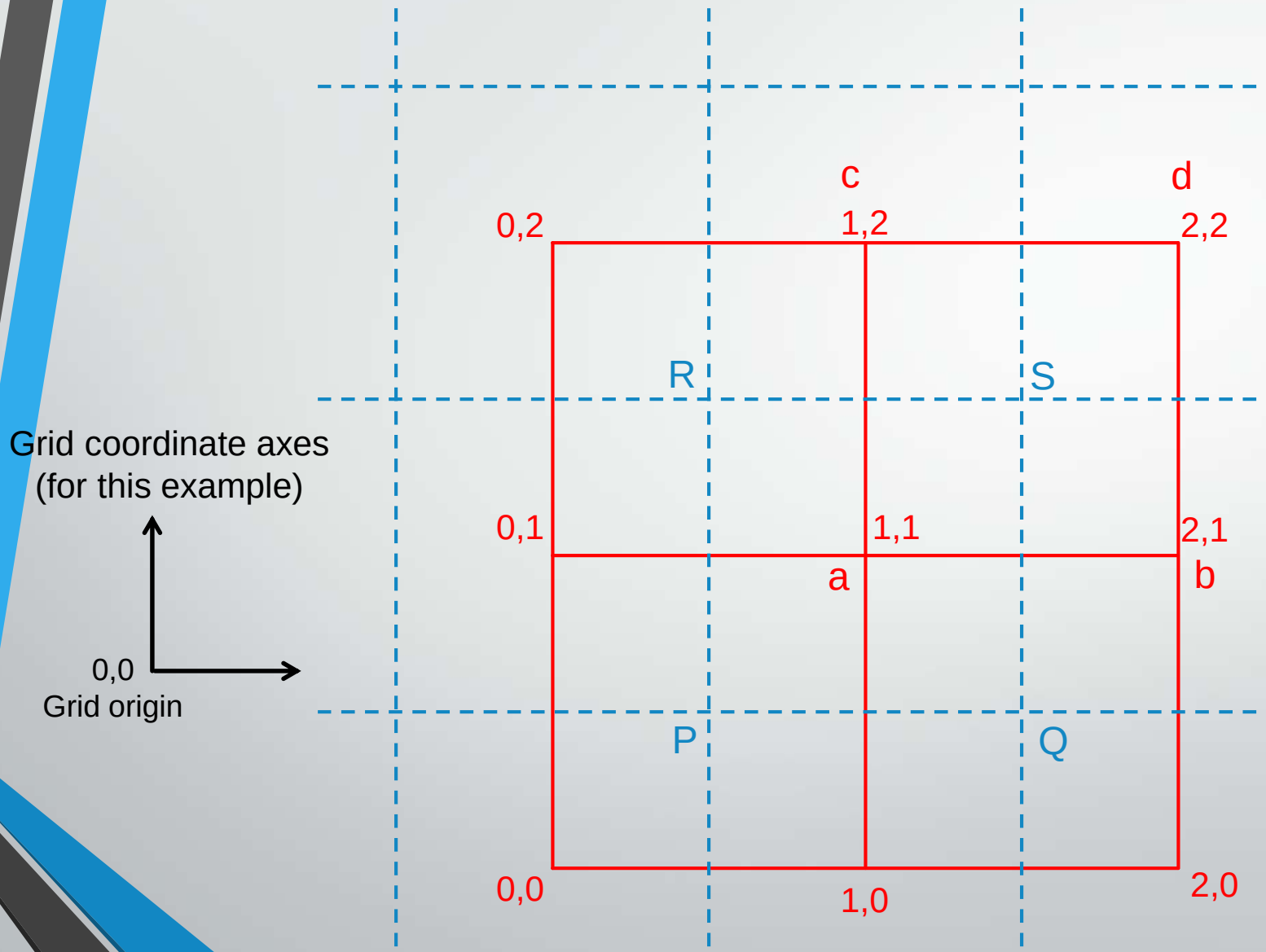
S100WG4-4.14 Location of data point in cell

- ISO 19123 and S-100 make the locations of the data points in grids coincident with the vertices of the grid (“grid points”).
- Project teams want the ability to specify where the data (sample) point is located in the grid cells. It matters for interpolation and portrayal.
  - Encoding gridded data with the data point at a corner or the center of a grid cell are both common practices.
  - Allows non-overlapping data points for adjacent grid features (e.g., for adjacent ENC cells).
- This proposal defines two (mutually exclusive) HDF5 attributes to indicate this.
  - The simple approach: dataOffsetCode – an enumeration attribute to indicate whether the lower/upper left/right corner, or the cell center, is the data point. This is intended for the most common cases – cell corner/center in 2-D grids.
  - The complete approach: dataOffsetVector – the relative position of the data point in a cell (relative to the cell size in each dimension). This works for all dimensions. It also allows the data point to be more precisely positioned if needed.
- Product specifications are expected to pick one or the other depending on their needs. If a product specification does not use either, the default ISO 19123/S-100 location (LL corner) applies.

Attribute - dataOffsetCode



Default situation

a,b,c,d: grid cell

a: grid point and also point location of data for cell

P,Q,R,S: (implicitly) sample space of grid point a

Proposal - dataOffsetCode

dataOffsetCode=1 (XMin, YMin) [“LL”]

a: data point location

dataOffsetCode=2 (XMax, YMax) [“UR”]

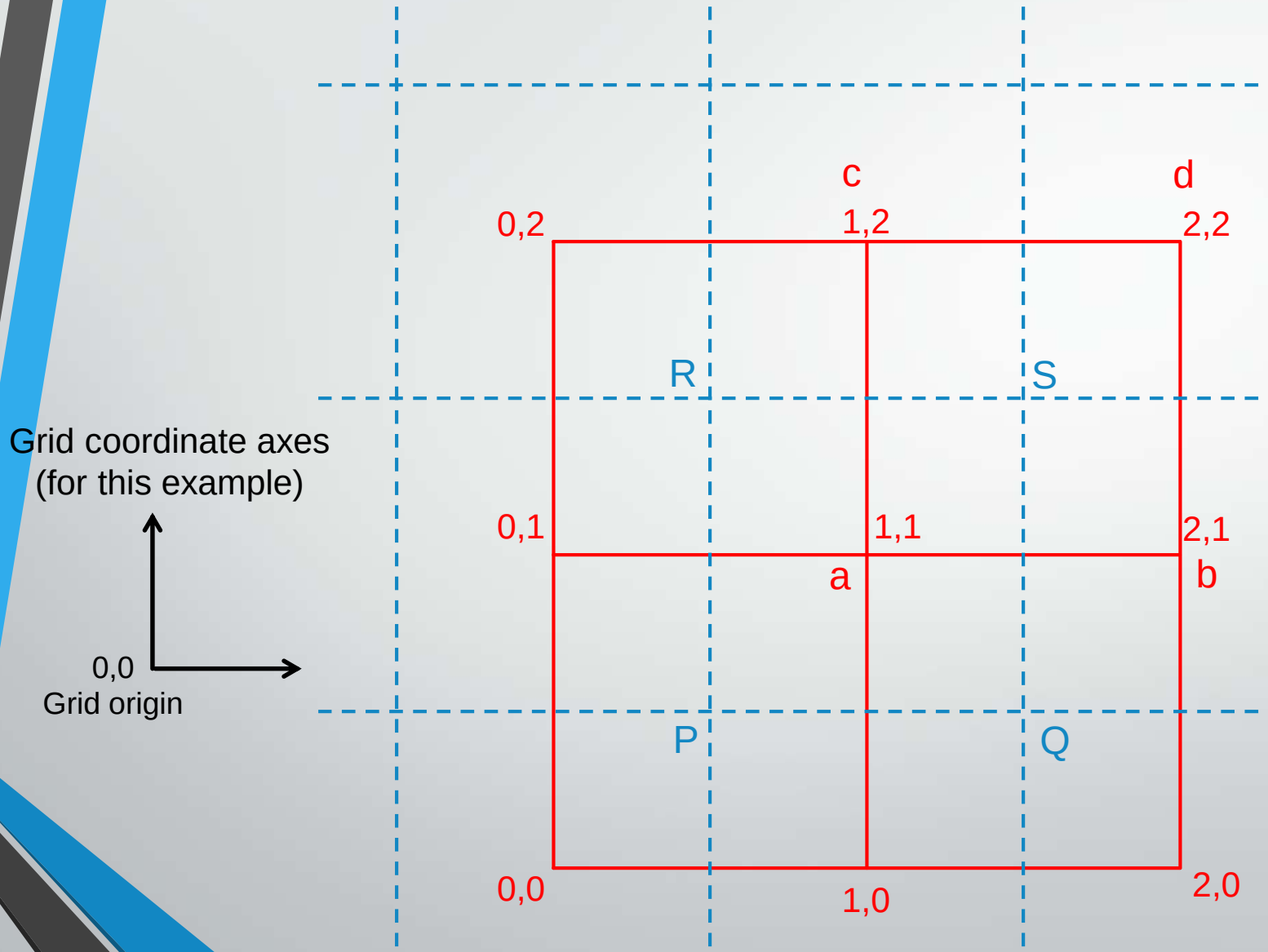
d: data point location

dataOffsetCode=5 (bary-center) [grid cell center]

S: data point location

3,4: other corners

Attribute - dataOffsetVector



Default situation

a,b,c,d: grid cell

a: grid point and also point location of data for cell

P,Q,R,S: (implicitly) sample space of grid point a

Proposal - dataOffsetVector

dataOffsetVector=(0.0, 0.0)

a: data point location

dataOffsetVector=(1.0, 1.0)

d: data point location

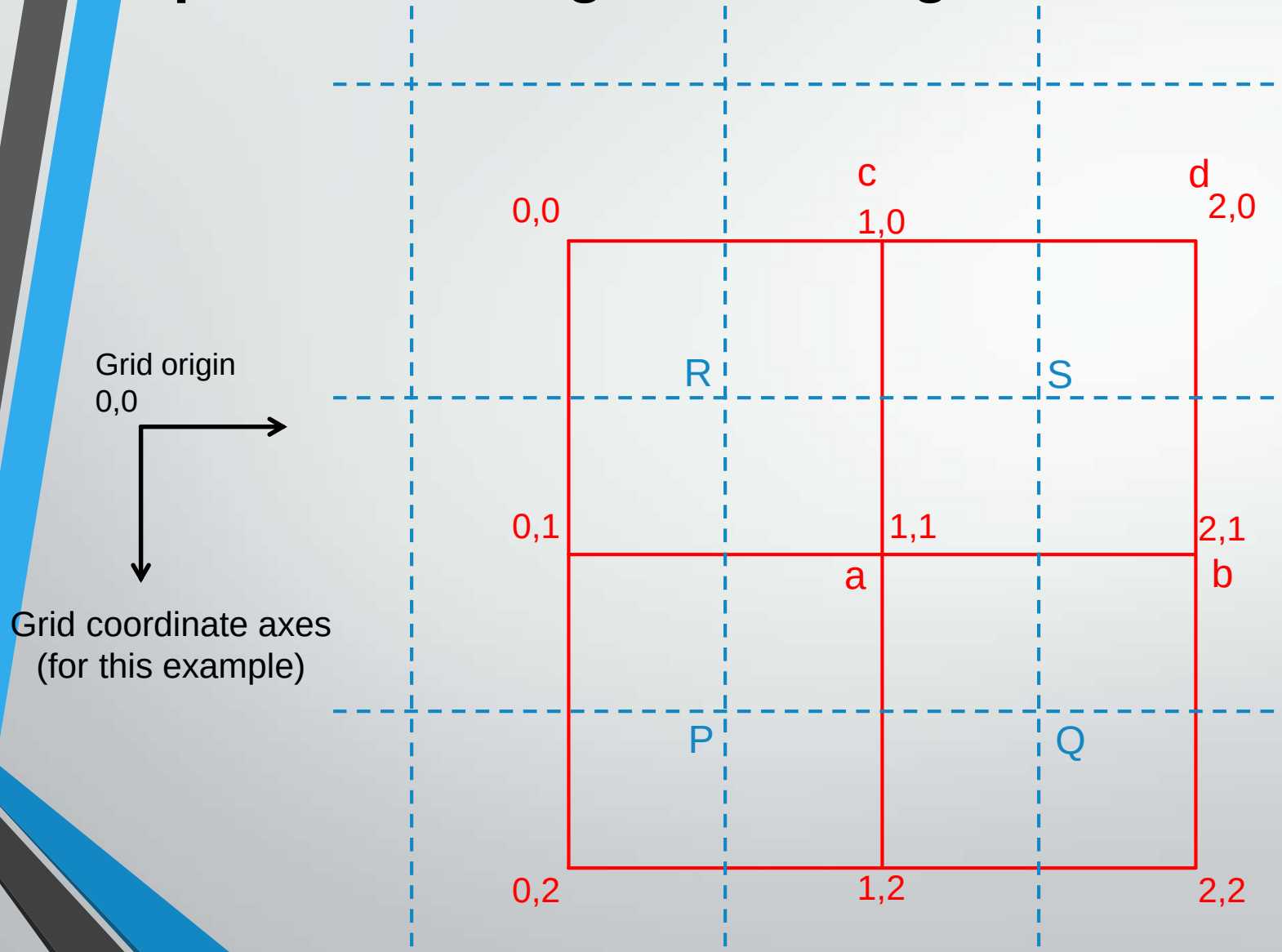
dataOffsetVector=(0.5,0.5)

S: data point location

Any position in the range [0.0, 0.0] to [1.0, 1.0]

Works for N dimensions

Dependence on grid axis origin/direction



Default situation

a,b,c,d: grid cell

c: grid point and also point location of data for cell abcd

Proposal - dataOffsetCode

dataOffsetCode=1 (XMin, YMin) [“LL”]

c: data point location

dataOffsetCode=2 (XMax, YMax) [“UR”]

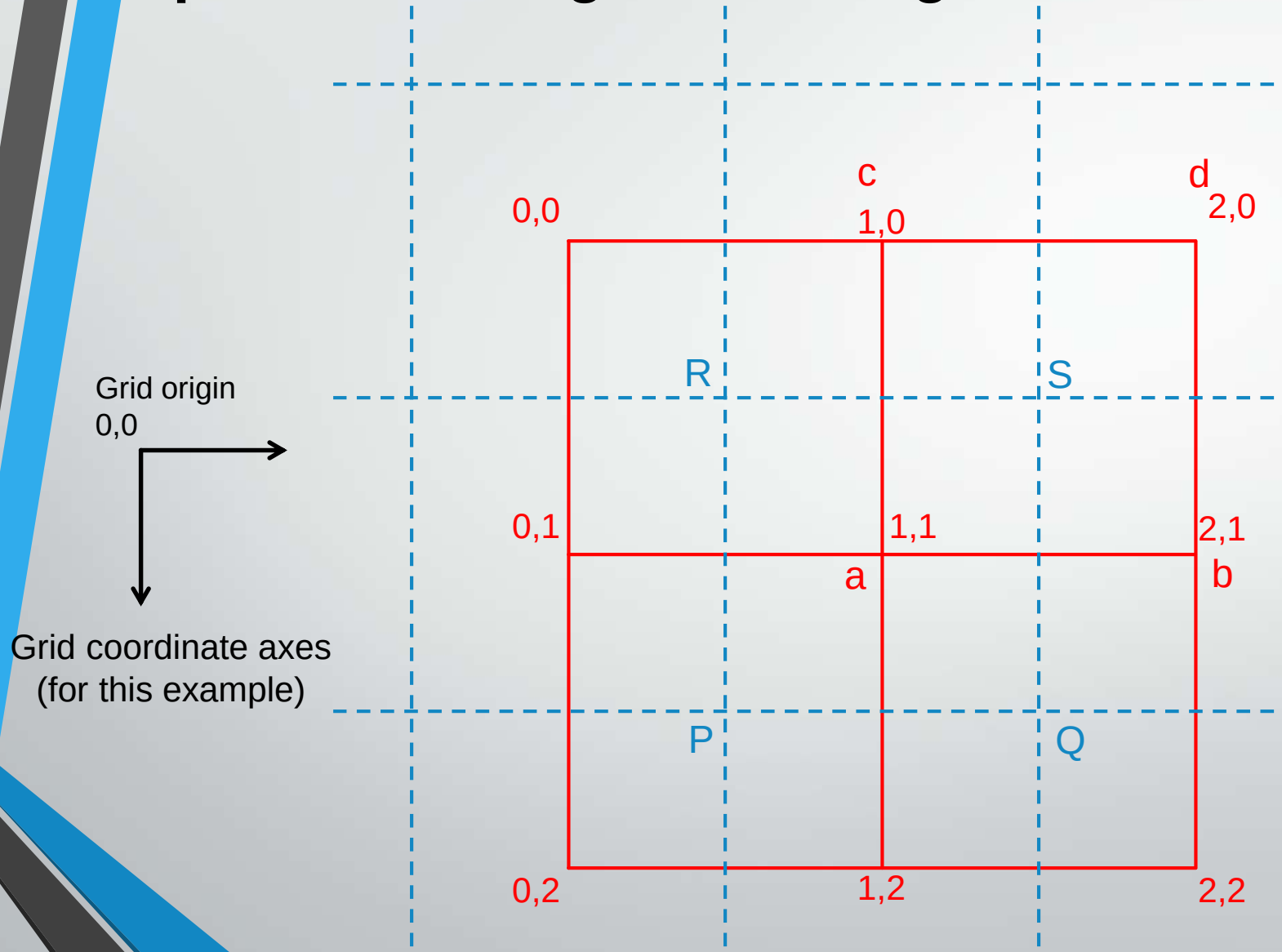
b: data point location

dataOffsetCode=5 (bary-center) [grid cell center]

S: data point location

3,4: other corners

Dependence on grid axis origin/direction



Default situation

a,b,c,d: grid cell

c: grid point and also point location of data for cell abcd

Proposal - dataOffsetVector

dataOffsetVector=(0.0, 0.0)

c: data point location

dataOffsetVector=(1.0, 1.0)

b: data point location

dataOffsetVector=(0.5,0.5)

S: data point location

Any position in the range [0.0, 0.0] to [1.0, 1.0]

Works for N dimensions

Things to consider

- Are all 4 (2-D) corner codes necessary in practice, or just LL, UR, and center?
  - If only the two extrema and the center – can use codes for 3-D grids as well.
- The underlying ISO standard describes the bilinear, biquadratic, and bicubic interpolation in terms of combinations of the values at the *vertices* of grid cells, implying that the data values are supposed to be located at the corners of the grid cells, i.e., exactly at the grid points.
- It is possible to achieve equivalent results by defining appropriate interpolation parameters instead.
  - The project teams prefer using an attribute, as being simpler than interpolation.

Details

10c-9.6 Feature container group

[Add the following attribute to Table 10c-10 in each of the sections for dataCodingFormat = 2 (Regularly-gridded arrays), 3 (Ungeorectified gridded arrays) , 5 (Irregular grid), 6 (Variable cell size). Add 10c-9.6.1 to explain the use of the new attributes.]

Name	Camel case	Mult.	Data Type	Remarks and/or units
Offset of data point in cell	dataOffsetCode	0..1	Enumeration	1: XMin, YMin ("Lower left") corner ("Cell origin") 2: XMax, YMax ("Upper right") corner 3: XMax, YMin ("Lower right") corner 4: XMin, YMax ("Upper left") corner 5: Barycenter (centroid) of cell
Offset of data point in cell as vector	dataOffsetVector	0..1	Float	Array (1-D) 0..D-1 where D is the value of the dimension attribute Values must be real numbers in the range [0,1].

10c-9.6.1 Location of data point within cell

Product specifications may require their data products to indicate the relative location of the data point corresponding to a grid cell in relation to the corners of the cell. The location can be indicated using either the dataOffsetCode or dataOffsetVector attribute. These attributes can be used only with grid-based coverages and not with time series, TIN, or moving platform data. Product specifications may use either dataOffsetCode or dataOffsetVector but not both.

Product specifications in which the data point is located at the (XMin, YMin) grid point need not use either dataOffsetCode or dataOffsetVector.

The attribute dataOffsetCode can be used only with two-dimensional grids. It indicates whether the data point is one of the four cell corners or the centre of the cell. Note that the definitions of the codes indicting the corners are in terms of X and Y grid coordinates relative to the grid origin. (This means that in a grid with its X axis directed from east to west and Y axis from north to south the "lower left" corner is different from the "lower left" corner in a grid with X axis directed west to east and Y axis south to north.)

The attribute dataOffsetVector is intended for use with higher-dimension grids or in cases where the data point location is not at one of the corners or the centre of the cell. The values in this array indicate the relative offset along each axis of the data point from the grid point whose grid coordinates are closest to those of the grid origin. In a two-dimensional grid, this will be the point with smallest X and Y grid coordinates. Again, it should be noted that the direction of the axes and the location of the grid origin determines which corner is the cell origin. Each offset is relative to the dimension of the cell along the corresponding axis. The order of values in dataOffsetVector must correspond to the order of axes in the axisNames array (Table 10c-9).

Conclusion – data point location in grid cell

- Comments and questions?

Details – data coding format

10c-10.4 Data coding format

Item	Name	Description	Code	Remarks
Enumeration	S100_HDF_ DataCodingFormat	Data coding formats for S-100 HDF5 data		
Literal	fixedStations	Data at multiple discrete fixed point locations.	1	
Literal	regularGrid	Data at grid points forming a regular grid with constant cell spacing.	2	Regular grids are commonly composed of perpendicularly crossing lines of equal spacing on each dimension, creating square or rectangular cells.
Literal	ungeorectifiedGrid	Data that does not include any information that can be used to determine a cell's geographic coordinate values, or in which cell spacing is variable, and there is no predefined association between one cell's location and that of another.	3	For example, a digital perspective aerial photograph without georectification information included
Literal	movingPlatform	Data at sequential discrete point locations of a moving sensor platform.	4	
Literal	irregularGrid	Data distributed over a grid with uniform cell spacing but irregular overall shape.	5	The irregularity of shape may consist of non-rectangular coverage area or relatively large regions which are not populated with data.
Literal	variableCellSize	Variable-density grid containing one or more regions with cell spacing that is a whole multiple of a common minimum uniform cell spacing.	6	The shape of the overall grid may be non-rectangular.
Literal	TIN	Triangulated irregular network.	7	A TIN is a representation of a continuous surface consisting entirely of triangular facets. The vertices at the corners of each triangle are shared with the adjacent triangle. These vertices form the control points of the coverage function.

Details – grid cell structure clarification

Part 8 Imagery and Gridded Data

8-6.2 Point Sets, Grids, and TINs

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8-6.2.8 Grid cell structure

S-100 utilizes the same view of grid cell structure as Section 8.2.2 of ISO 19123. The grid data in S-100 grid coverages are nominally situated exactly at the grid points defined by the grid coordinates. The grid points are therefore the "sample points." Data values at a sample point represent measurements over a neighbourhood of the sample point. This neighbourhood is assumed to extend a half-cell in each dimension. The effect is that the sample space corresponding to each grid point is a cell centred at the grid point.

Note that applying interpolation methods to a coverage means that the value of a data characteristic at a location between grid points may be different from that at any or all of the grid points which are its nearest neighbours.

Some data products may find it convenient to use nominal locations of data measurements that do not coincide with grid points as outlined above. Part 10c provides a method for encoding such data products by selecting one of the corners of the cell or by defining a standard offset to be applied to the default grid point locations in order to determine the nominal locations of the data values.