2.6. Relationship between the SDM and the Measurement Set

Both ALMA and the EVLA have adopted CASA as their main post-processing package. The SDM is derived from CASA's Measurement Set model (1), taking much of the structure of the MS' auxiliary tables. There are however several significant differences.

1. The binary data in the SDM are located in separate BLOBs referenced from the Main Table, while the binary data in the MS are located in the Main Table itself.
2. The SDM adds a ConfigDescription Table to identify the basic hardware configuration: the sets of antennas, frequency windows, and backends used. These change rarely during an observation and this new table simplifies the Main Table considerably.
3. The SDM contains a great deal of information that is not stored in the MS. Eventually this information will either prove interesting (in which case the MS and filler should be modified to use it) or boring (in which case it should be dropped from the SDM).
4. Several items and tables have been renamed to match ALMA terminology (scans, observations, integrations).
5. The SDM has no keywords (variables attached to a table which characterize the table as a whole and do not vary from row to row).
6. The SDM uses tags and keys to identify rows, with integer IDs in some cases being part of complex keys. The MS uses integer IDs rather differently (see §2.2.2) and also has the concept of a row number, which does not exist in the SDM.

The correspondence between data in the SDM and data in the MS is discussed in §C. This is not part of the definition of the SDM (which is entirely independent of the MS) but is often useful in understanding what is going on.

2.7. Relationship between the SDM and the BDF

Each row in the SDM's Main Table references a unique BDF file through `dataOid`. There is necessarily some association between the contents of that BDF file and the corresponding entries in the SDM; and the definitions of the BDF and the SDM *jointly* determine what can be stored in a single binary data file. This section discusses these inter-dependencies.

2.7.1. Spectral Windows in the BDF

The BDF's `sdmDataHeader` defines the axes, dimensionality, and ordering of the visibility data. Here is an example of how this works:

```
<crossData size="540672" axes="BAL BAB SPW BIN SPP POL"/>
<numAntenna>12</numAntenna>
<baseband name="BB_1">
  <spectralWindow sw="1"
    swbb="BB_1"
    crossPolProducts="RR RL LR LL"
    numSpectralPoint="256"
    numBin="1"
    scaleFactor="1.000000" sideband="NOSB"/>
  <spectralWindow sw="3"
    swbb="BB_1"
    crossPolProducts="RR"
    numSpectralPoint="1024"
    numBin="1"
    scaleFactor="1.000000" sideband="NOSB"/>
</baseband>
<baseband name="BB_2">
  <spectralWindow sw="1"
    swbb="BB_2"
    crossPolProducts="RR LL"
    numSpectralPoint="512"
    numBin="2"
    scaleFactor="1.000000" sideband="NOSB"/>
</baseband>
```

- The values of the `<baseband name>` and `swbb` attributes must be identical. This redundancy is required (1) to match the APDM, and (2) for ease of implementation (validation, code generation, and use of query languages).
- The ordering of the `baseband` and `spectralWindow` elements in the `sdmDataHeader` defines the order in which the actual binary data appear. In this example the order of the binary data will be:
  `BB_1/sw=2 BB_1/sw=1 BB_2/sw=1`
  - The `baseband` and `swbb` attributes must be in *ascending* order: i.e., `swbb="BB_4"` must occur after `swbb="BB_2"`. The actual values of these attributes are not important, although it would be good practice to match those used in the corresponding SDM.
  - The `sw` attributes must be in *ascending* order: i.e., `sw="3"` must occur after `sw="1"`. Note that this attribute does not correspond in any direct way to the `spectralWindowId` tag in the SDM (for one thing, that's a tag, not an integer).
  - The `sw` values are important only when there are sideband associations.

EVLA note:

Since the EVLA uses only single-sideband receivers the values of the `sw` attributes are not important, and the `sideband` must be set to `"NOSB"`.

ALMA note:

The `sw` values are used by ALMA to track sideband associations: the `image` attribute references a local `sw` id.

– The BDF does not require any particular ordering of these elements. However, consistency with the SDM requires that the ordering of these elements in the BDF must match the order of the elements in the `dataDescriptionId` array in the corresponding row of the SDM's ConfigDescription Table. This is discussed further below.

ALMA note:

For double-sideband receivers, spectral windows which are image sidebands of each other must be defined contiguously, with the lower sideband (LSB) first, and the upper sideband (USB) following.

For the ACA correlator, the spectral windows should be arranged in ascending order of the first channel of the spectral window in terms of 3.8 kHz channels.

- For this example the dimensions of the binary data are as follows:
  - `BAL`: `numAntenna*(numAntenna-1)/2= 66`
  - `BAB`: number of `baseband` elements= 2
  - `SPW`: number of `spectralWindow` elements:
first `BAB` (set by order of `baseband` elements) → 2
second `BAB` (set by order of `baseband` elements) → 1
  - `BIN`: given explicitly for each spectral window
  - `SPP`: given explicitly for each spectral window
  - `POL`: given implicitly for each spectral window by the number of `crossPolProducts`

2.7.2. Correspondences between spectral windows in the BDF and in the SDM

The SDM's Main Table refers to a BDF file through `dataOid`. Each `dataOid` occurs in a Main Table row which includes a `configDescriptionId`. The `configDescriptionId` is a tag and refers to a unique row in the ConfigDescription Table. That ConfigDescription row references a number of rows in the DataDescription Table through an array, `dataDescriptionId`, which has `numDataDescription` elements.

- `numDataDescription` is the total number of Spectral Windows, summed over all basebands. For the above BDF example this is 3.
- The order of the elements in the `dataDescriptionId` array is vital: the ith spectral window in the BDF's `sdmDataHeader` corresponds to the ith element in `dataDescriptionId`, and the corresponding row in the DataDescription Table points to the header information for that Spectral Window in the SpectralWindow and Polarization Tables (ignoring holography for now!).
  So in the above example, the header information for:
  `BB_1/sw=1` comes from `dataDescriptionId[0]`
  `BB_1/sw=3` comes from `dataDescriptionId[1]`
  `BB_2/sw=1` comes from `dataDescriptionId[2]`

2.7.3. Multiple simultaneous BDF files

Each row of the Main Table refers to a unique binary data file. This implies that the number of integrations (`numIntegration`) and the nominal data interval (scheduled duration; `interval`) must be the same for all data in a single binary data file. Modern correlators allow considerably more flexibility – one might for instance employ recirculation to increase the spectral resolution for one spectral window, at the expense of poorer time sampling. In this case one would write multiple binary data files at the same time; each would be referenced by a different row in the Main Table; and each such row could refer to a different row in the ConfigDescription Table, and hence (through the `dataDescriptionId` array) to a different set of spectral windows.

3. SDM Tables

TO BE DONE!

```
- Add ASDM Table
- separate CalDM tables
- Name
- Status: last modified & by whom
- ‘‘references" & ‘‘referenced by"
- Meaning of special values (e.g., blank or non-existent)
- Notes a la MS
```