

Marine High Density Data Management and Visualization

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Canada

Netherlands

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Australia

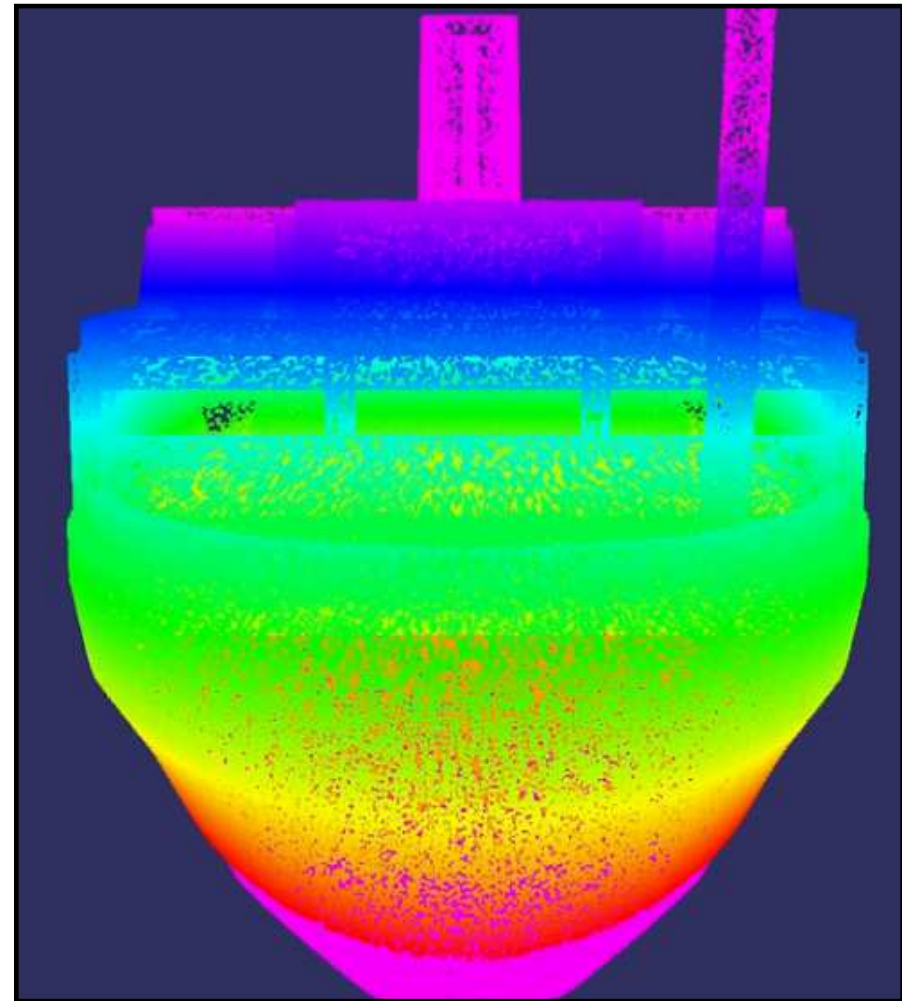
United Kingdom

caris



Point Clouds

- True 3D volume
- Randomly distributed (X,Y,Z) points
- Applications
 - Modeling vertical surfaces (walls, cliffs)
 - Multibeam
 - LiDAR
 - Laserscan





Our Design Goals

- 3D representation
 - Billions of points
 - High precision
 - Multiple Attributes per point
- Visualization
 - Fast 2D/3D Visualization
- Modifiable
 - Add new points or edit existing ones
- Complex Queries
 - Spatial, attribution



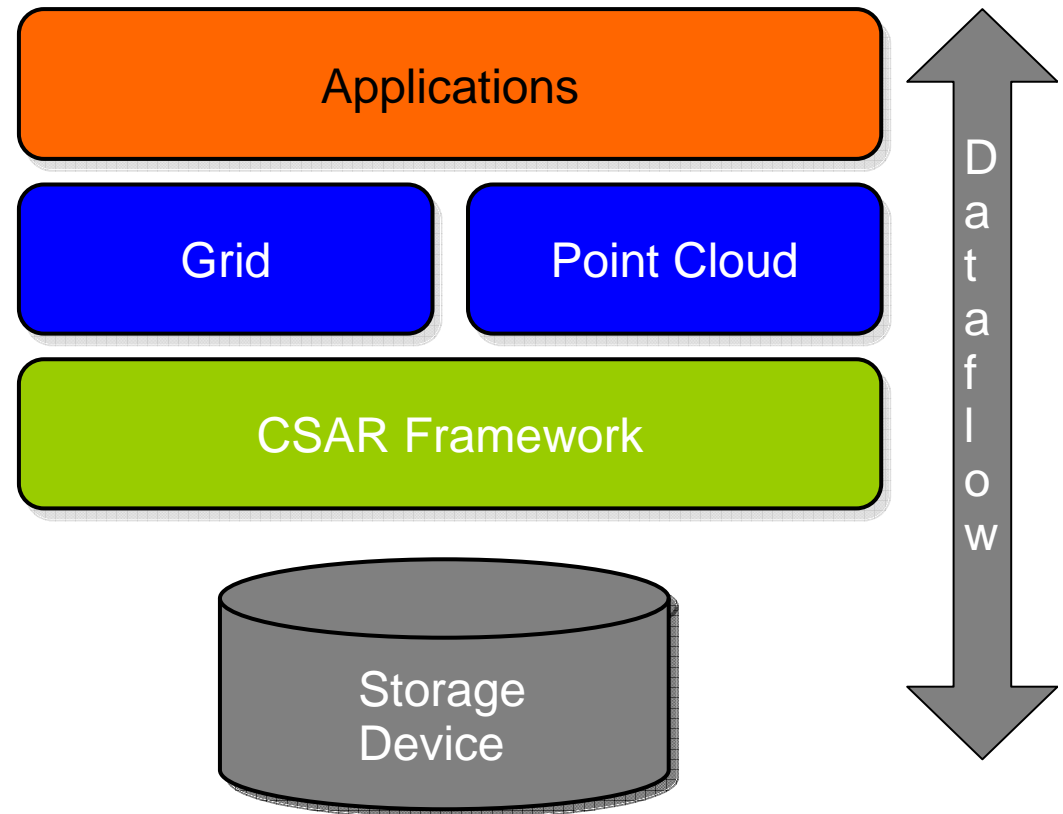
Data Structure

- Point structure
 - Double precision spatial position
 - Multiple flags per point
 - Multiple returns per point supported (LiDAR)
- Multiple levels of resolution
 - No duplicates
- Multiple Attributes per point
 - Attributes grouped into *bands*
 - Bands stored independently to minimize IO for unneeded data



Data Storage

- Implemented using CARIS CSAR system
 - huge data sets (>1 TB)
 - Flexible client-side caching, threaded IO
 - Consistent internal representation
 - Translation to different storage systems
 - Bathy Database proprietary
 - RDBMS tables
 - Oracle Spatial Point Cloud





Performance test

- Example
 - Import bathymetric multibeam from GSF (100s of files)
 - Merge into a single cloud
 - 3 attributes per point
- Stats
 - 1.2 Billion points in single cloud
 - 30 GB data file
 - Initial 2D/3D overview: <1.0 sec



Editing and Querying

- Cloud can be modified
 - New points added after initial construction
 - Points can be edited
- Queries using
 - Spatial volumes, Resolution constraints, Attribution
 - Efficient use of spatial organization in cloud
- Selection/Classification using flag word
 - Multiple flags per point

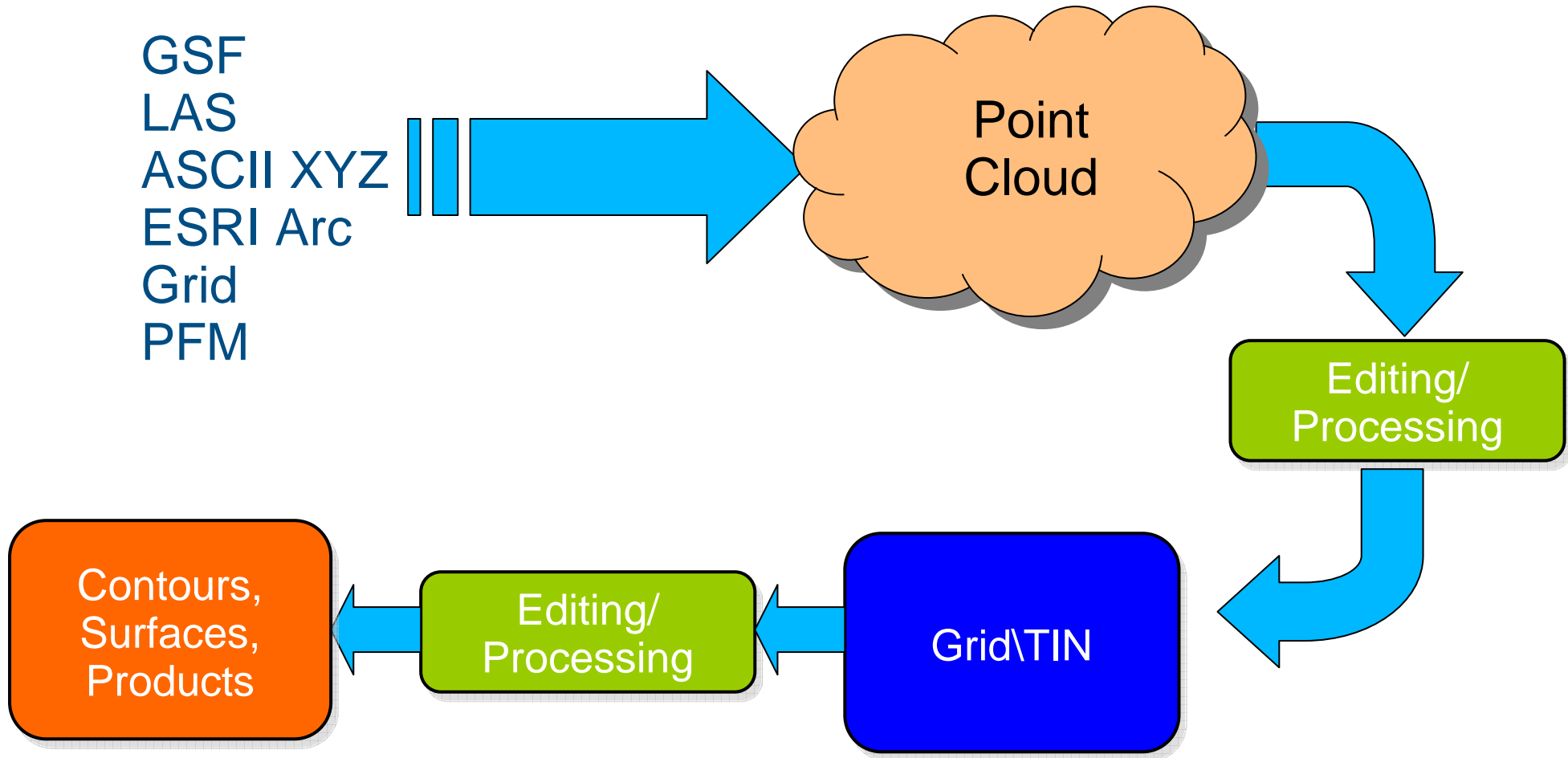


Visualization

Video



Point Cloud Workflows





Grid and Cloud Processing

- Cloud Processing
 - Merge, extract, shift, create TIN, CUBE, Gridding tools
- Grid Processing
 - Stored using CSAR framework (50+ billion nodes)
 - Multiple attributes per node
 - Multiple resolution levels
 - Combine, filter, extract, reproject, shift, contour, generate isolines
 - **On-the-fly reprojection and resampling of multiple grids**



CARIS Bathy Database

- Visualize or process Grids or Point Clouds from database
 - Efficient client-side caching, processing and visualization
 - Data loaded from database to client on-demand, files don't have to be exported
 - Suitable for low-bandwidth connections
- Version 2.3 (**available now**)
 - File based storage
- Version 3.0 (**Q2 2010**)
 - RDBMS/Oracle Spatial storage
 - Will store data as Oracle Spatial GeoRaster, Point Cloud (now being prototyped)



Upcoming work

- Speed Improvements
 - Faster construction
 - Better memory management
- Automatic analysis tools
 - Generate polygons from spatial characteristics
 - Polygon boundary extraction
- Visualization
 - Improve FPS
 - Exploit sub-trees for smooth blending
 - Texture draping