Initial work on development of an open Streaming Media Standard for Field of Light Displays (SMFoLD)

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Third Dimension Technologies

Stereo Displays & Applications
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Standard for Streaming 3D Media

- Sponsored by the Air Force (AFRL)
- Program Facilitators
  - Third Dimension Technologies
  - Oak Ridge National Laboratory
  - Insight Media

SMFOLD.ORG

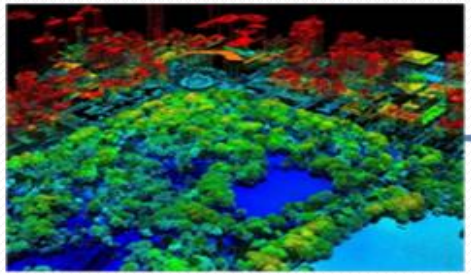
Motivation for SMFoLD

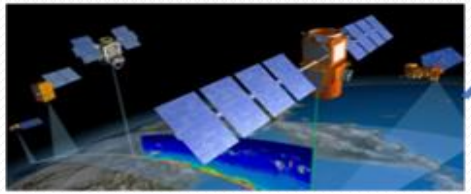
- 3D Data Increasing Dramatically
  - LiDAR, SAR, plenoptic camera, stereo or multi-view to 3D
  - 3D models (actual and created)
- 3D Visualization Needed to Improve Productivity
  - Stereoscopic 3D (S3D) not acceptable
  - Field of Light Display (FoLD) is desired
- Lack of Streaming Standard is Barrier to FoLD Adoption
  - Commercial standards bodies are focused on 2D and S3D (MPEG-I and JPEG Pleno are working on Light Field standards)
  - Common model needed for application portability
  - Nonproprietary standardized format for plug and play

Field of Light Displays (FoLD)

- Light field displays attempt to perfectly reproduce the actual 3D field of light that surrounds us
- See True 3D without glasses
- No gear strapped to your face
- No visual conflict discomfort
- Enhanced visual perception, situational awareness, sense of presence, and cognition

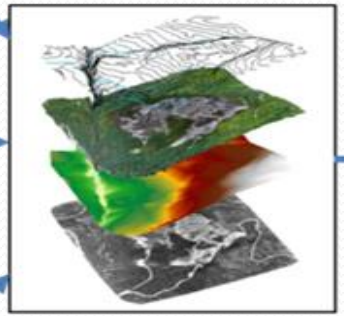
SMFoLD Use Case Example





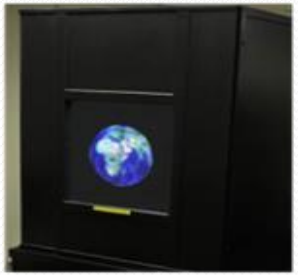
Enormous Amounts of 3D Data Being Generated

3D Streaming?



Spatially Heterogeneous and Multi-Scale Data with Inherently 3D Context

New Class of Field of Light Displays (FoLDs)



Third Dimension Technologies

- TDT is a Developer of FoLD Systems
- Well Versed in Multiview Rendering Challenges
- Current Projects
  - FoLD Integrated Flight Simulator
  - Standard for Streaming 3D Media to Field of Light Displays (SMFoLD)

3RD DIMENSION TECHNOLOGIES

Problem to be Solved

- FoLD Systems Must Render 3D Scenes from Multiple Viewpoints
  - FoLDs generate gigapixels, streaming not feasible
  - 3D applications should not be tied to a specific display type
  - FoLDs need access to shaders
  - S3D applications typically provide only one viewpoint

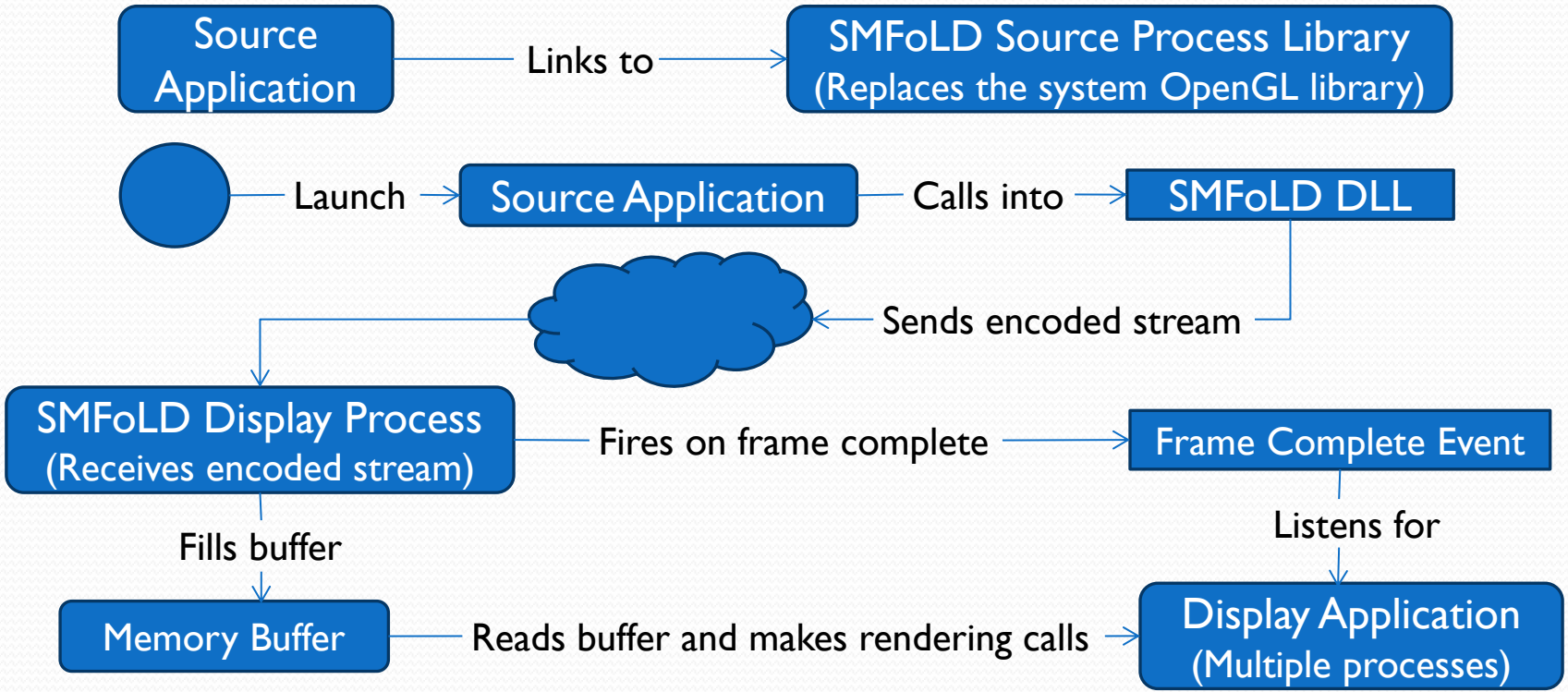
SMFoLD Objectives

- Display Agnostic 3D Streaming
  - Viewable on any 2D, S3D or FoLD system
  - Includes scene description and transmission format
  - Allows for flow and point of view control
- Open International Standard
- Supports Commercial and DoD Needs
- Supported by Display and Application Developers
- Allows More 3D Applications to Run on FoLD Systems

SMFoLD Approach

- Use OpenGL for the SMFoLD Interface
  - Source Applications link to SMFoLD library (SMFoLD.lib)
  - Display Applications include SMFoLD definitions
- Data Types Limited to Mesh, Texture & OpenGL Primitives
  - Mesh formats reduce bandwidth requirements
- Hooks to Named Variables ("Uniforms") in Shaders
  - Camera position, camera angle, focal plane, camera field of view, and others (TBD)

SMFoLD Flow Model



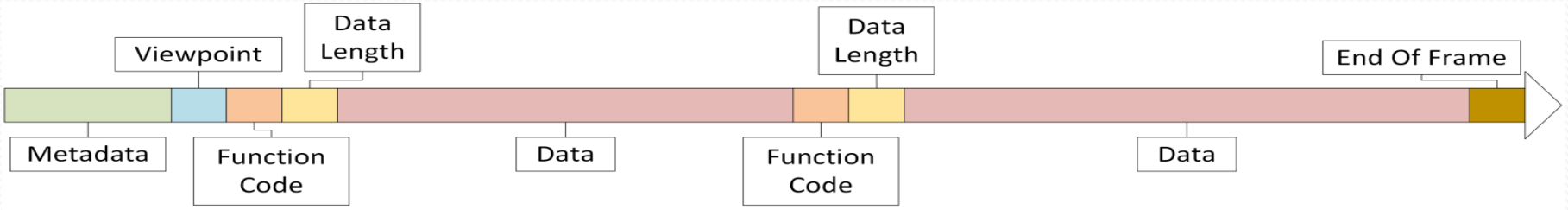
What is in an SMFoLD 3D Frame?

- All Information Needed to Display Image in 2D or 3D
  - Values that represent function calls (opcodes)
  - Data that the function calls use (function arguments)
  - Metadata to allow the display to create any number of viewpoints
- 3D Objects Defined as Discreet Objects
  - Object definition downloaded once and stored locally
  - Object can be locally manipulated without changing the object data

What is in an SMFoLD 3D Frame? (2)

- Graphics Primitives (functions) Used to Describe 3D Scene
  - Viewpoint as defined by the application
  - Metadata needed by 3D displays for multi-viewpoint rendering
  - Geometry transformation matrix
  - Colors, material properties, blending, etc.
  - Arrays of values expressing 3D structures or models
- Shaders - rendering pipeline logic for all frames

Typical SMFoLD 3D Data Frame Format

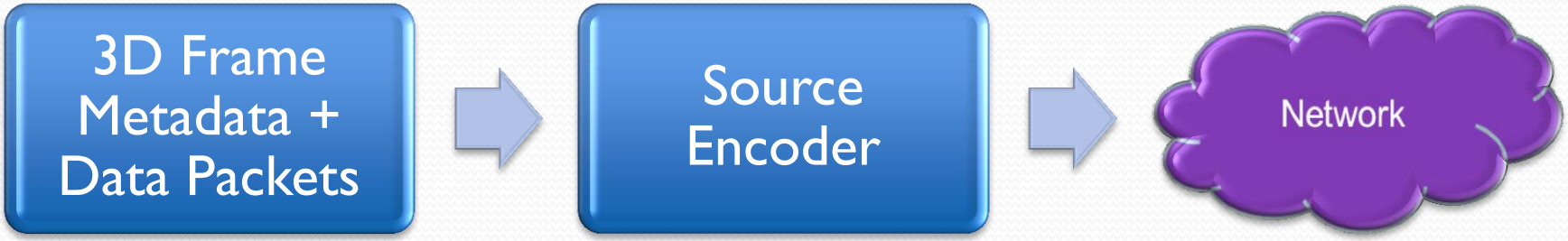


Structure of the SMFoLD Stream

Source Process Encodes 3D Frame

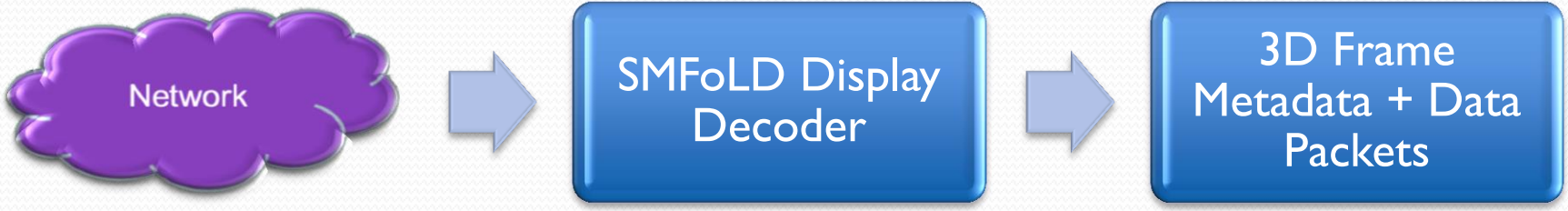
- Application Processes 3D Data
- Application Calls Source Process API to Create 3D Frame
- Source Process Encodes Functions and Arguments
- Writes Encoded Data to Memory Buffer

3D Frame Prepared for Transmission



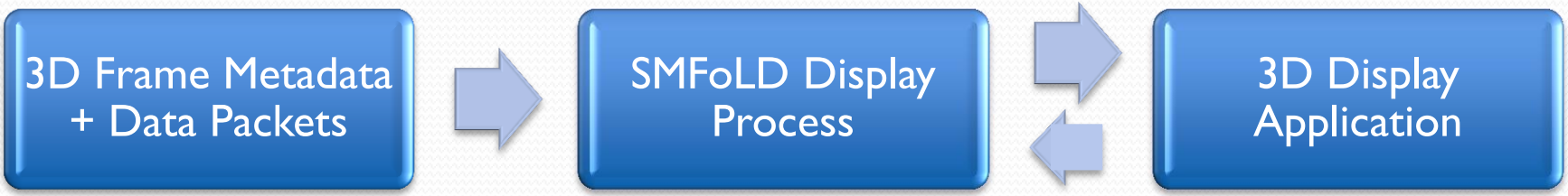
- 3D Frames Compressed and Encrypted
- 3D Frames Output to Network

3D Frame Decoded



- 3D Frames Decompressed and Decrypted
- 3D Frame Restored to Opcodes and Data

Display Creates GPU Code



- Display Process Writes Incoming Stream to Memory
  - Notifies Display Application when frame is ready for rendering
- Display Application Performs Multiview Rendering
- Metadata Used to Set Display Specific Parameters
- Shaders
  - Shader hooks used to set view geometry

Shaders

- Graphics Pipeline is Implemented in Shaders
- Vertex Shader Performs Geometric Transformations
- Shader Hooks Allow Geometry Changes by Display Application
  - Hooks are named variables that a display application can access
  - Source application shader code is required to provide hooks
- SMFoLD Defined Shader Function Called by Vertex Shader
  - Function will use the named variables

Conclusions

- OpenGL API Graphics Primitives Plus Extensions Provides a Short Path to Display Agnostic 3D Streaming
- High Frame Rates can be Achieved Over Existing Networks
- Different 3D Data Types can be Added
- Need Support of Application and Display System Providers

Next Steps

- Implement Model and Share Test Results
- When Authorized Share as Open Source Software
- Engage Application and Display Providers
- Attend SMFoLD Workshops
- Visit SMFoLD.org
- Find a Home With an Existing Standards Body