Ongoing Challenges in the Creation of AR Experiences: Standards Update

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*[Original Slides by **Gerry Kim & Marius Preda**]*

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Exciting Times!

- A lot of ‘Wild West’ innovation and compelling applications
- A growing concern for longevity and interoperability of MAR content: deliberate design for long term success
- Between 2011 and 2013, several SDOs took on the problem

Mixed and Augmented Reality

What is a Reference Model?

- A reference model (for a given domain) defines an authoritative basis that outlines:
  - Set of principles
  - Terms and their precise definitions
  - Generic system model of mixed/augmented reality system
    - Major components and their functionalities
    - Inter-component interfaces (data and control)
    - @ the right abstraction level w.r.t. purpose
  - Use cases
  - Others …

Purpose: A Model Architecture

- Help develop/extend consistent and comprehensive MAR standards
- Help MAR system designers and information architects and service developers
- Promote fluid communication among MAR practitioners in the field
- Identify and derive areas of standardization
- Validation and conformance

Principles

- Provide many views:
  - Business/Marketing
  - Developer (Systems/Applications), System Architects
  - Standards Developer

- Provide a “Model”: Independence from *specific implementations*
  - Algorithms: E.g. Recognition/tracking, Rendering, …
  - Sensors and real world capture
  - Platform / Distribution of computation
  - Scene description
  - Output Displays
  - …

- Be able to describe a reasonable range of “ARC (or MAR)” applications/systems

Hard Problem for 1 SDO!

- Web3D Consortium
  - http://www.web3d.org/realtime-3d/working-groups/augmented-reality-ar
- Open Geospatial Consortium
  - http://www.opengeospatial.org/projects/groups/arml2.0swg
- Khronos
  - Web/OpenGL, OpenMax AL/SL, StreamInput
- MPEG
  - ARAF: http://wg11.sc29.org/augmentedReality/

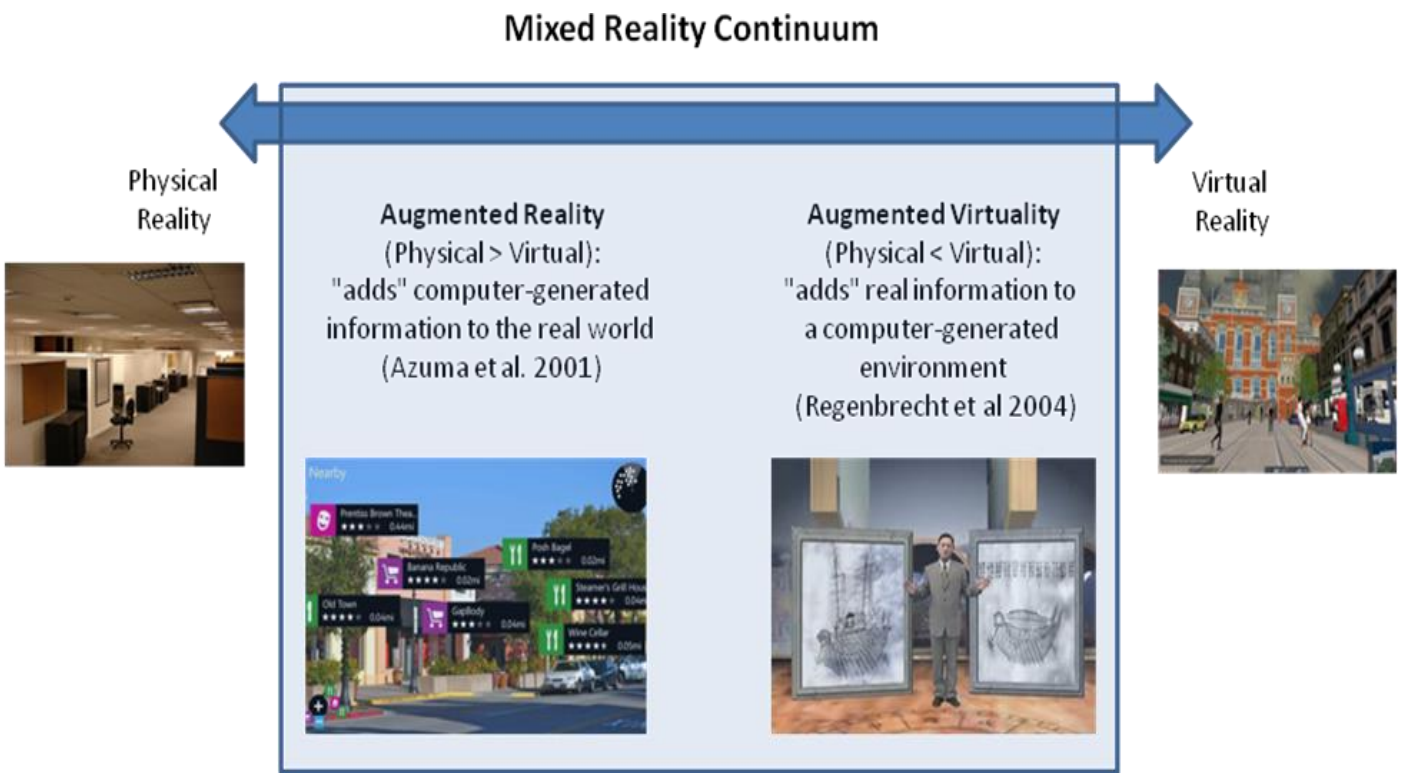
=====➔ ISO SC 24 + SC 29: Joint (ad-hoc) Working Group

Direct perception

Computer mediated perception

Definition

MAR focus


Mixed Reality Continuum
Physical Reality
Augmented Reality
(Physical > Virtual):
"adds" computer-generated information to the real world
(Azuma et al. 2001)
Augmented Virtuality
(Physical < Virtual):
"adds" real information to a computer-generated environment
(Regenbrecht et al 2004)
Virtual Reality

Views

Viewpoint	Viewpoint Definition	Topics in RM-MAR
Computational	• Outer specification of a generic system/module /component • Interconnection	• MAR component functionalities and interconnections • Input / output specification
Information	• Information requirement • Semantics • Data/information model	• Generic MAR Content • Inter-module data model • MAR context/event model
Enterprise	• Business model • Actors	• Potential business model for each actor • Actors and their role for MAR

Global Architecture

Sensors / Actuators

AVH Display / UI

MAR Engine

MAR Scene Descriptions

Services

Additional Media

Enterprise Viewpoint

EUP

Device Manufacturer (DM)
Device Middleware/Component Provider (DMCP)

Service Middleware/Component Provider (SMCP)
AR Service Provider (ARSP)

Telecommunication Operator (TO)

End-User Profile (EU)

AR Authoring Tools Creator (ARAT)
AR Experience Creator (AREC)
Content Creator (CC)

Content Aggregator (CA)

Sensors / Actuators
DMCP
AVH Display / UI
TO
DM
DMCP
MAR Engine
TO
TO
AREC
ARATC
MAR Scene Descriptions
CC
TO
ARSP
Services
SMCP
Additional Media
CC
CA

Computational Viewpoint

Real World AVH Capture

Actuator Device

AVH Display / UI

Rec/Tracker

Spatial Mapper

Context Mapper

Scene Graph Engine

AVH Renderer

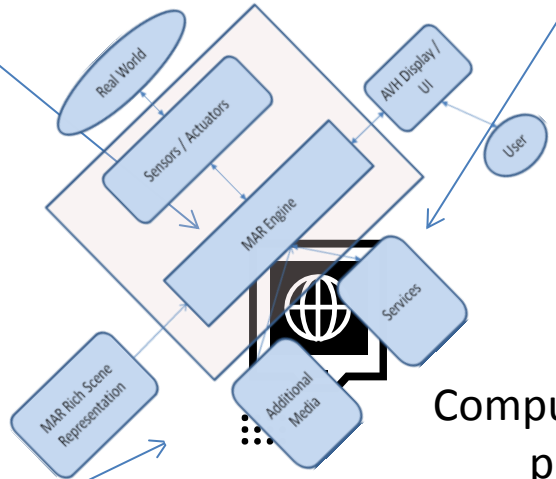
MAR Engine

MAR Scene Descriptions

Services

Additional Media

Direct perception



Computer mediated perception

ISO MAR Reference Model

- **In development**
- **Uses a component-based classification system**
- **Covers terminology**
- **Demonstrates models with local and remote resources for processing and presentation**
  - 6 state-of-the-art use cases
  - 2 Point Of Interest (POI) use cases
  - Using 3D video
  - Using 3D audio

Sensor data

Cloud

Client

Recognizer

Tracker

Context / Event data

Spatial/Event Mapper

Spatial data

Scene data
Display data
…

UI data

MAR Scene Simulation

Scene tree

Renderer

Capture data

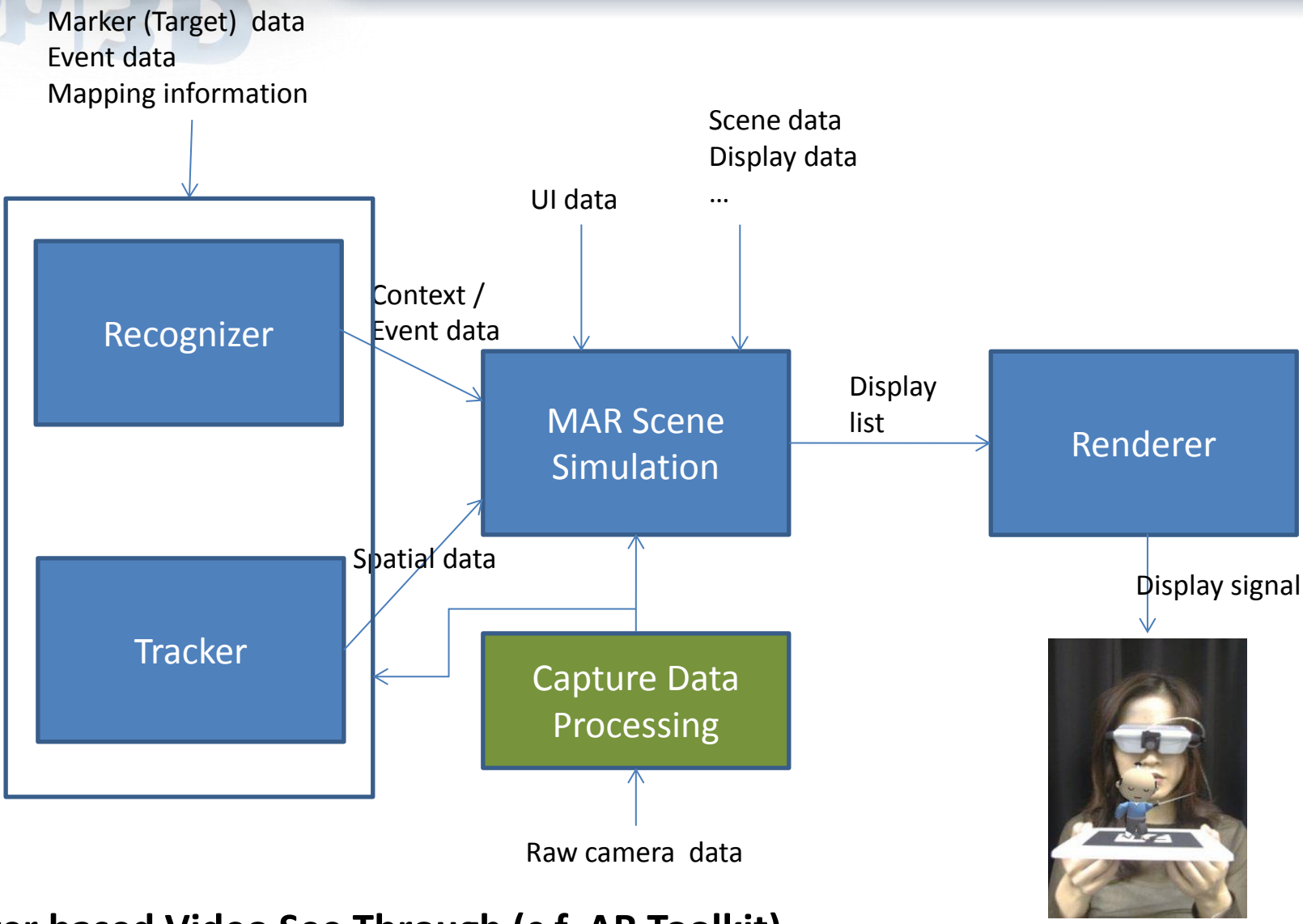
Display signal

Target data

Target Objet DB

Target description

Cloud MR Engine (c.f. Vuforia)



Marker based Video See Through (c.f. AR Toolkit)

Raw GPS data

Map Service

GPS Data Processing

Sensor data

Context/event map data
Spatial map data

UI data

Scene data
Target data
Display data
...

Context / Event data

Recognizer

MAR Scene (Screen) Composer

Renderer

Target data

Capture data

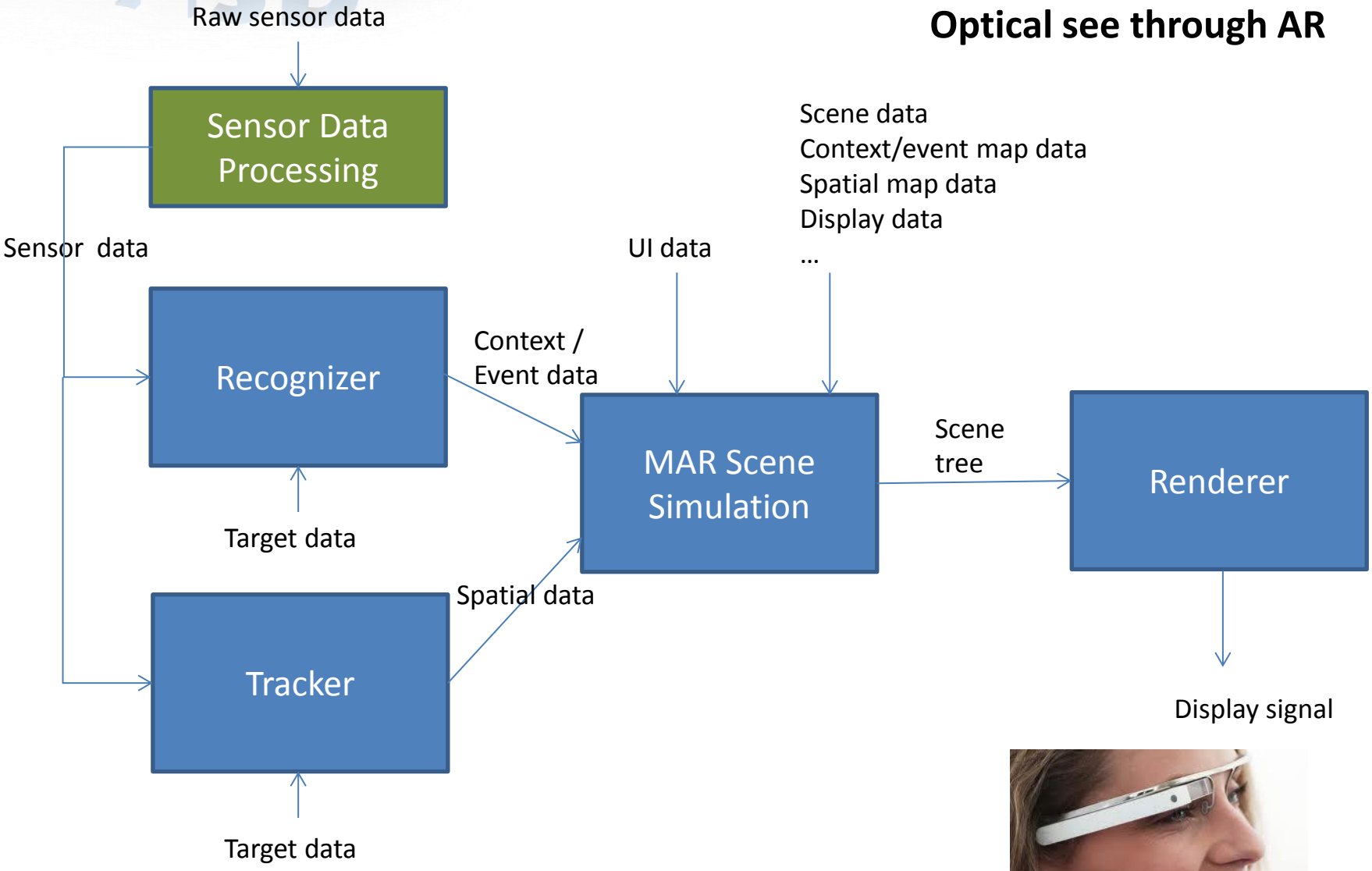
Display signal

Capture Data Processing

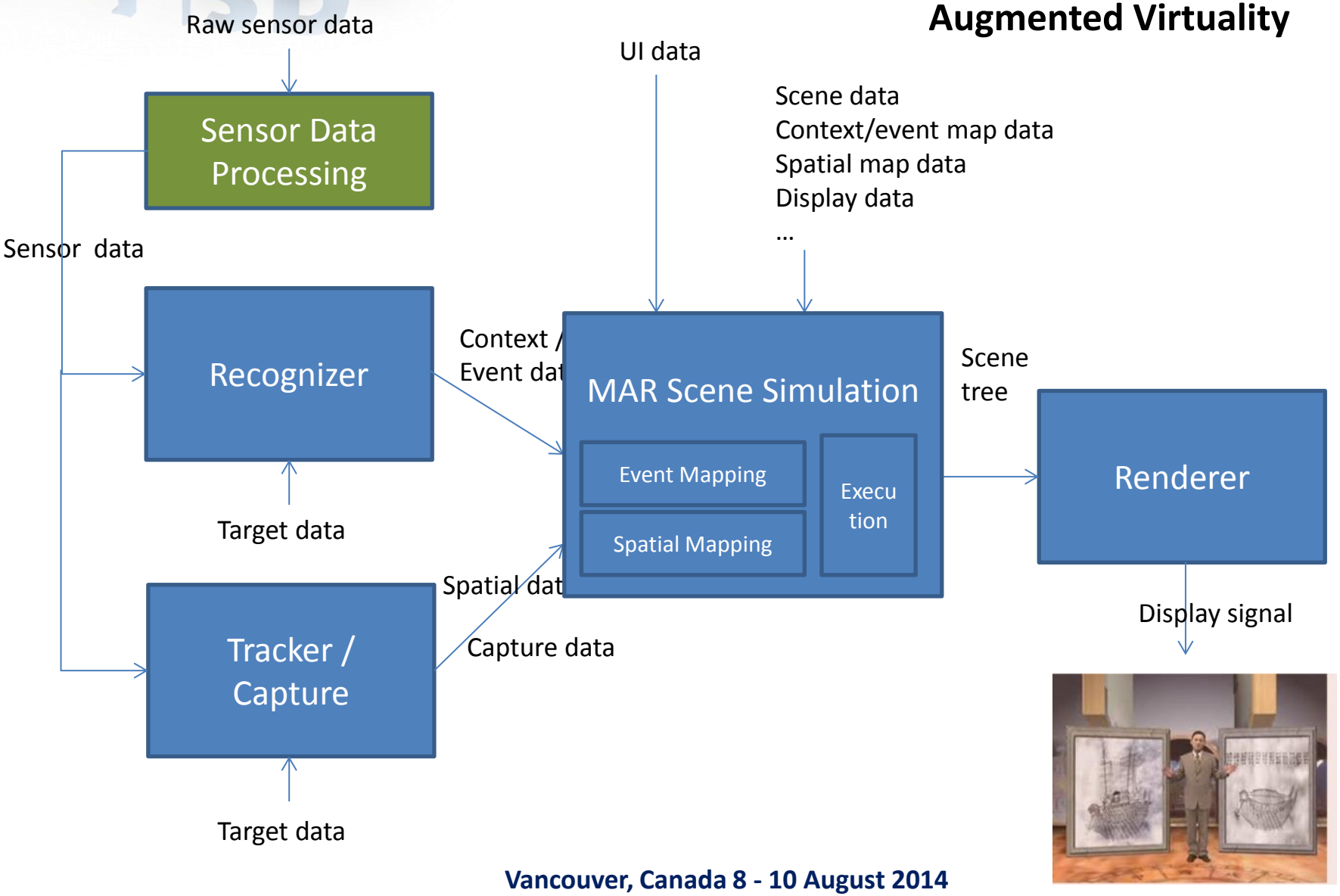
Raw capture data

GPS (Location based) AR

Optical see through AR



Augmented Virtuality



Get involved in MAR Reference Model

1. Stakeholders and participants
   - MAR Reference Model is intended to become an ISO standard
   - Animated by SC24/WG9 and SC29/WG11
   - Contributions from Web3D, ARS, OGC
   - Open to all interested in developing an open and free standard
2. ISO Intellectual property rights policy
   - MAR Reference model will be published by ISO under the royalty free policy
3. How to get involved
   - Participate to meetings of any standard organization involved (ISO, Web3D, OGC)
   - Direct contributions on http://wg11.sc29.org/trac/augmentedreality
4. Contact information
   - Marius Preda (marius.preda@it-sudparis.eu)
   - Gerry Kim (gjkim@korea.ac.kr)

Web3D Consortium

- Members from Korea, Germany, France actively working:
  - Rationalized X3D node proposal to support the MAR Reference Model
  - Ongoing design discussions on mailing list, phone calls, wiki:
    - http://www.web3d.org/wiki/index.php/X3D_and_Augmented_Reality
    - http://www.web3d.org/wiki/index.php?title=AR_Proposal_Public_Review

What is Extensible 3D (X3D)?

X3D is a royalty-free open-standard file format

- Communicate animated 3D scenes using XML
- Run-time architecture for consistent user interaction
- ISO-ratified standard for storage, retrieval and playback of real-time graphics content
- Enables real-time communication of 3D data across applications: archival publishing format for Web
- Rich set of componentized features for engineering and scientific visualization, CAD and architecture, medical visualization, training and simulation, multimedia, entertainment, education, and more

X3D AR

- **X3D version 3.4 and 4.0 will support the MAR Reference model (4.0 = HTML5/DOM/X3DOM)**
  - Much work is complete already
- **X3D AR working group cochairs:**
  - ar_chairs@web3d.org
  - Gun Lee, University of New Zealand
  - Timo Engelke, Fraunhofer

- **X3D working group cochair:**
  - Don Brutzman, Naval Postgraduate School
  - brutzman@nps.edu cell +1.831.402.4809

Appendix:
Usage cases

Local *vs* Remote

Modeling of 6 state of the art AR use cases:

1. Real-time, local detection, no registration
2. Real-time, local detection, local registration

3. Real-time, remote detection, no registration
4. Real-time, remote detection, remote registration

5. Real-time, remote detection, local registration

6. Real-time, remote detection, registration and augmentation, local presentation

MAR Reference Model

Points of Interests

Modeling of 2 AR use cases using Point of Interests:

1. Content embedded POIs
2. Server available POIs

MAR Reference Model

2D *vs* 3D video

Modeling of 4 AR use cases using 3D video:

1. Real-time, local depth estimation, condition based augmentation
2. Real-time, local depth estimation, model based augmentation

3. Real-time, remote depth estimation, condition based augmentation
4. Real-time, remote depth estimation, model based augmentation

MAR Reference Model

Stereo *vs* 3D audio

Modeling of 2 AR use cases using 3D audio:

1. Real-time, spatial audio based in intensity
2. Real-time, 3D audio based HRTF (Head-related Transfer Function)

MAR Reference Model

Use cases

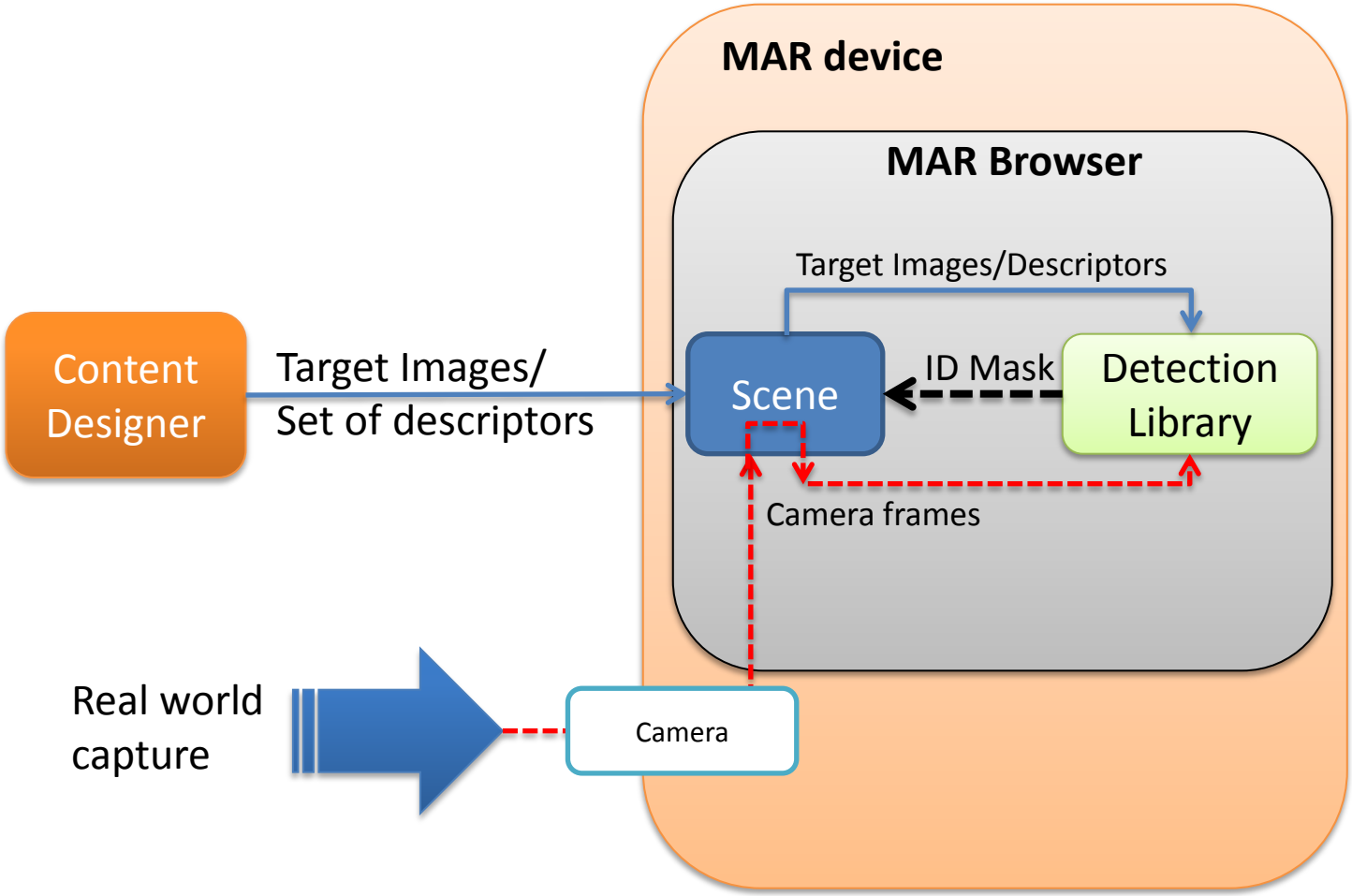
Local vs Remote
Point of Interests
3D video
3D audio

MAR Reference Model

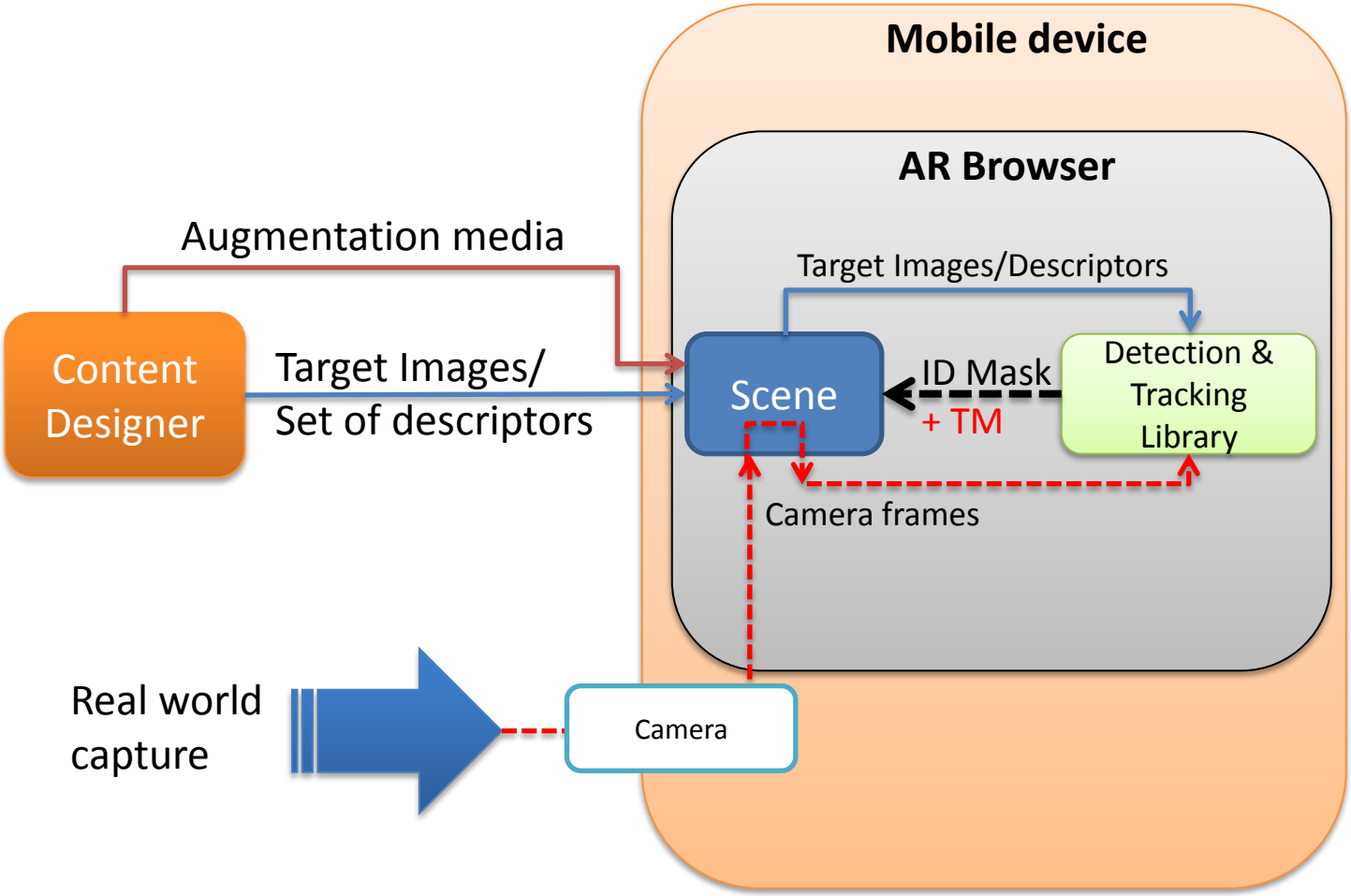
Use cases

Local vs Remote
Point of Interests
3D video
3D audio

1. Real-time, local detection, no registration

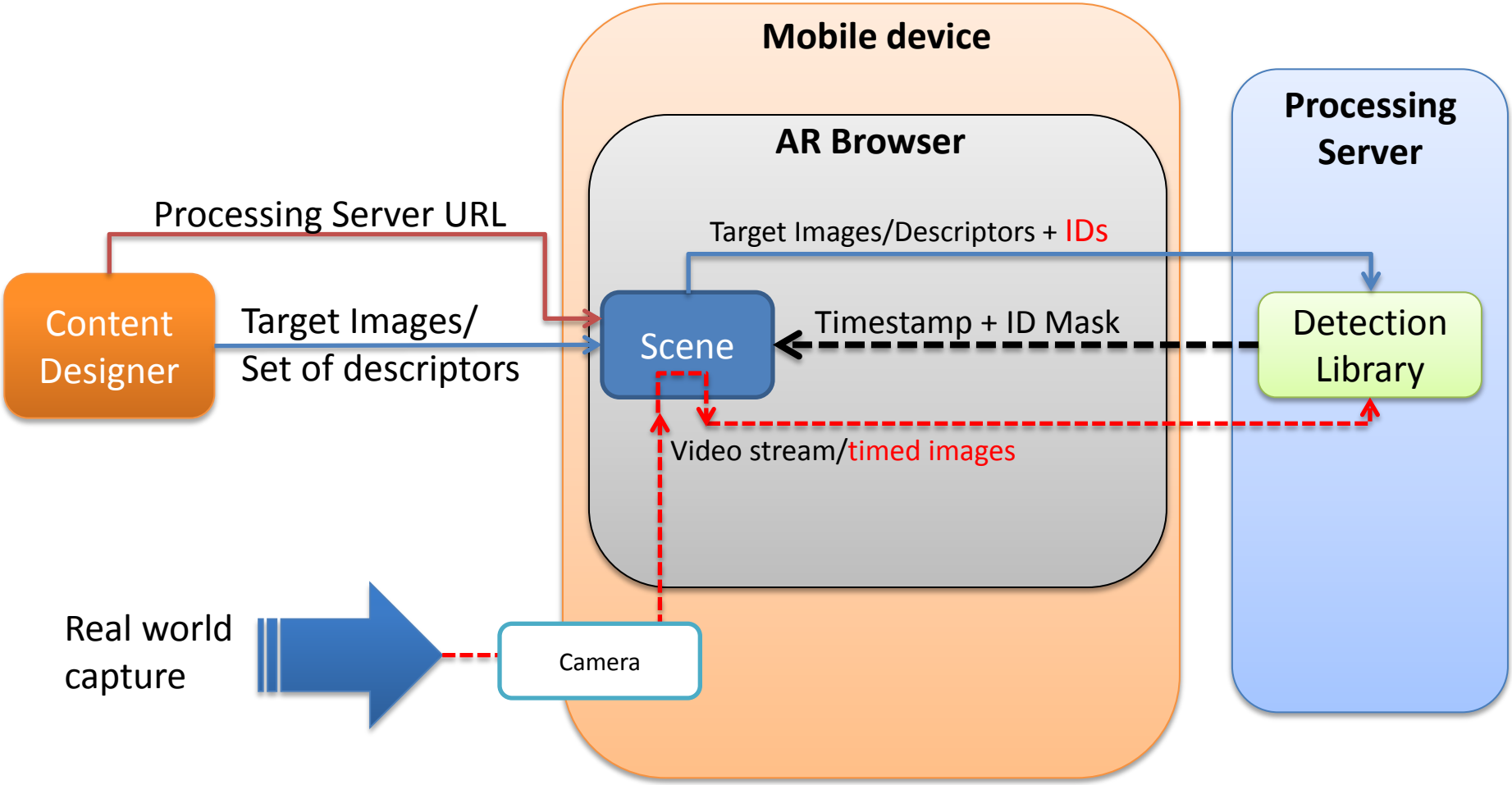


2. Real-time, local detection, local registration

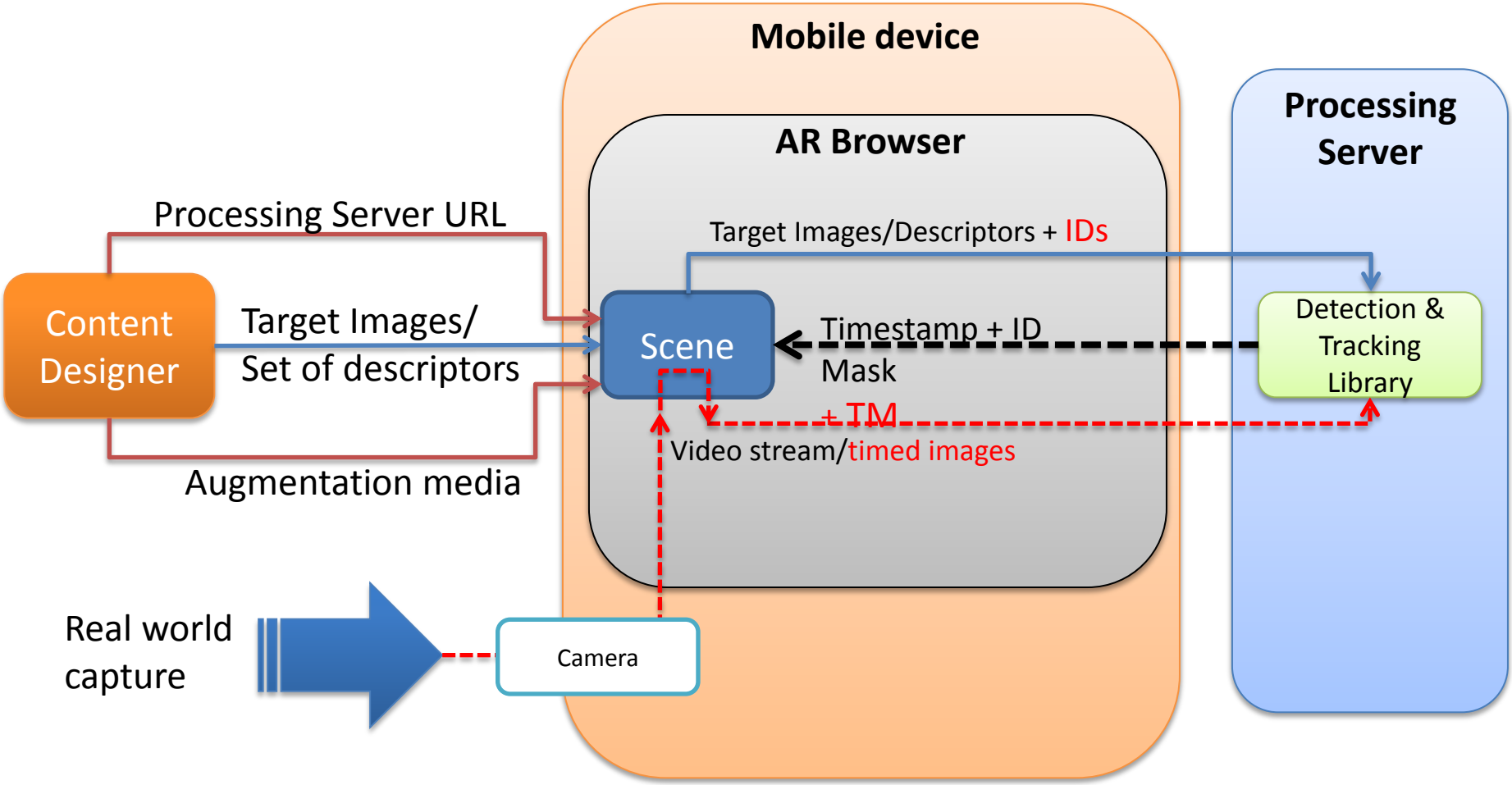


TM = Transformation Matrix

3. Real-time, remote detection, no registration

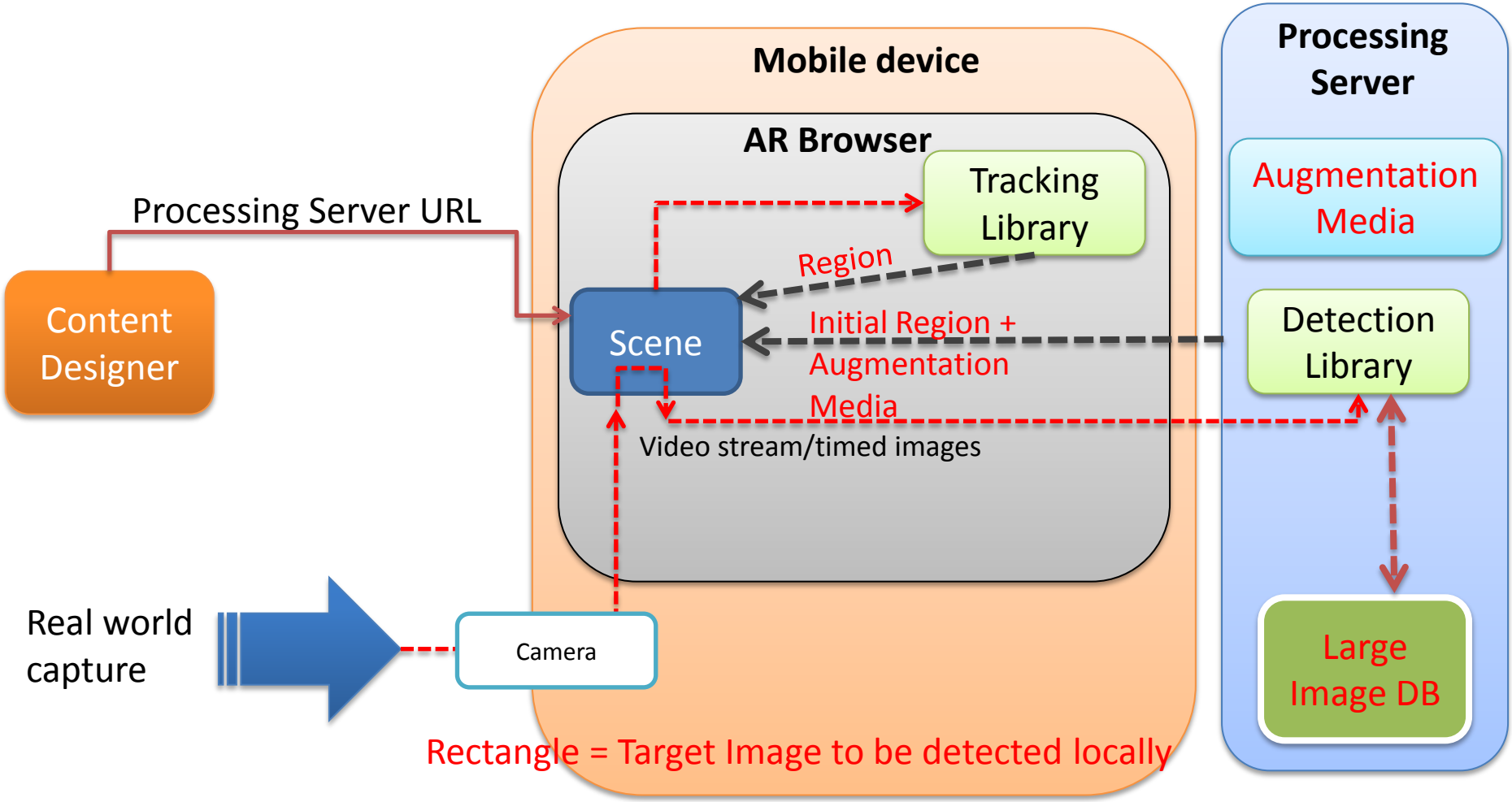


4. Real-time, remote detection, remote registration

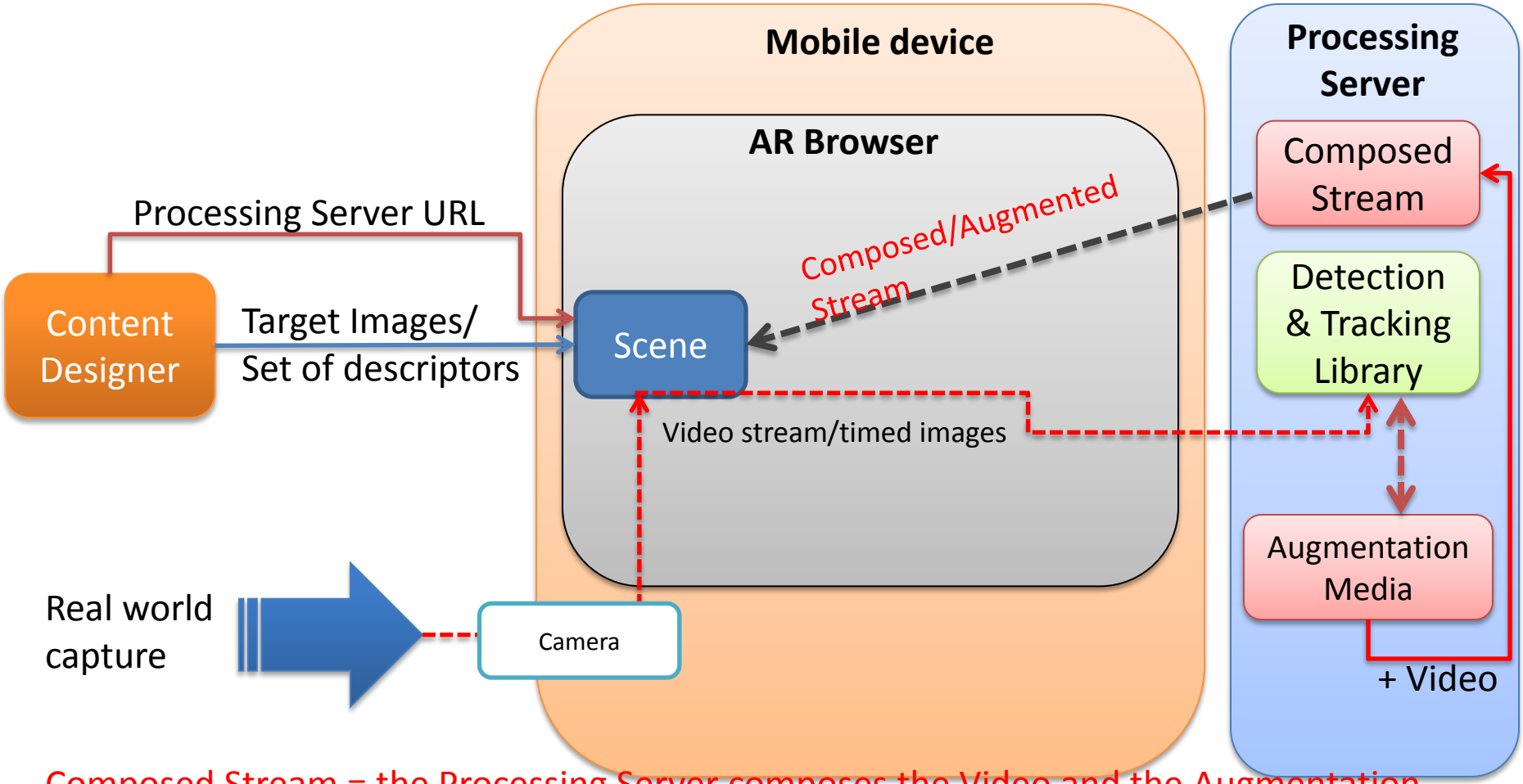


TM = Transformation Matrix

5. Real-time, remote detection, local registration



6. Real-time, remote registration and detection, local presentation

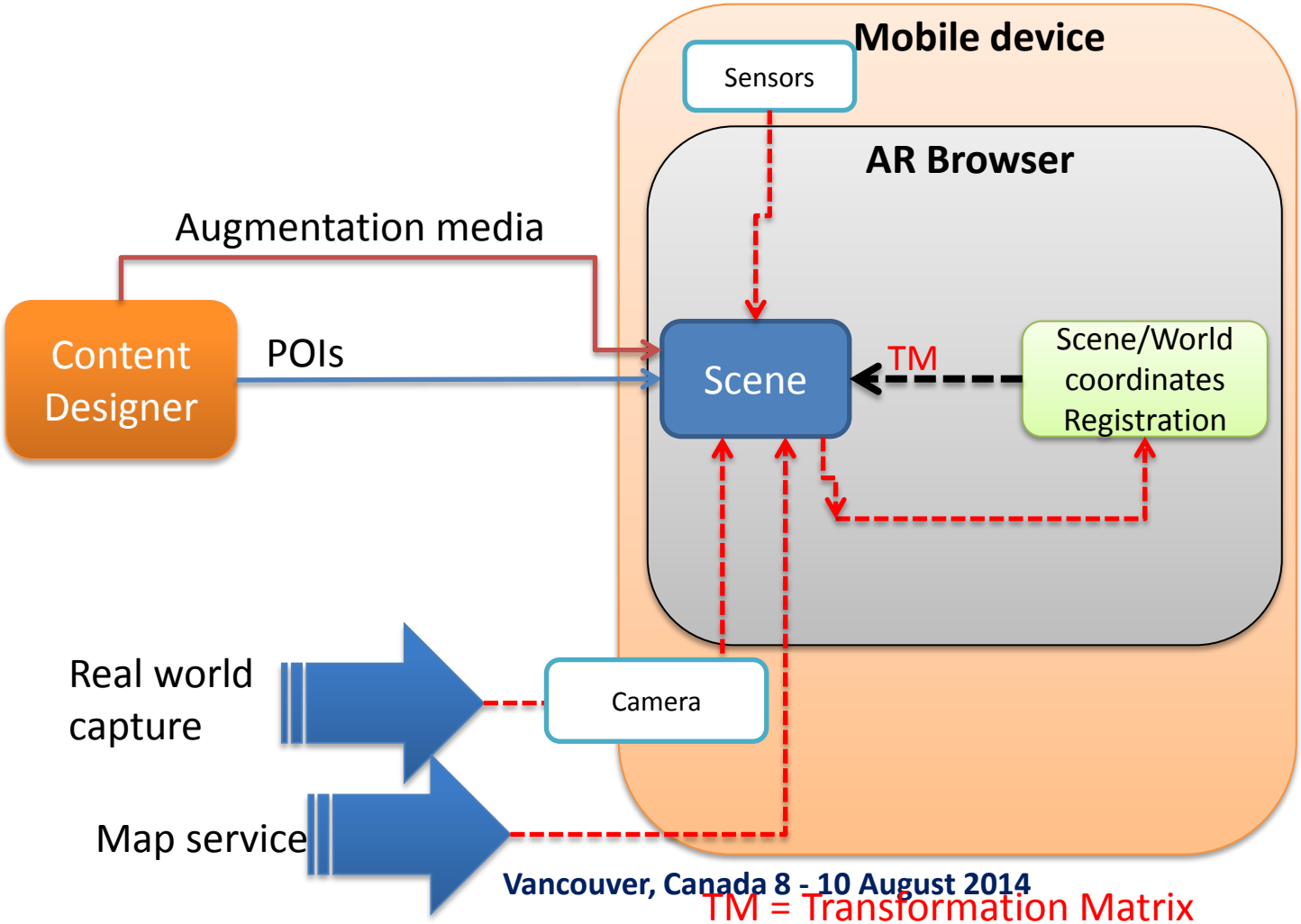


Composed Stream = the Processing Server composes the Video and the Augmentation Media and sends back the Augmented Stream

Use cases

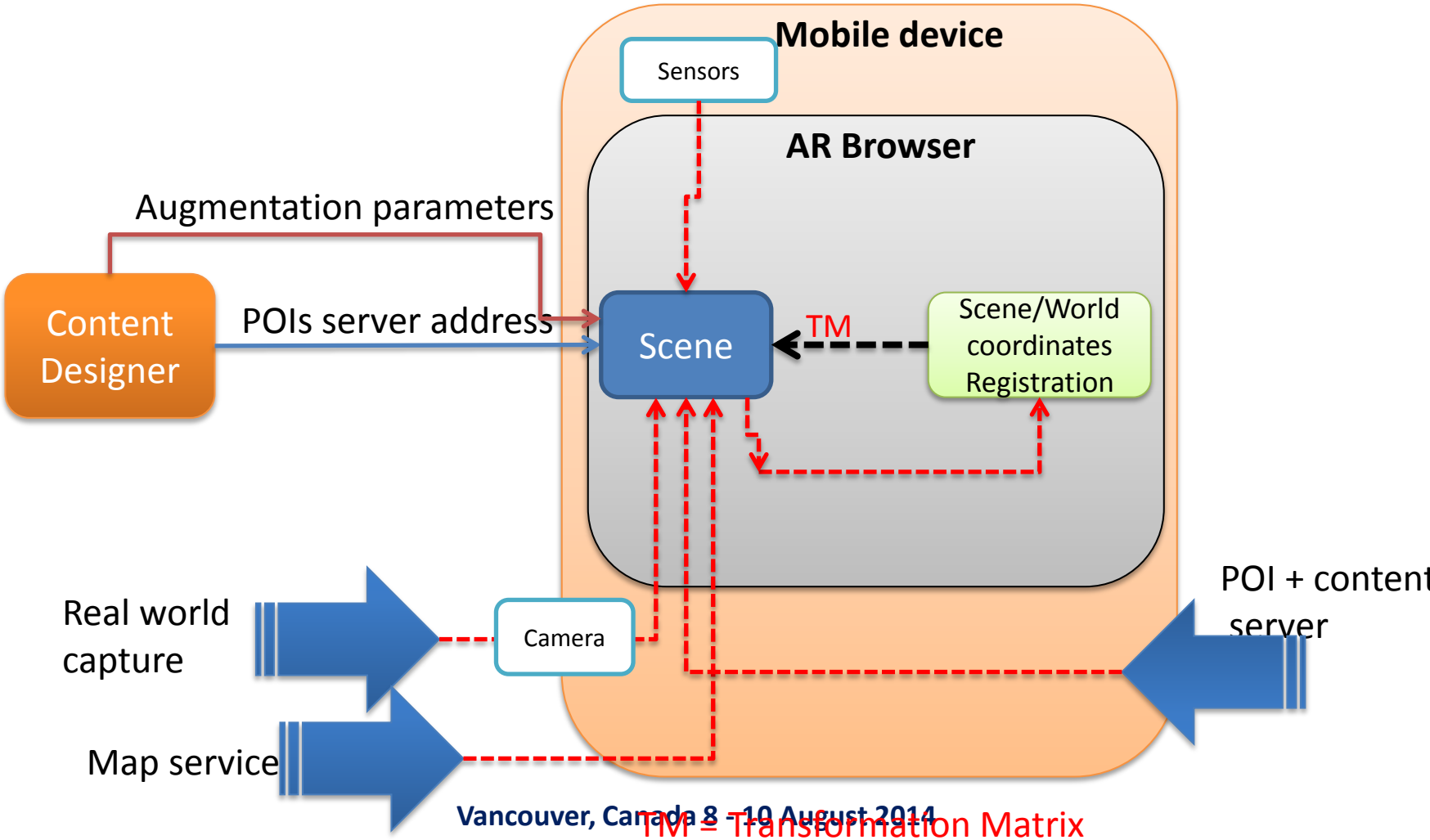
Local vs Remote
Point of Interests
3D video
3D audio

1. Content embedded POIs



TM = Transformation Matrix

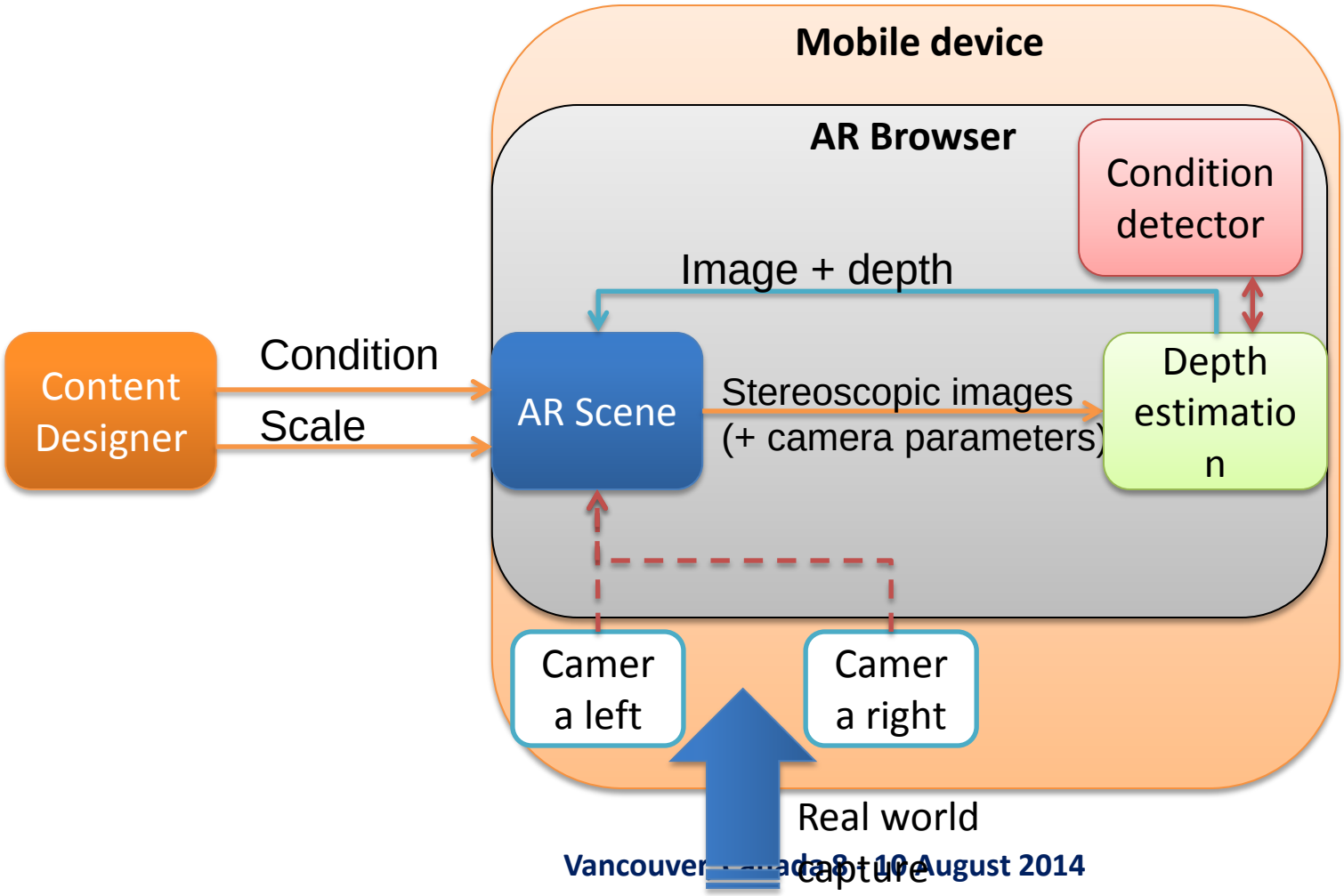
2. Server available POIs



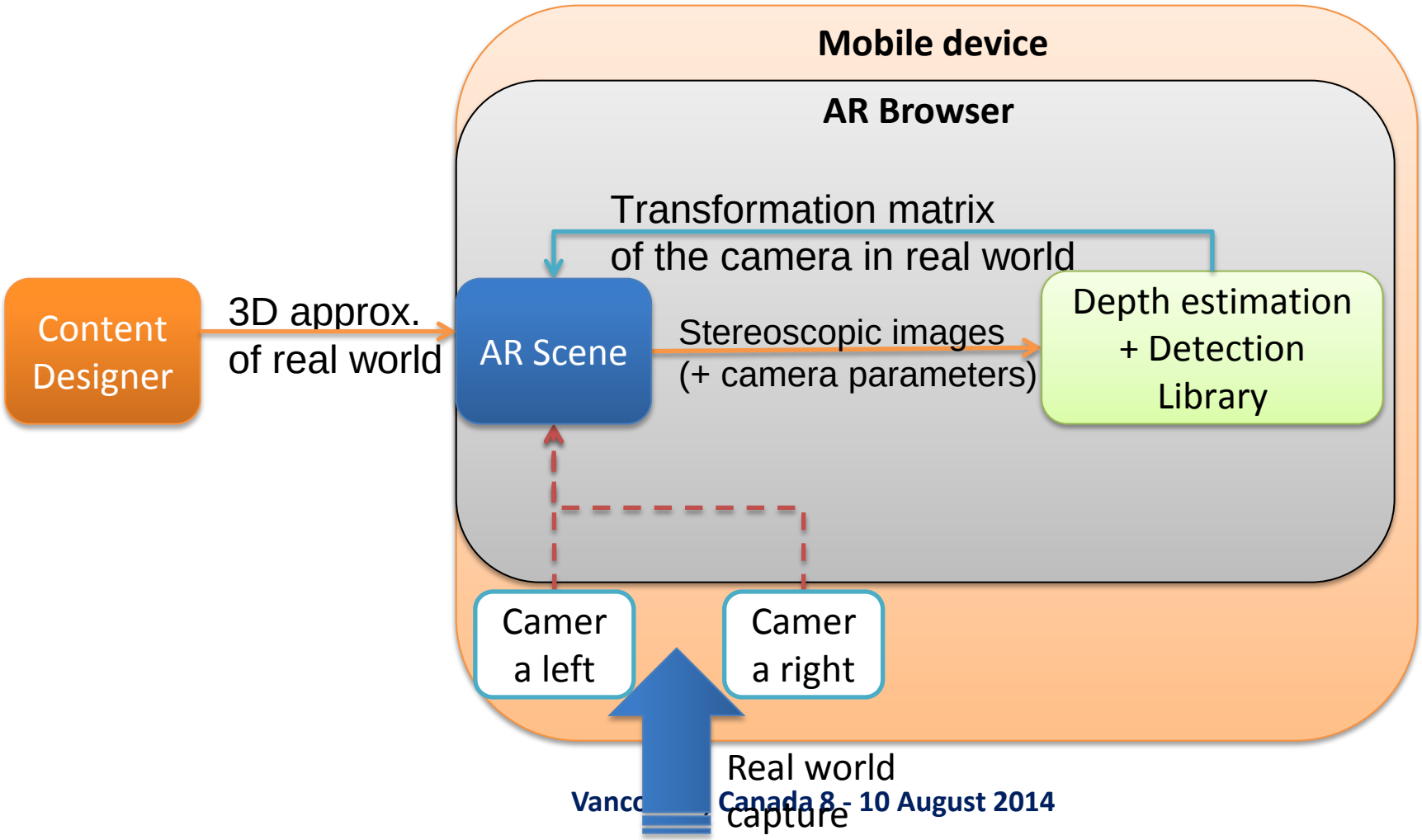
Use cases

Local vs Remote
Point of Interests
3D video
3D audio

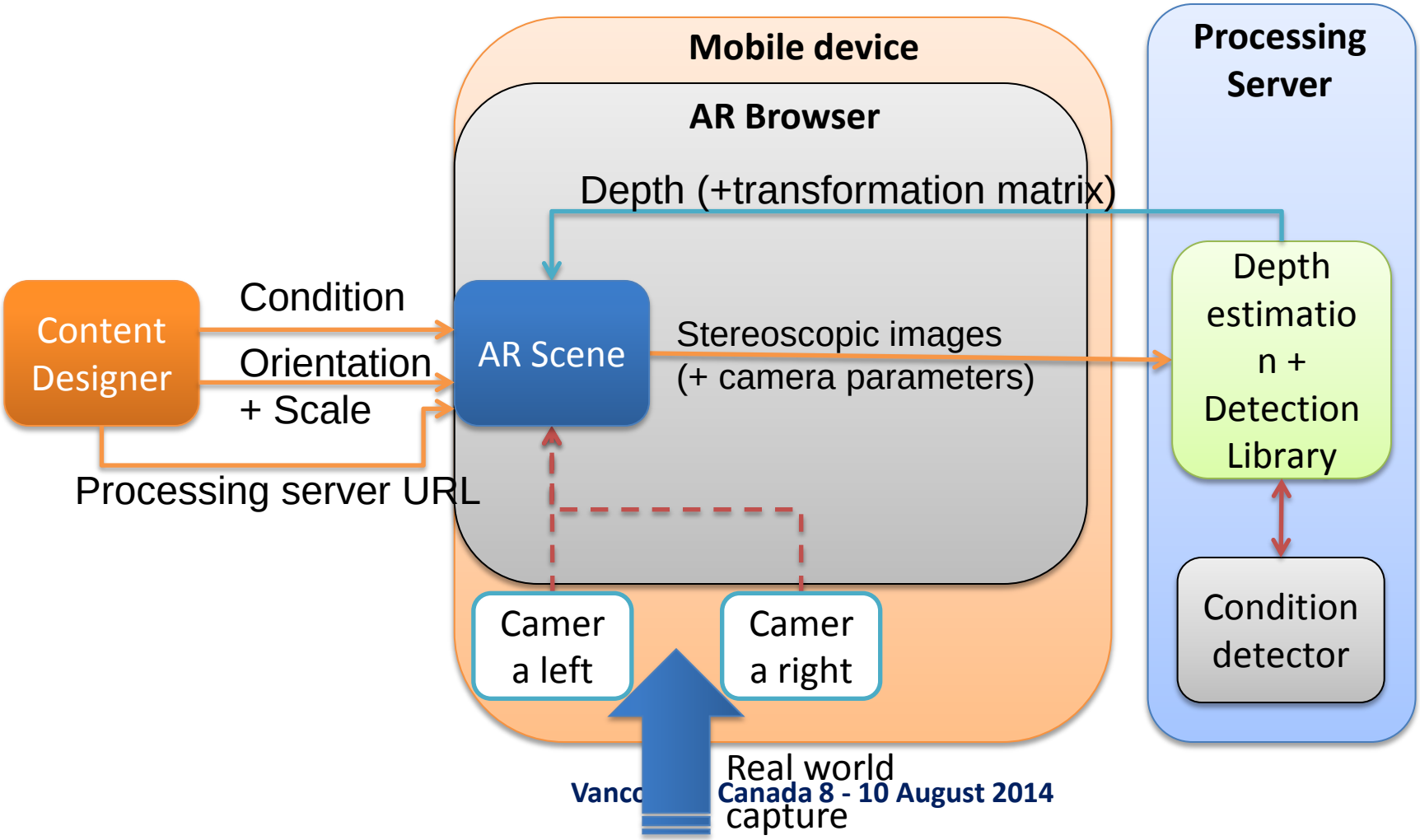
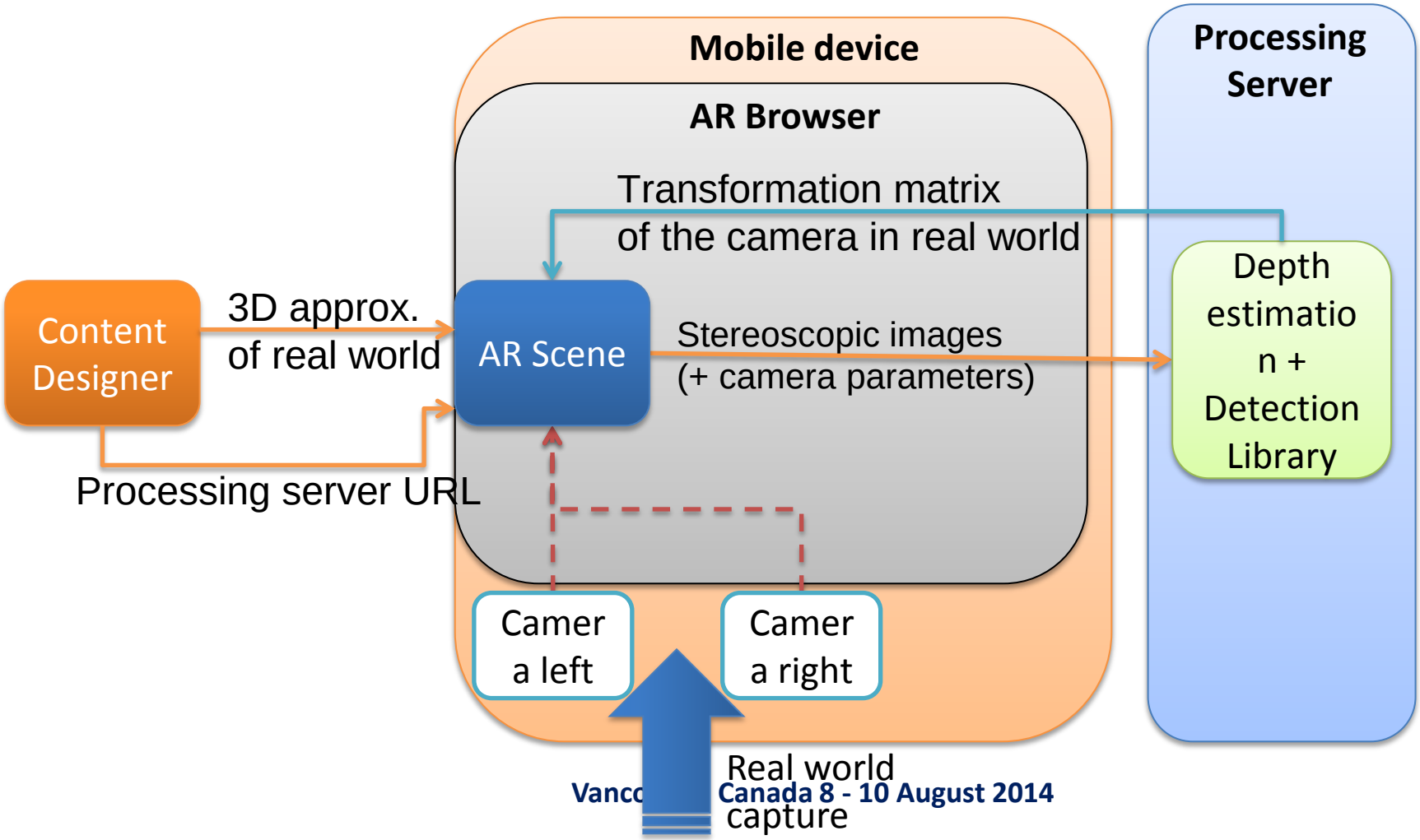
1. Real-time, local depth estimation, condition based augmentation



2. Real-time, local depth estimation, model based augmentation



3. Real-time, remote depth estimation, condition based augmentation



4. Real-time, remote depth estimation, model based augmentation