

# Into the Blue

dynamic real time  
cloud processing

**Cloud Futures 2011**

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**RICE®**

# Uncharted Skies: Streaming Cloud

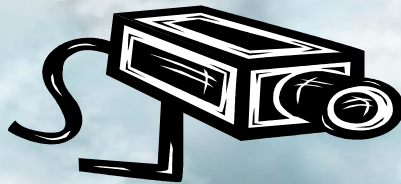
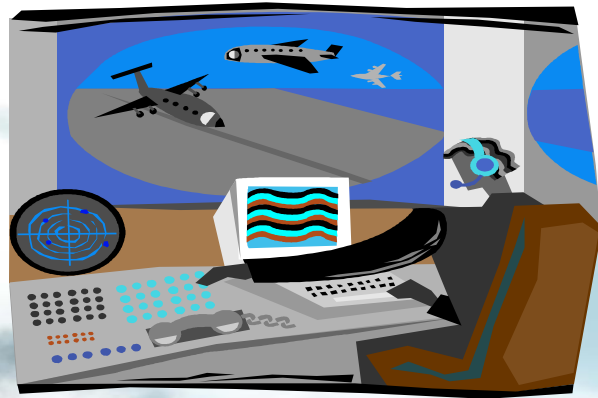


- Real time data streams ground  $\Leftrightarrow$  cloud
  - Process data in the cloud
  - Stream the results back to the ground
- Huge parallel processing capability
- Elasticity  $\rightarrow$  dynamic configurability!



# Practical Uses

- Air/Auto Traffic Control
- Environmental Sensors
- Inventory Tracking
- Surveillance
- Home Automation

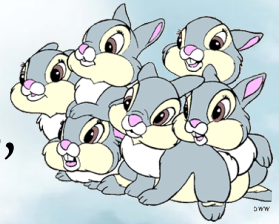


# Initial Project Motivations



Interactive Art

Dynamically changing inputs,  
incl. game controllers



Scalable number of users

Multiple, simultaneous  
results visualizations





# The Team

- **4 students** in semester-long software-engineering project
- **No initial experience** in C#, .NET, Azure, enterprise systems, etc.
- **Self-organized and self-directed** team created and assigned own tasks.
- **Discovery process:** Make mistakes and learn from them.

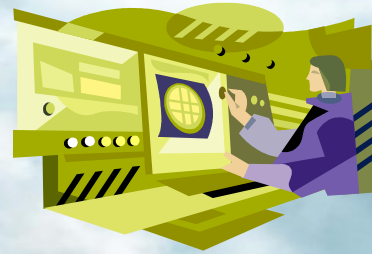


# User Experience: The Ground



**Connect Streams to the Cloud**

**Manage Processing of Streams**



**Visual Representation of Results**

# Architecture: The Ground

## Control Panel

- Administration of cloud functionality
- How input streams are used in processing
- Coordinate the creation of processing graph
- Receives streaming output from the cloud
- Renders the output from the cloud
- Assigns display outputs to processed data.
- Displays the results on a screen
- User Friendly
- Arbitrary physical location

Cloud Settings  
Options  
Status

## Display

Visualization of  
Cloud Output

Display  
Visualization of  
Cloud Output



# Architecture – The Cloud

Stream Entry

Feature

## Control Process

- Creates the process
- Provides user access
- Manages fault tolerance

## Mixers

- Given an arbitrary lambda
- Syncs and Processes Stream
- Linked to produce a graph

Control  
Process

2-way

## Feature Extractors

- Stream entry into the cloud
- Single Stream Number Crunching
- Converts streams into internal events
- Forwards events to proper Mixer

## State Repository

- Shared database
- Stores processing graph configuration data
- Allows for re-creation of lost module/connection

## Display Adapters

- Converts the processing results to Visualization commands
- Different adapters can be set to produce different results

Stream Exit

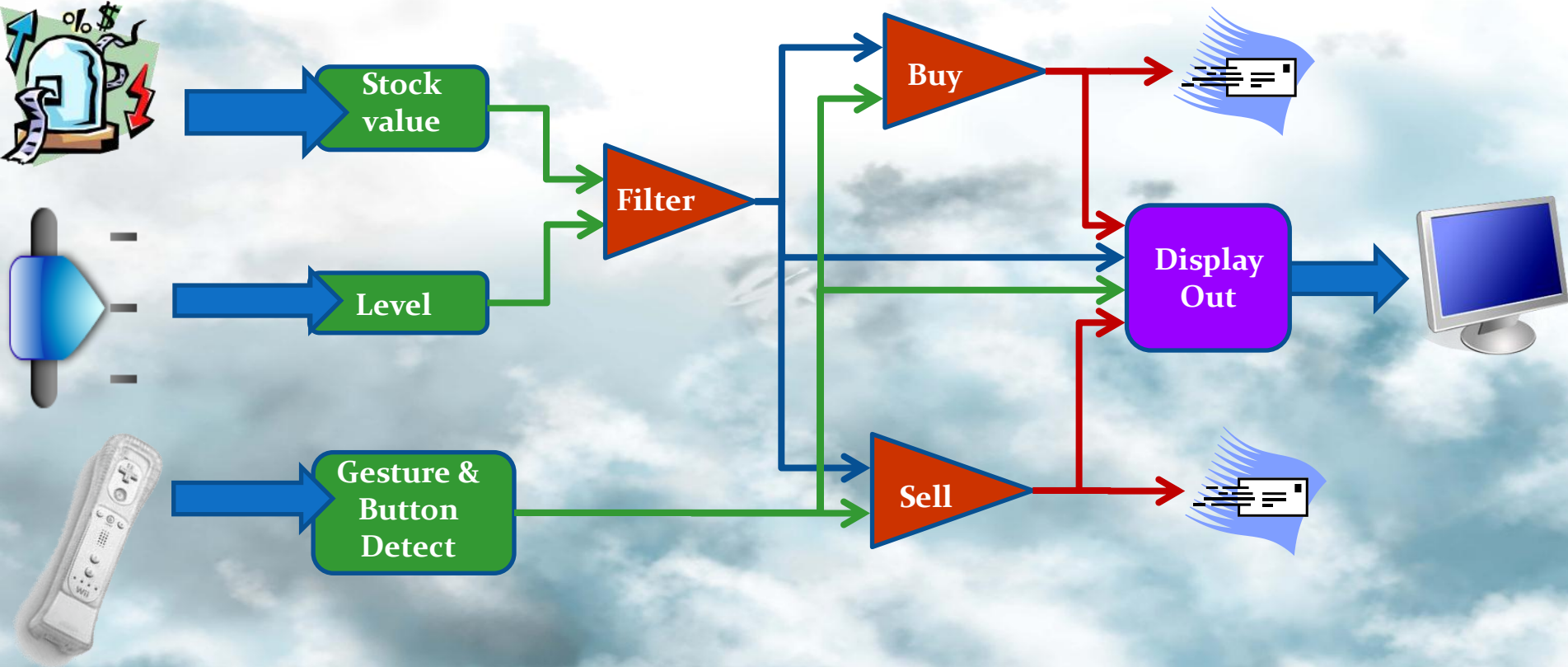
Display

Stream

Stream



# Demo Structure



# Real-time challenges in the Cloud

## TCP timeout



Azure does not assume persistent connections!

## Dev Fabric Isolation



Doesn't allow outside connections

## Reconstruction of lost modules



Modules are not identical!

## Lost Connections



Azure load balancer can't make specific connection.

# Into the Blue

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*Questions?*

# Into the Blue was supported by



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*Thank-you for enabling us to take flight!*