Setting up CLUE telepresence sessions via the WebRTC data channel

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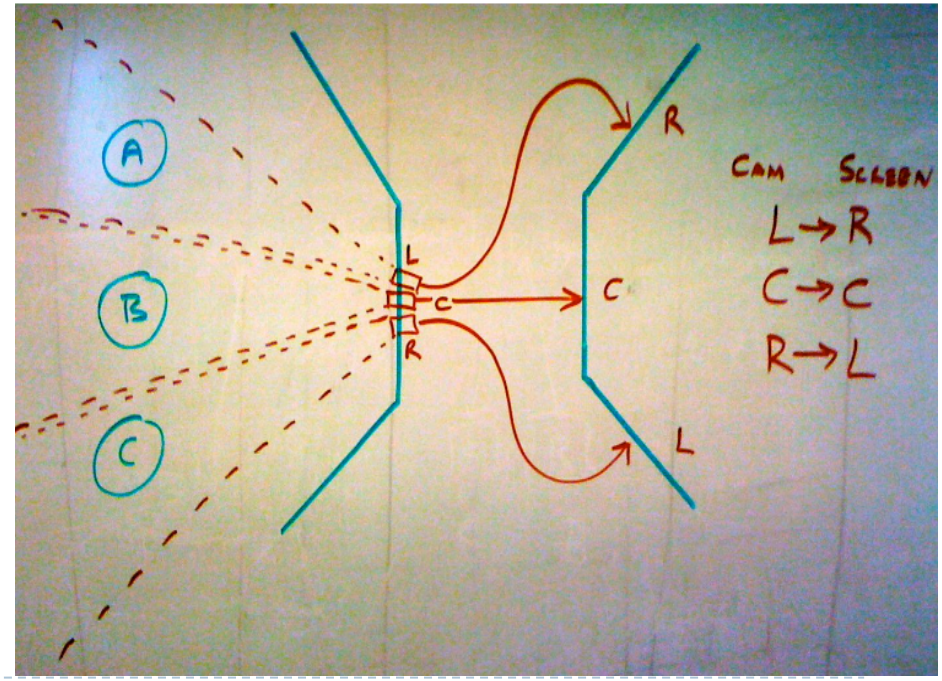
Roberta Presta & **Simon Pietro Romano**
{roberta.presta,spromano}@unina.it

Telepresence

- Real-time multimedia application over the Internet
- Provides remote users with a "being-there" experience
- Leverages special, fully-equipped rooms
  - Multiple displays, loudspeakers, cameras, mics, …
- Application domains
  - Business
  - Education
  - Games
  - Telemedicine
  - Multi-modal communications
  - …

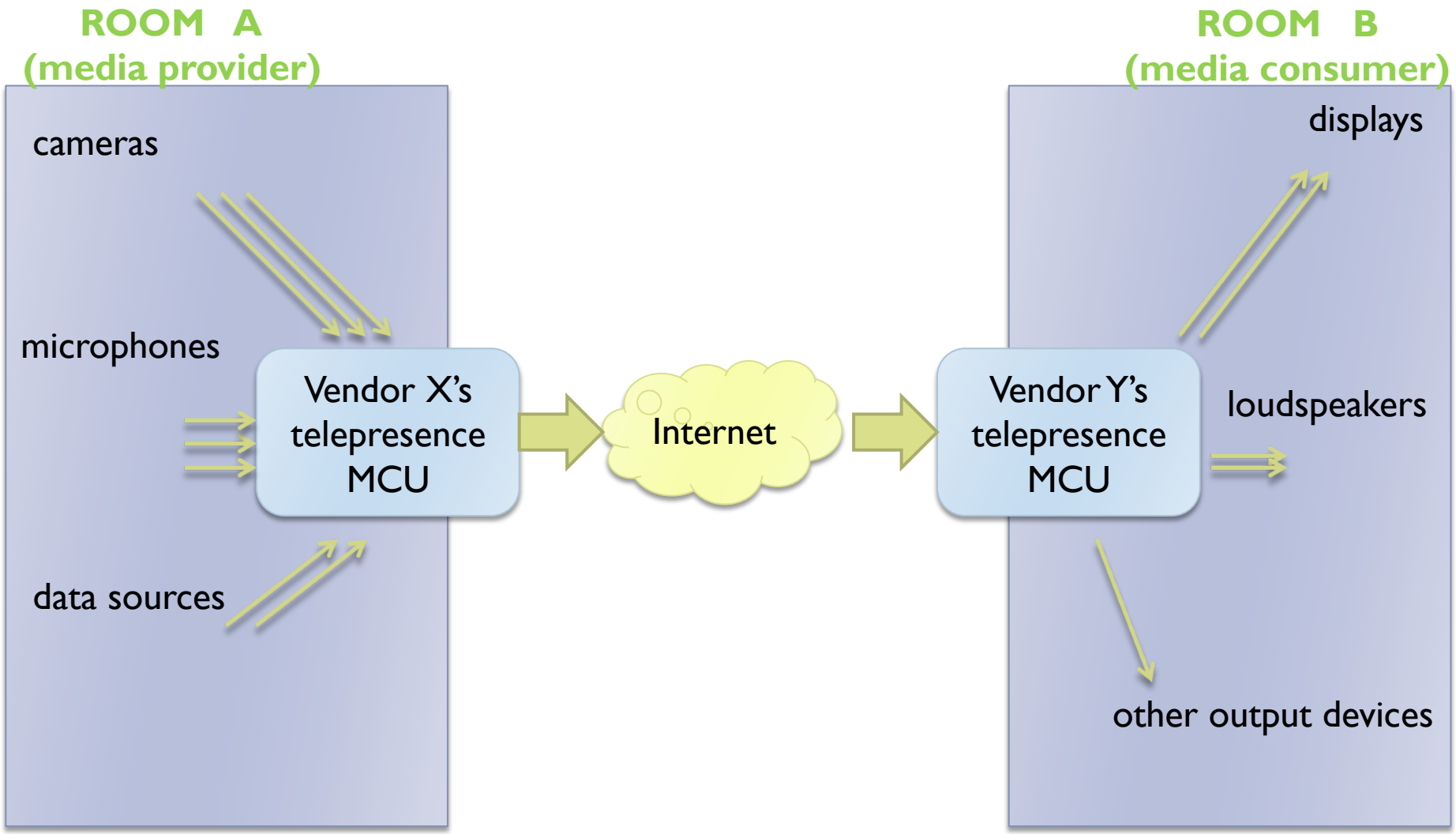
Main issues

- Describing, transmitting and rendering real-time multimedia streams
- Many more streams than basic video-conferencing
- Media captures spatial arrangements
- Interoperability problems

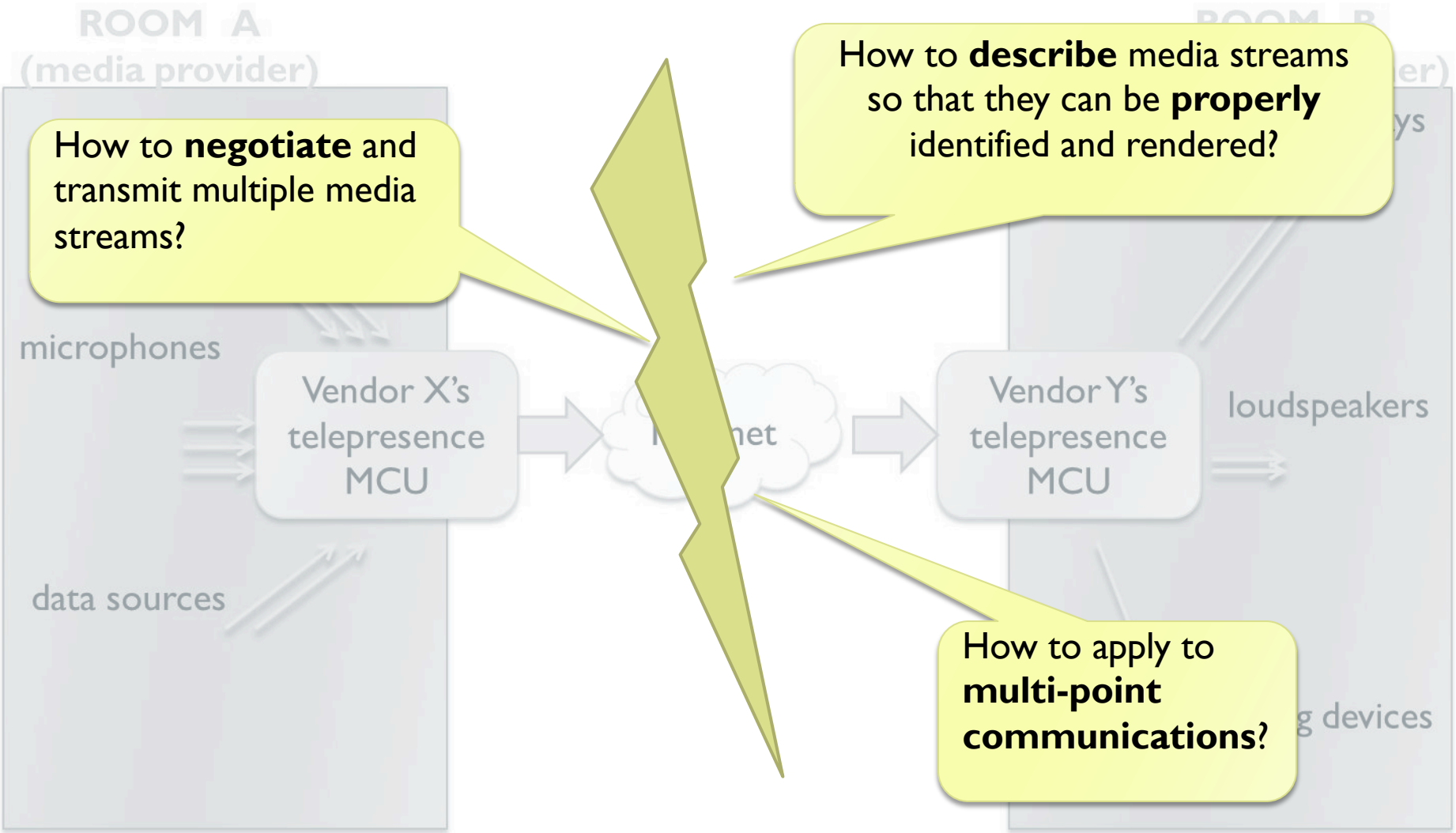


… and others

A (very) simplified view



Managing interoperability



Alternatives

1. Operator assistance / additional equipment translating from one vendor to another

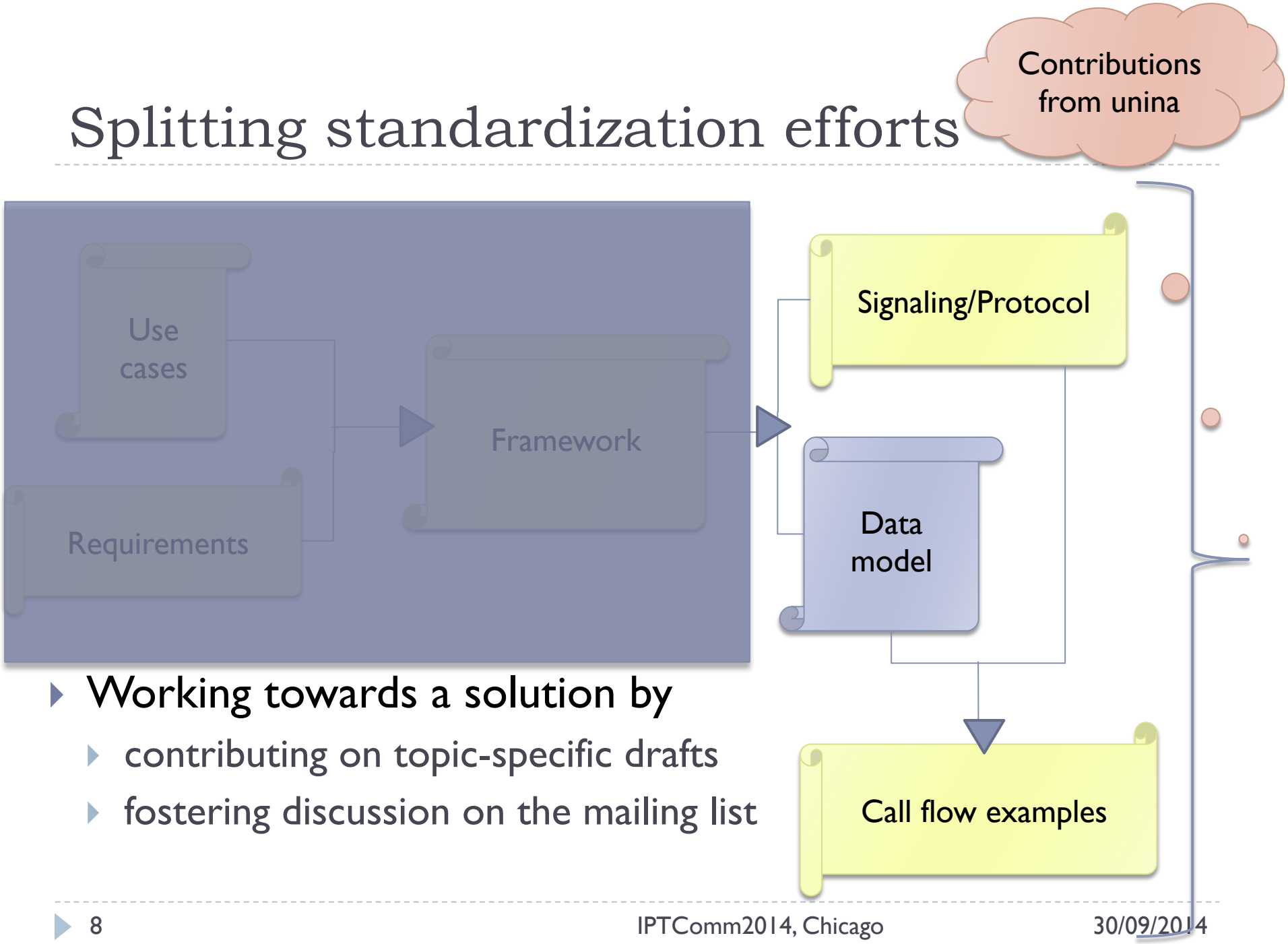
2. Leveraging existing standard architectures and protocols
   - Most existing telepresence systems rely on them…
     - SIP – Session Initiation Protocol
     - SDP – Session Description Protocol
     - RTP – Real-time Transport Protocol
     - SIP Conferencing Framework
   - …BUT:
     - Lack of an effective way of describing media streams
     - RTP multiplexing issues

3. Developing a new standard telepresence framework
   - ➔ IETF CLUE Working Group

CLUE

- ControLling mUltiple streams for tElepresence
- IETF RAI area WG
  - Real-time Applications and Infrastructure
  - 2010
- Active participation from the University of Naples
- Mission
  - New specifications for RTP- and SIP-based conferencing system overcoming existing limitations
  - Definition of communication mechanism aimed to set multi-stream telepresence sessions among sending systems, receving systems, and intermediate systems

Splitting standardization efforts



- Working towards a solution by
  - contributing on topic-specific drafts
  - fostering discussion on the mailing list

CLUE framework and protocol

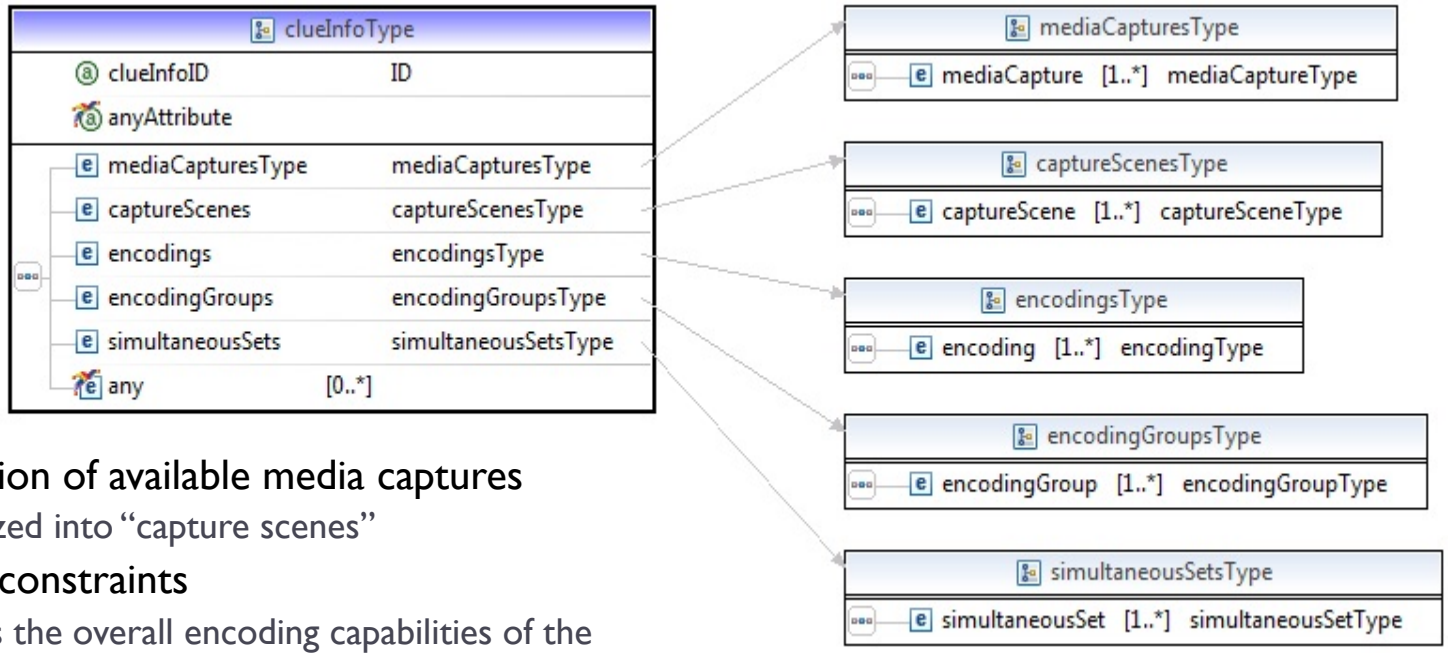
- Architecture
  - Main components
    - Media Provider (MP), Media Consumer (MC), and MCU
  - Managed information
    - Refers to the data model draft for further details
  - Media stream negotiation protocol
    - Refers to the signaling and protocol drafts for further details
- CLUE protocol
    - ADVERTISEMENT message
      - Used by MP to advertise the available media streams to MC(s)
    - CONFIGURE message
      - Used by MC to select the desired media streams advertised by the MP
  - Exploits information defined in the data model draft

CLUE data model

- Formal description of information managed within the application domain
  - Media streams description
- Helps identify problems and weaknesses in the framework concepts and stemming from their natural language definitions
- Basic principles
  - Flexibility
  - Extensibility
- XML Schema as modeling language
  - Well-known XML-based modeling language
  - Adopted for companion data model definitions developed in the RAI area

Data model overview

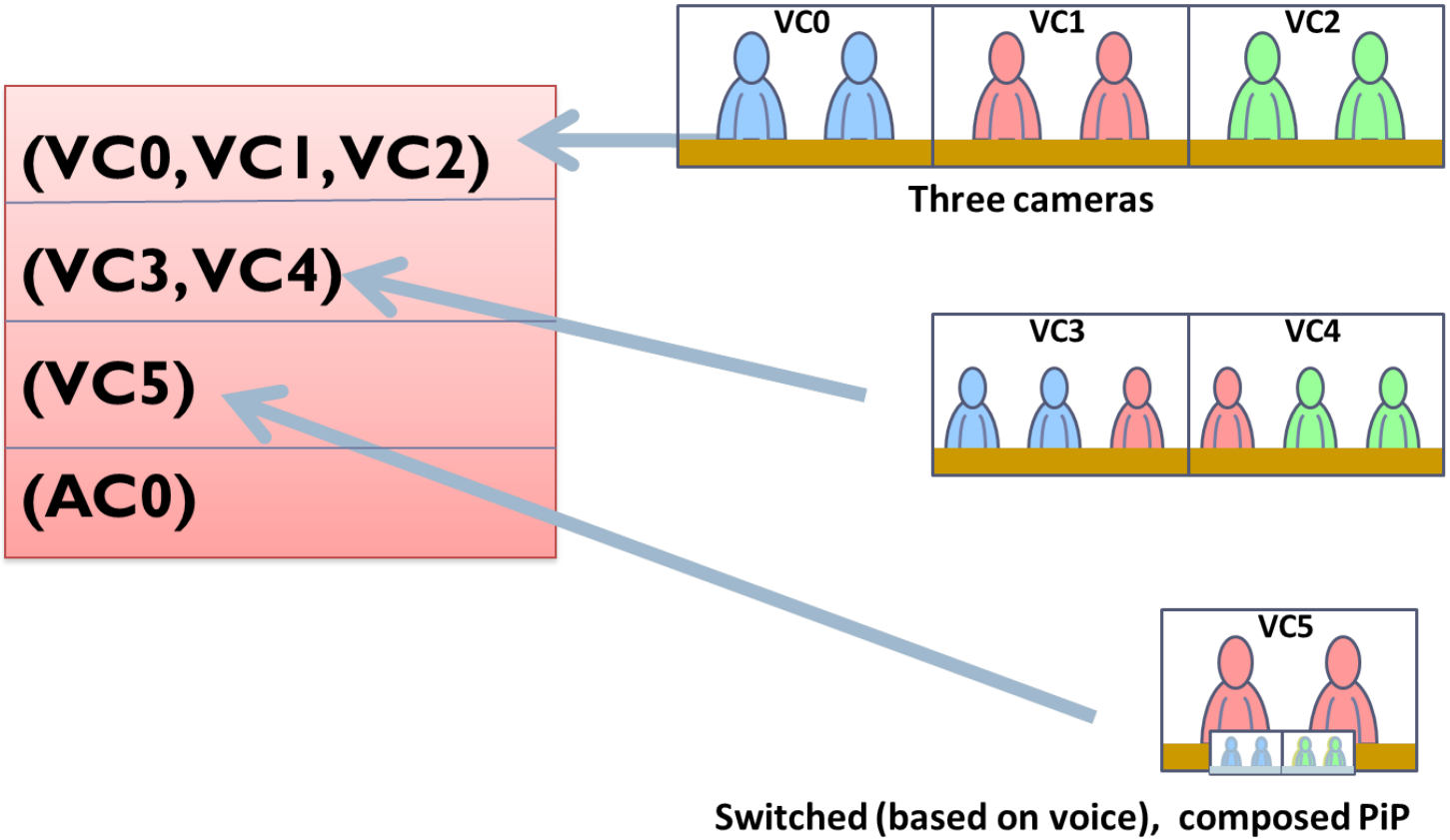
- Information needed to describe the CLUE capabilities of a telepresence room



- Enumeration of available media captures
  - Organized into "capture scenes"
- Encoding constraints
  - Express the overall encoding capabilities of the media provider
- Physical constraints ("simultaneous sets")
  - e.g., center camera may also be used for "zoomed out" view

Capture scenes

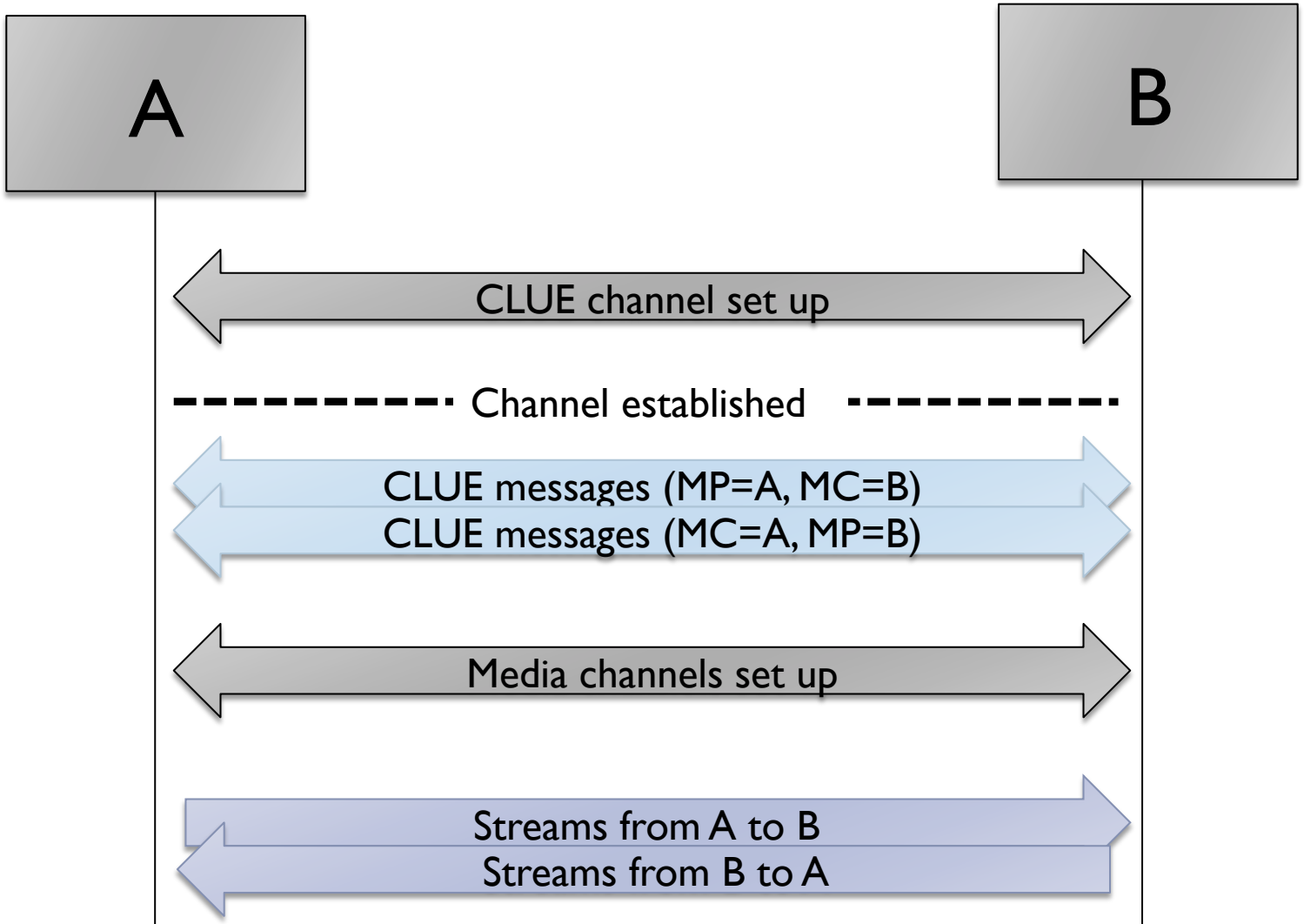
- Made of entries (scene alternatives) grouping media captures



CLUE protocol overview

- Needed to set up media streams in a CLUE telepresence session
- CLUE protocol messages flow over the CLUE channel
  - A DTLS/SCTP channel is assumed to be already in place
- Stateful, XML-based, client-server protocol
  - Media Provider (the server)
    - Advertises capabilities, provides multimedia streams
  - Media Consumer (the client)
    - Requests/configures streams

CLUE call flow in a nutshell



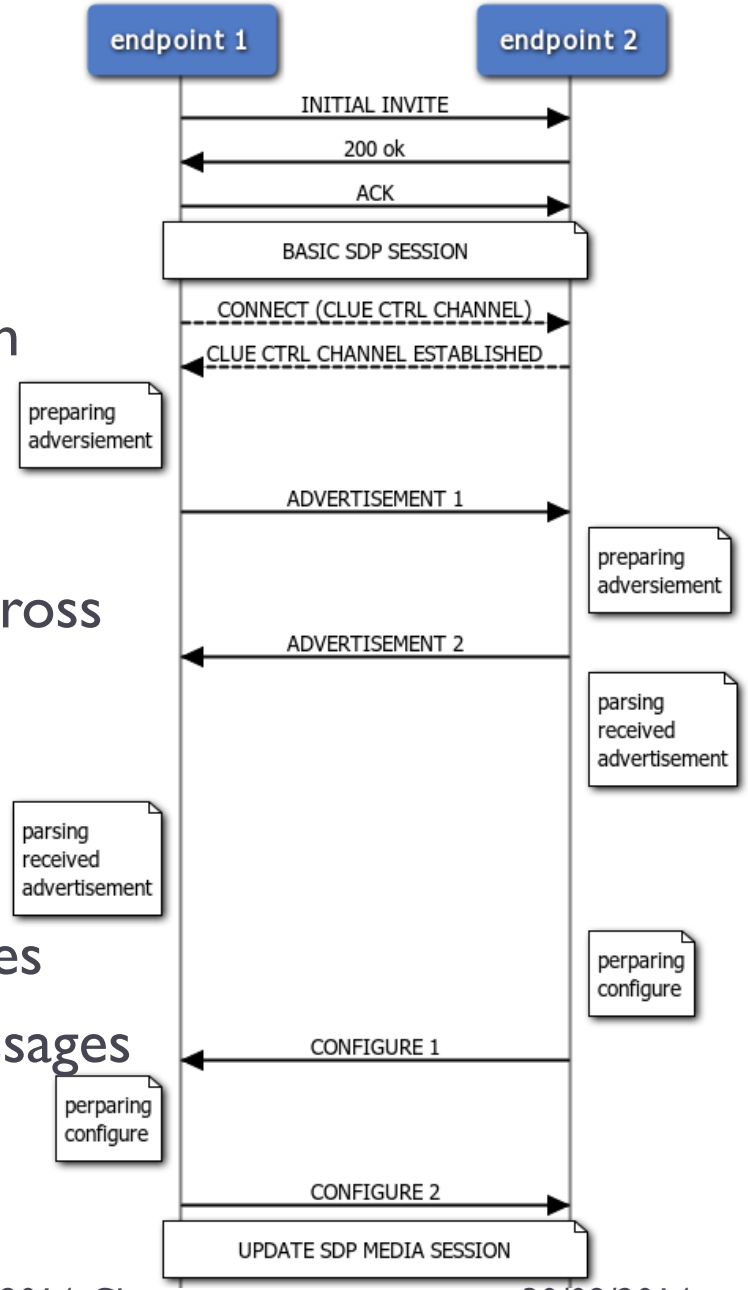
Main CLUE messages

- ADVERTISEMENT
  - Asynchronously sent by a MP to advertise its telepresence capabilities
- CONFIGURE
  - Sent from a MC to a MP to list the desired streams
- (CONFIGURE) RESPONSE
  - Sent from a MP to a MC to accept or decline (for any reason) the CONFIGURE request

Putting it all together: the 'legacy' approach

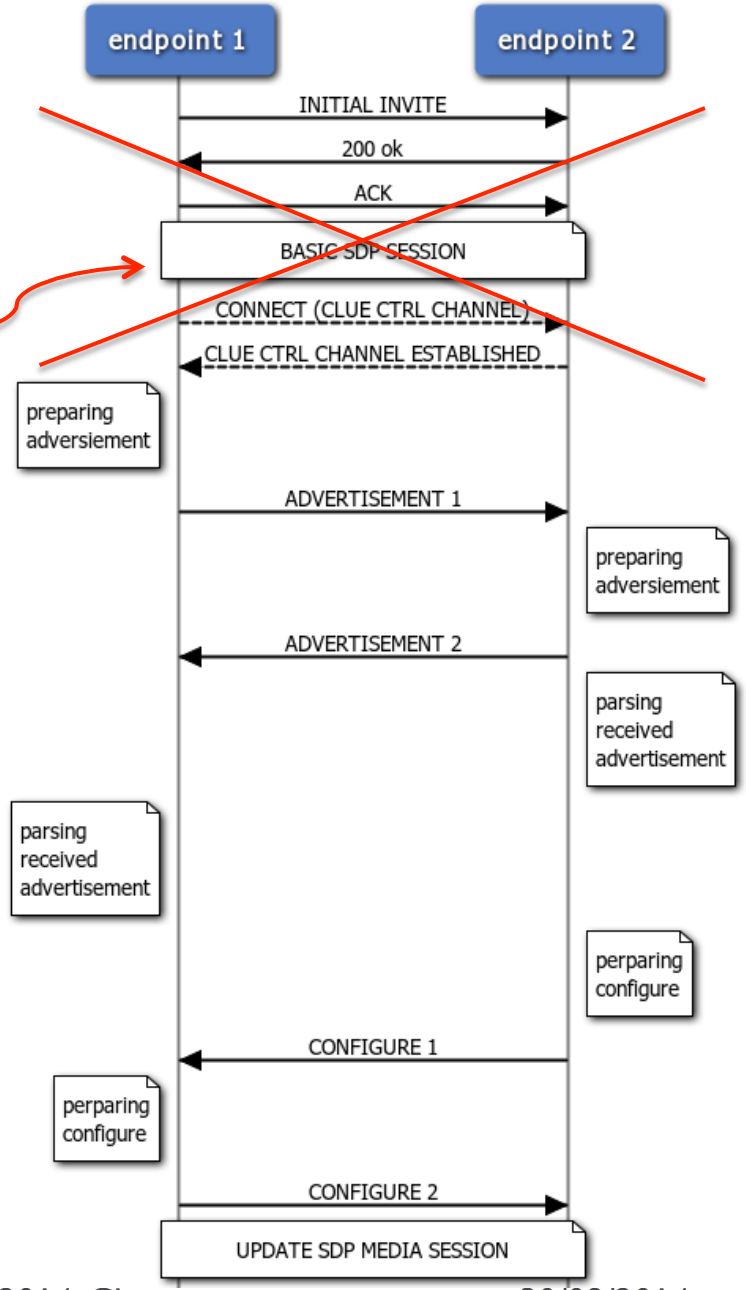
- Use SIP to establish:
  - a basic (i.e., 'plain old') media session
  - the CLUE channel
- Once done:
  - start exchanging CLUE messages across the newly created CLUE channel
- Steady state:
  - the channel is up
  - Media Producer sends ADV messages
  - Media Consumer sends CONF messages

*Note: a single endpoint typically plays both the MP and the MC role…

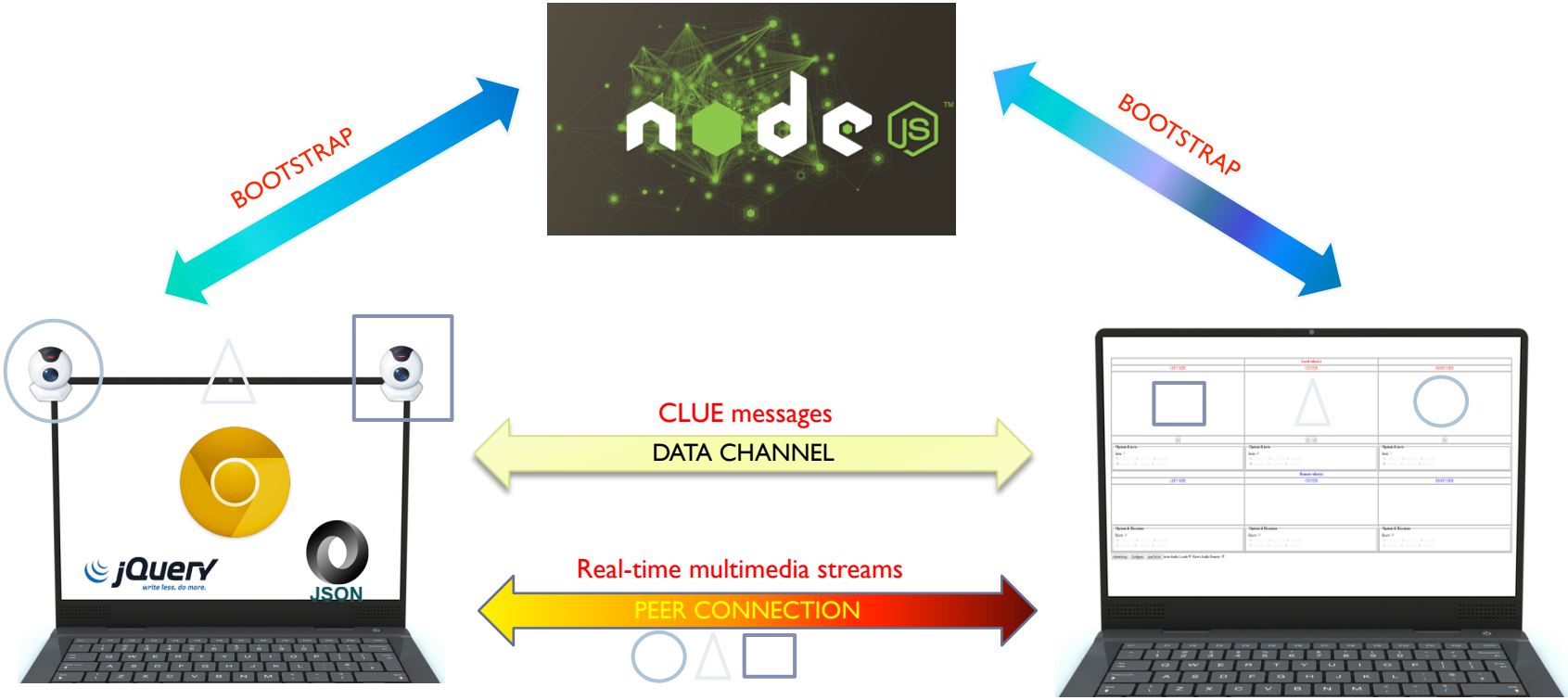


Putting it all together: doing it the WebRTC way!

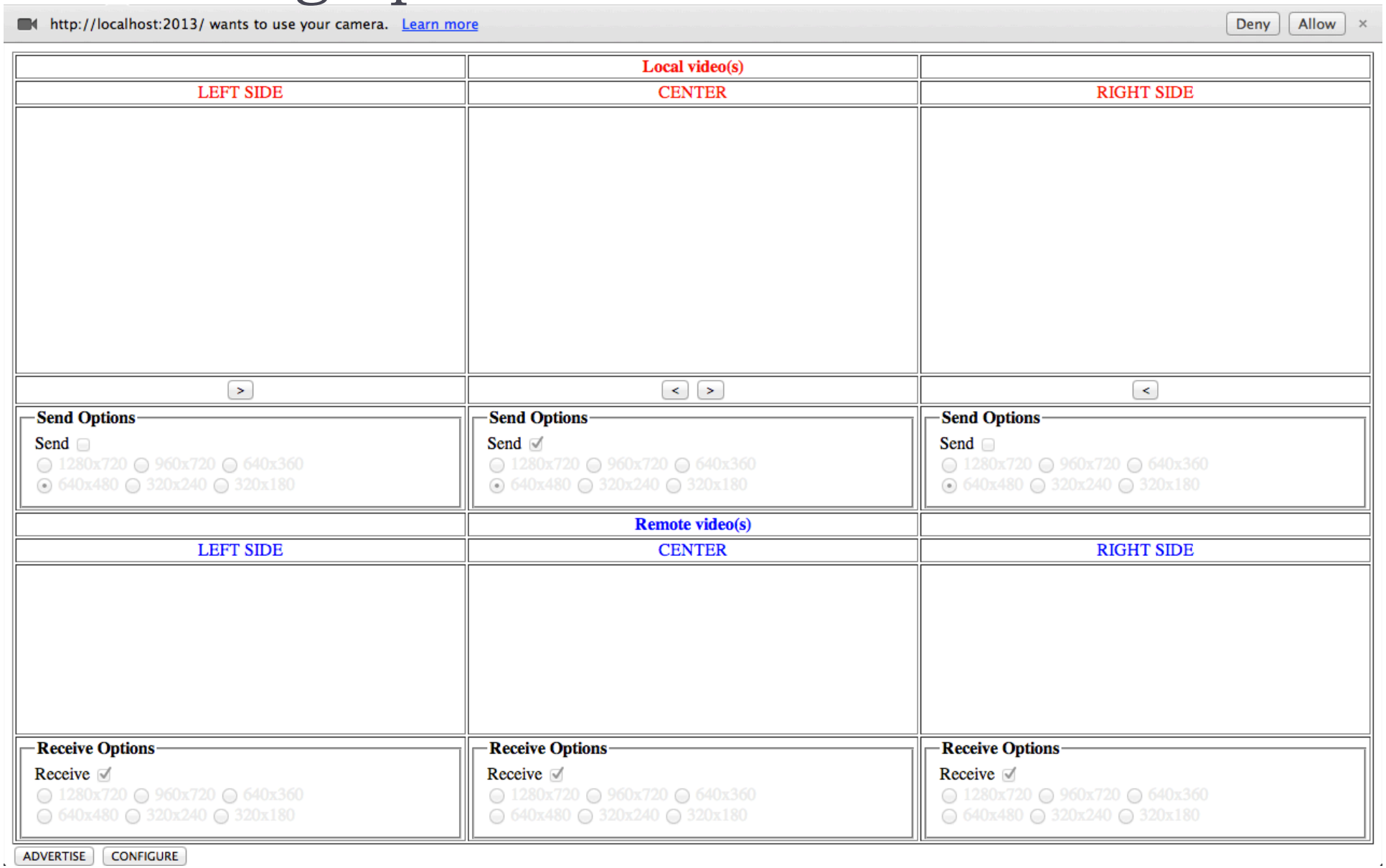
- Negotiate a WebRTC session between the two endpoints:
  - create a PeerConnection between MP and MC
  - start 'basic' media session
  - associate a data channel with the available PeerConnection
- Allow MP to advertise its capabilities (ADV message) across the data channel
- Allow MC to choose desired media features (e.g. resolution)
  - send CFG messages across the data channel
- Upon reception of a CFG message, the MP:
  - I) either gets new user's media…
  - …or applies new constraints to available media;
  - II) either creates new Peer Conncections…
  - …or adds new/modiifed streams to the already available PC (bundling!);
  - III) starts sending consumer-configured streams to the other endpoint



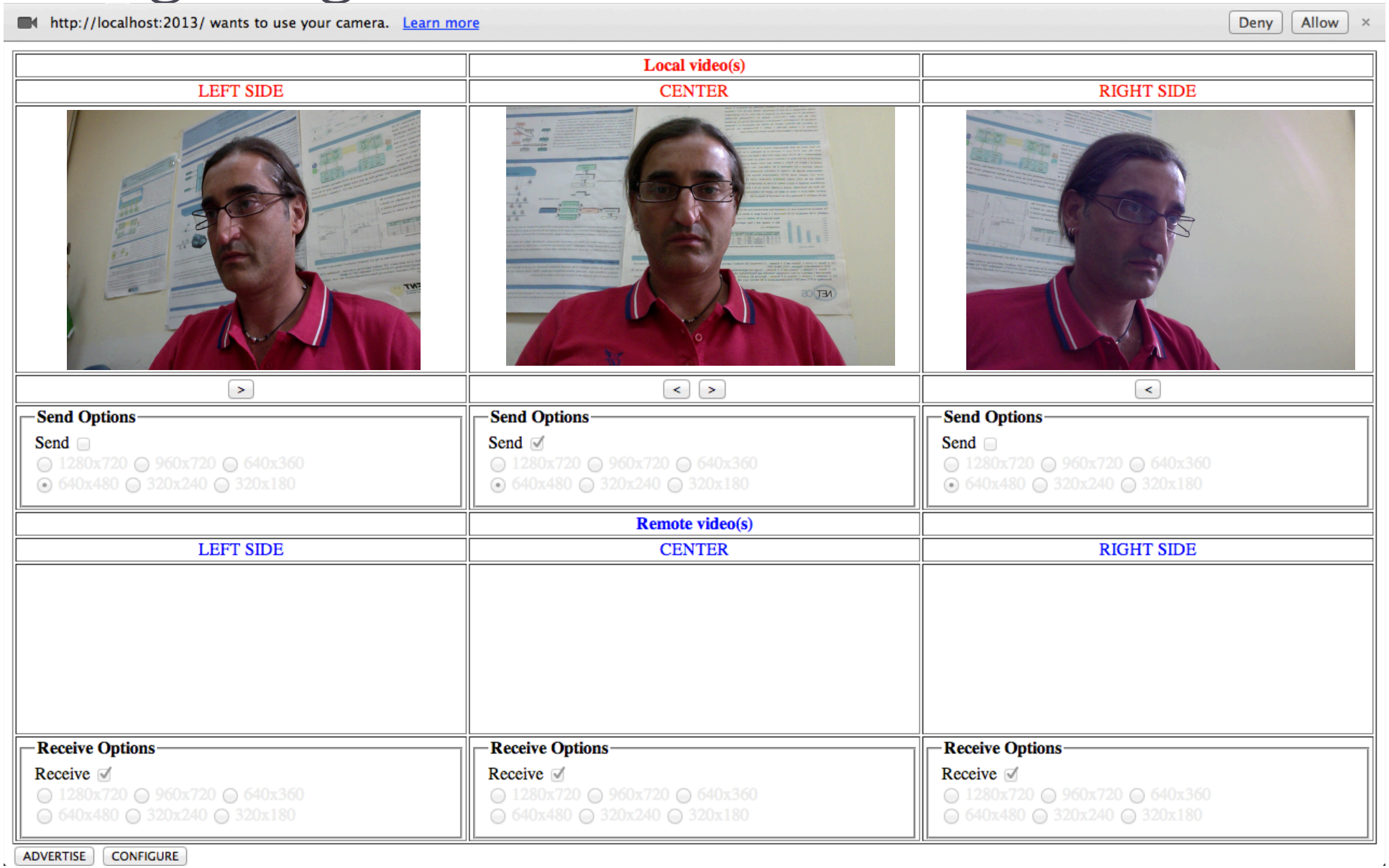
Clue over WebRTC prototype



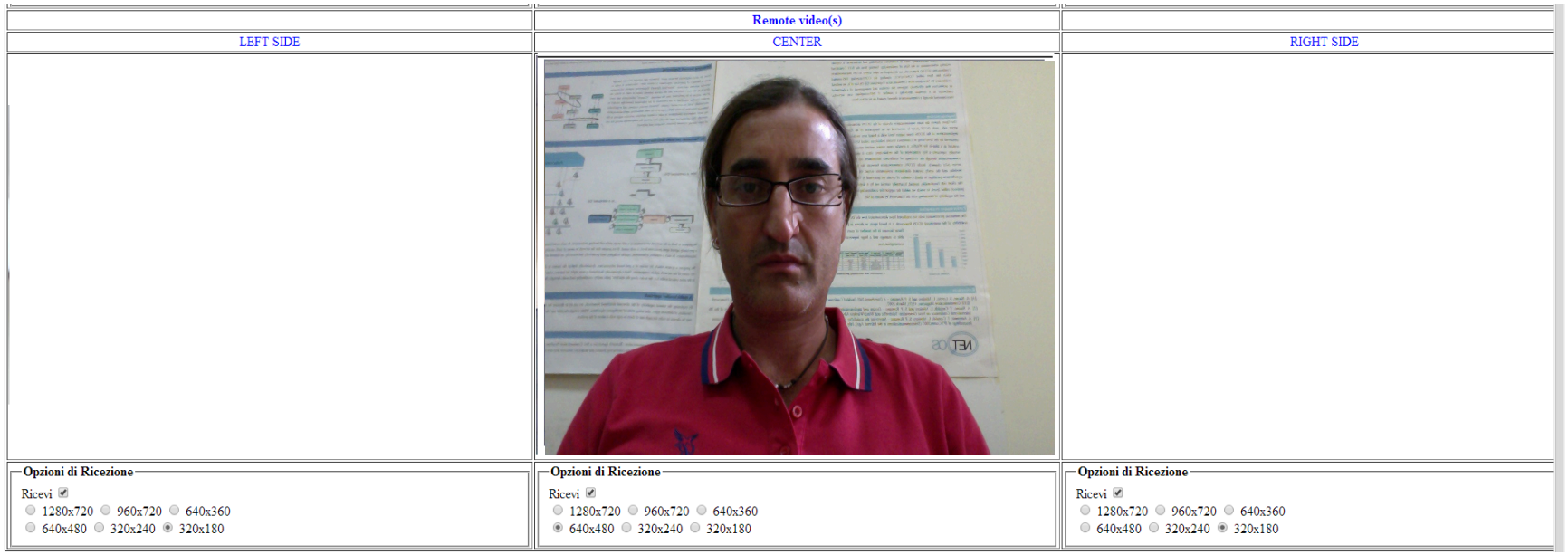
Starting up…


http://localhost:2013/ wants to use your camera. Learn more
Deny
Allow
Local video(s)
LEFT SIDE
CENTER
RIGHT SIDE
Send Options
Send
1280x720 960x720 640x360
640x480 320x240 320x180
Remote video(s)
Receive Options
Receive
ADVERTISE
CONFIGURE

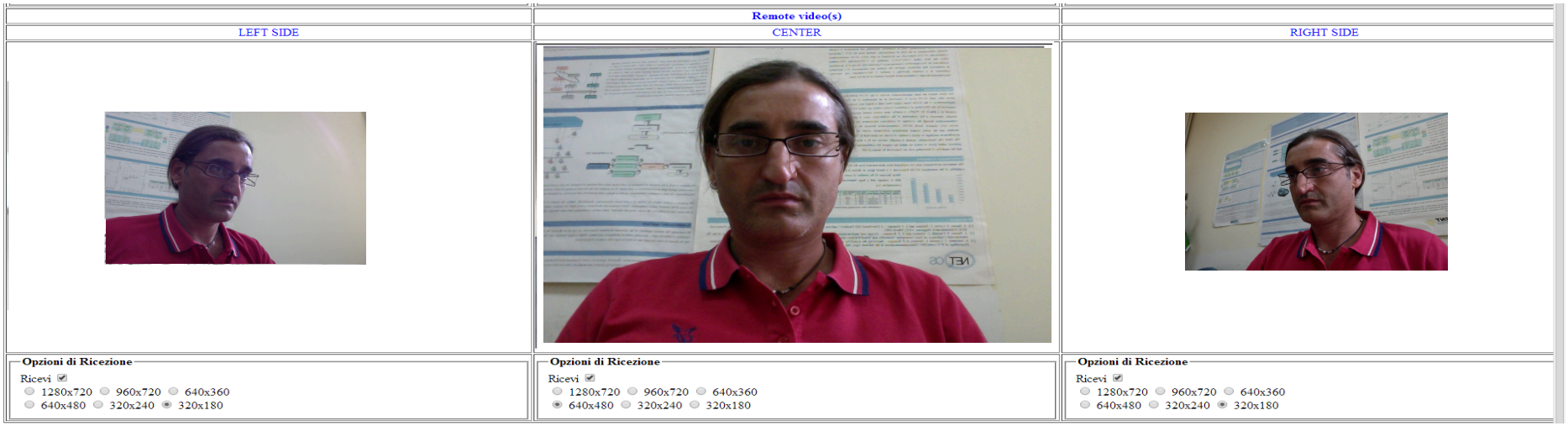
…getting user's media



…receiver's side: getting the 'basic' stream



Receiver's side: getting consumer-configured streams



Conclusions and future work

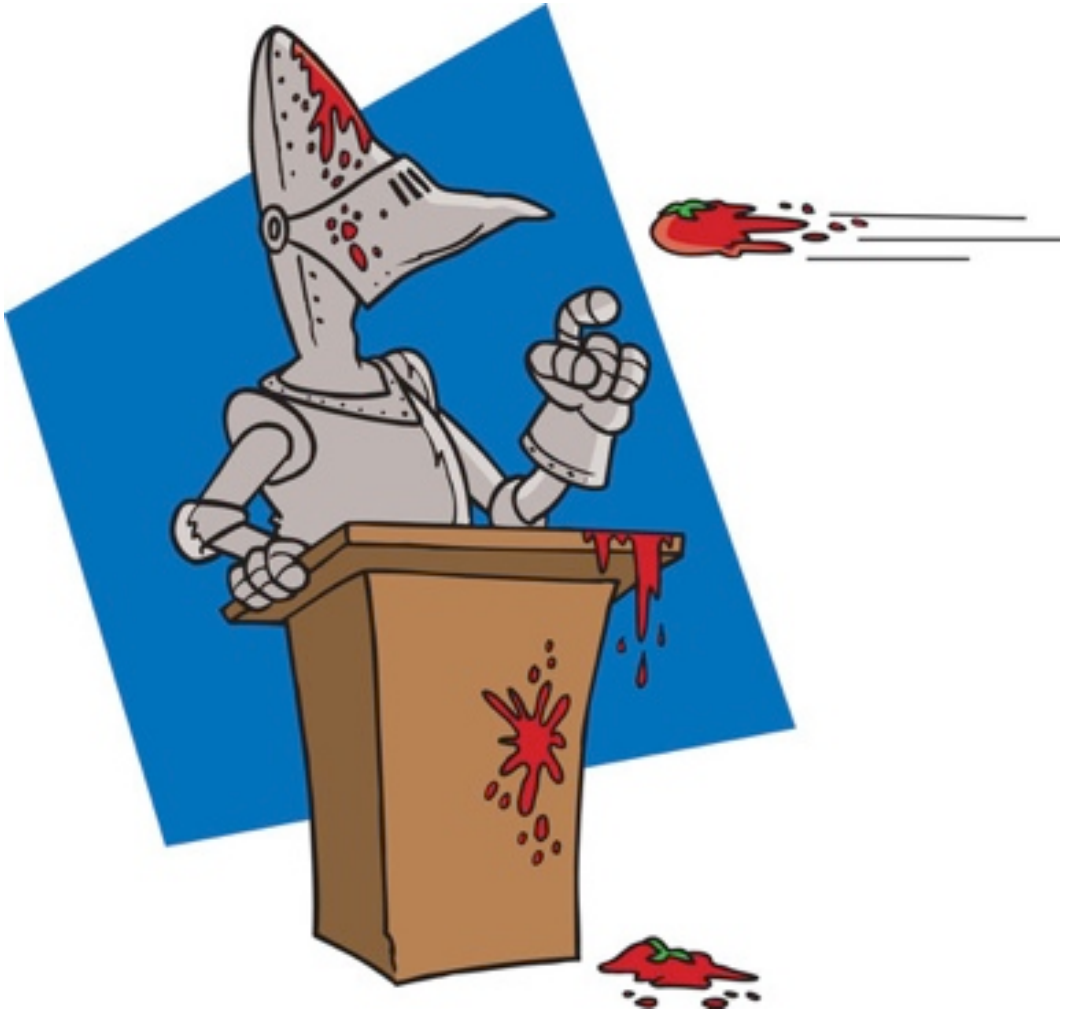
- Conclusions
  - Telepresence systems standardization
    - Main interoperability challenges
    - Existing standards limitations
    - Current efforts within the IETF: a focus on the CLUE protocol
    - Implementing the CLUE protocol on top of the WebRTC data channel
- Open issues
  - Moving targets:
    - CLUE standardization yet to be completed!
    - RtcWeb/WebRTC work still in progress!
      - most critical items:
        - SDP 'bundling'
        - WebRTC1.0 specification completion
        - browsers support and compatibility
- Future work
  - Keep on supporting the standard definition both on paper and in practice
    - Rough consensus, running code! (IETF motto)
  - Develop prototypes and perform interoperability tests with other (hopefully forthcoming) implementations

A quick look at ongoing developments…

- Working on a 3D web GUI based on WebGL:
  - graphically design your own CLUE-enabled telepresence room
    - add devices:
      - chairs, microphones, webcams, screens
    - associate spatial information with available devices
    - associate labels to both media and devices
    - associate roles to telepresence session participants
  - use the inserted information items to dynamically generate advertisement messages to be sent (over the data channel) to the remote party
  - play with the GUI in order to mimic variegated test scenarios
  - collect call flows
  - use call flows for protocol debugging/testing purposes
  - use prototype GUI for CLUE-related educational purposes

WIP: the CLUE WebGL GUI

Questions? Comments?



Simon Pietro Romano:

spromano@unina.it

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