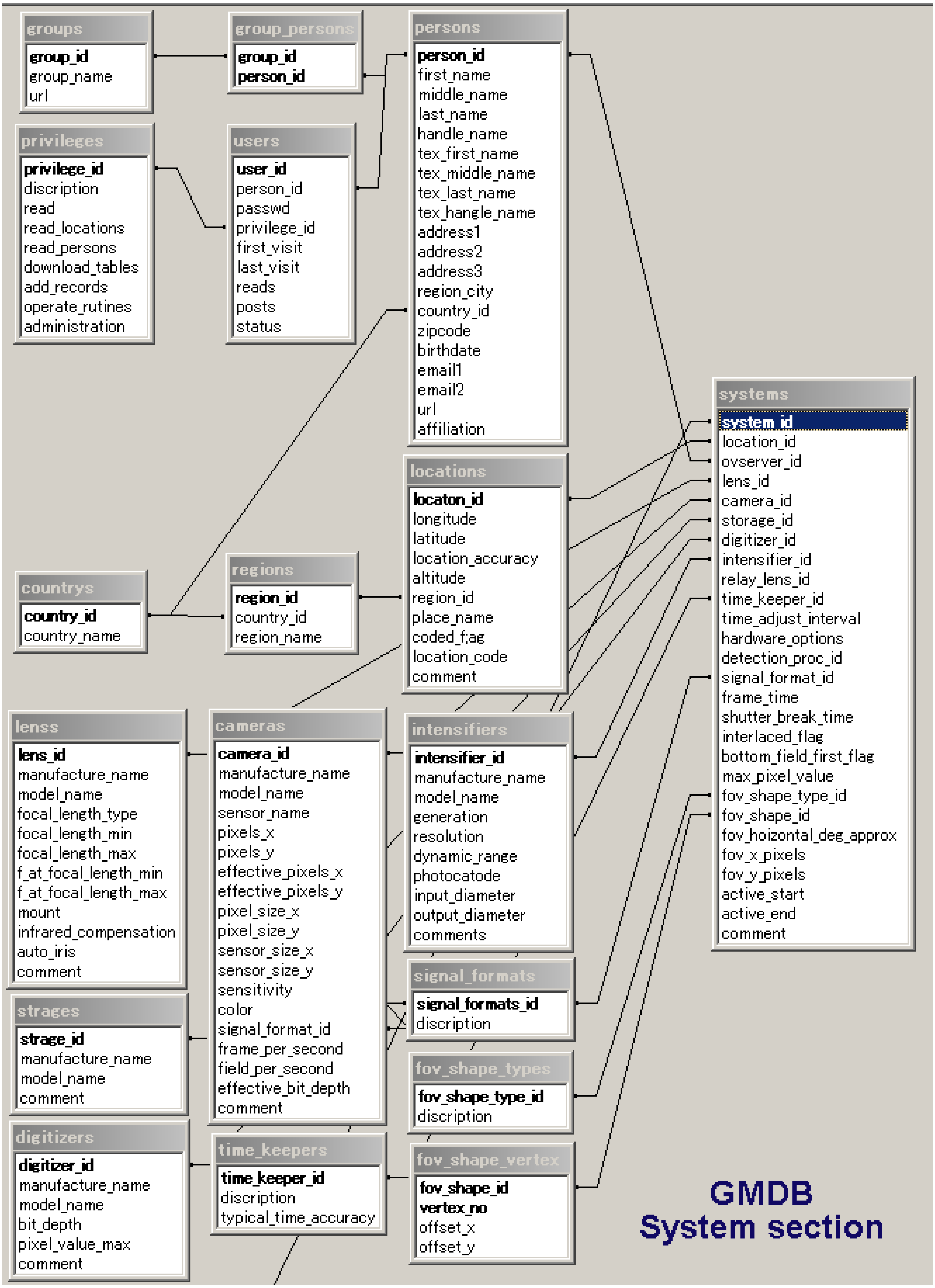
Shower section contains shower catalogs, showers, and shower link to other tables.
These are designed for the simultaneous usage of multiple catalogs.
Shower tables should contain orbital elements for the computation of D and D-dash.
Latest appearance year might be worth to add to showers table.
Shower links have some values that relate the accuracy of class determination. If they are not needed by many people, those values can be deleted to reduce the size of database.



System section

System section contains information of one system that has one field of view.

Note: precise longitude and latitude should be able to hide from public eyes. This is very important feature to increase the number of individual observers.



Id management

I strongly recommend to use strings that have meanings as the key of tables.

This simplifies structure of database and increases the human readability very much.

No meaningless value is needed. RDB systems manage them very well.

This enables the independent determination of ids at the outside of database.

It make it possible to give a same name both on local machine and on server records.

Id	Length	Exsample	Origin
proc_code	1	**u**	processing program code defined by porcs table
country_id	2	**jp**	defined by country table (ISO 3166-1 alpha-2)
region_id	4	**jptk**	country_id + region id (defined by a member of each country)
location_id	6	**jptk01**	region_id + suffix (defined by a member of each region
system_id	8	**jptk01a1**	location_id + camera id (defined by observer)
observation_id	25	**20071231_235959a_jptk01a1**	UT + suffix(object id in a time) + system_id
measurement_id	27	**20071231_235959a_jptk01a1_u**	system_id + measurement_porc_code
arrangement_id	28	**20071231_235959a_jptk01a1_uu**	measurement_id + correction_proc_code
combination_id	21	**20071231_235959b_u001**	the earliest UT in the simultaneous observations + suffix(object id in a time) + combination proc_code + combination number
trajectory_id	33	**20071231_235959b_u001_jptk01a1_uu**	combination_id + arrangement_id
orbit_id	18	**20071231_235959c_u**	the earliest UT in the simultaneous combinations + suffix(object id in a time) + orbit decision proc_code
meteor_id	16	**20071231_235959d**	the earliest UT in the same meteor's orbits + suffix(object id in a time)
shower_id	6	**J1_Leo**	shower_catalog_id + shower id decided by moderator of catalog
shower_catalog_id	2	**J1**	unique id defined by moderator of catalog, must be unique in the world

Comments on current design of VMO

This is comments for “VMO Database Model” Geert Barentsen posted to MODWG 31/Oct/2007.
I comment on what I felt as having big problems only.

- meteor_id
  - The meaning of meteor_id is ambiguous. It is used as primary key in many tables that might mean another matter.
  - While orbit_id appears on ORBIT_TRACE table only. Multi_observaion_id and multi_meteor_id are defined but not used also.
  - If a meteor_id represents a single station observation, it must not used as primary key of ORBIT_METEOR table.
  - If a meteor_id represents a actual event, cambos_meteor table must not contain this, because the meteor_id is not known at the stage of single site observation.
  - Correspondence between actual event, orbit computation result, and observed event is changable because the determination of them are depending on the procedures.
  - Also, if a meteor_id represents a actual event, METEOR table should contain information that helps the identification.

- SHOWER table
  - An unique id (ex. shower_id) that represents one shower of one catalog should be defined. Because it will use in many tables and shower_code might change in future.
  - The meaning of velocity (written as “Typical atmosphere velocity”) is ambiguous. Some catalogs use v_obs or v_inf as velocity, while others are using v_geo. It makes confusions now in the world. It is obvious that v_geo is better for catalog, because v_obs or v_inf is changing according to the observed elevation of radiant by zenithal attraction.
  - SHOWER table should contain typical orbital elements also, because the D or D' measures are useful.
  - It might be better that SHOWER table contains the information for the classification of meteors such as typical radiant area size or deviation of V.

- SHOWER_RADIANT table
  - V_geo at a specified sollog field might be worth to add. Because it will be possible to measure it in near future.

- SHOWER_CATALOG table
  - Moderator field will be needed because updates of catalogs will become frequent.

- CAMSYS_SYSTEM table
  - Parameters that might change should move to camobs_period or camops_meteor (exposure time, fov_az, fov_altitude).
  - Sampling_interval is ambiguous. It should be 4 fields such as frame_time, shutter_break_time, interlaced_flag, field_order.
  - Timekeeper info and time adjust interval should be added.
  - Signal format code (ex. NTSC_analog,PAL_analog,NTSC_IEEE1394_720x480, 16bit_monocrome....) may be worth to add. It represents many aspects by a single word.

- CAMOBS_OBSERVATION table
  - I cannot imagine why gain, max_pixel_value, time_accuracy are here.

- CAMOBS_OBSERVATION PERIOD table
  - Non eq_guided systems such as fixed mount or az_ev_guide should be considered here.

- CAMOBS_METEOR table

- Some kind of id that represents the raw observation must be here. Meteor_id makes confusions.
- Relation against showers must be independent form raw observation record (shower_code, shower_code_original should be in other table).
- Time should contain sub second information.
- Object number in one file must be here. Multiple meters on one files is not rare.
- This table should contain enough information for the re-measurement of files. Such as set of fov reduction parameters must be here.

✧ CAMOBS_POSITIONS table
- This table must contain original values. We must not lost raw data. Therefore correcting_flag must not be here.
- The correction and selection of positions is very important in orbit computation. It is the dominant error cause now. There is big possibility that new methods appear. Therefore we should record the corrected data to another table and keep this table as it was.

✧ ORBIT_METEOR table
- If the method_code is one of PRIMARY KEY in this table, then multiple result by multiple method can exist at a same time.
- It enables comparison of methods.
- I suggest to make meteor_id and orbit_id. Where Meteor_id corresponds to a actual meteor event. While orbit_id is for one computation result of one method.
- I recommend to use peri,node instead of omega and large_omega. It reduces mistakes a lot.
- I recommend to add geographical locations summary of an event. It is very useful for identification of observation. There are many meteors that occurs at a same time and have same radiant but their ground trajectory is different.
- Shower_code must not be here by the reason I mentioned before.

✧ ORBIT_TRAJECTORY table
- I recommend to use absolute time instead of point_no. There are many cases one meteor is observed by many sections. Absolute time simplifies the process of those.

✧ About covariance
- I do not oppose to add tables for covariance. But I oppose to delete usual accuracy values from tables.
- I think covariance is a a kind of method but not result. I think computation of covariance could produce more comprehensible values as its result.

Though I listed up many points, I am appreciating the Geert's effort very much.
His design is the most precise RDB design of meteors that I have ever seen.
I believe that he can create a new meteor database that is truly useful.
If it becomes true, we will join it, and I can have a vacation.

Cheers.