Lars Tiede
John Markus BJORNDALEN
Otto J. Anshus
University of Tromso, Norway

Cloud Displays for mobile users in a display cloud

Presenter: Saurabh Trivedi
Motivation
Scenario (cont.)
Scenario (cont.)
Research Challenges

- A scalable way with regards to performance metrics
- Simple and responsive for the user
- Flexible way with regards to tiling multiple displays
- Secure way demanding no or very little trust
Cloud Display Approach

- User with mobile device can configure a cloud display
- Securely and scalably display content onto cloud display
- Flexibly define many content entities termed as visuals
- Display moves with user, across rooms to different continents
First, the mobile device detects local D1 and D2. It already knows the remote D3 (1).

Then, the user adds D1, D2, and D3 to his cloud display, in an arrangement of his choosing (2).

Then, the user arranges visuals (here, only one) in his cloud display (3), the mobile device instructs the affected displays (4) and visual sources (5) to connect, and then content is transported from the visual source to the displays (6).
Cloud Display Architecture

- Display must be able to interact with mobile device
- Functionality making all user data received by displays disappear from display
- Mobile device functionality enabling it to dynamically discover nearby displays
- Mobile device functionality to compose displays into a cloud display
- Implements VNC style approach
  - Drawbacks?
Virtual Network Computing
- Graphical desktop sharing system
- RFB protocol (Remote frame buffer)
Remote Frame Buffer protocol

- Send small rectangles of frame buffer
- Client and server negotiate which encoding to be used
- Most optimal encoding?
  - Optimal = minimal bandwidth
Prototype

- Core functionalities
  - Creating a cloud display
  - Displaying visuals
  - Moving display across devices
- Display daemon
- User controller
- Visual controller
Listens to network connections from mobile devices

Starts visual viewers
  - This introduces an overhead
  - Stateless user-interaction
  - Presently does not know when to stop the display
User Controller (Prototype cont.)

- Manipulating visuals on the display
  - Creating
  - Placing
  - Cloning
  - Resizing
- Has not been ported to mobile device
Visual Controller (Prototype cont.)

- Handles display co-ordinates
- Viewer management
  - Start
  - Stop
- One visual controller instance for each visual
  - Managed by user controller
- Responsible for authorization features and proper interactions
150ms (below 3m/s) - ?
Emailed Lars Tiede. Awaiting Response
“...since VNC uses RFB protocol, delay in updating pixels relative to speed measured in dip/sec or px/sec across displays give a better representation on why a visual might be slow.”
“...in the particular experiment you refer to, pixels/s would have worked equally well as m/s, as the displays we used all have the same pixel density...”

“...but I think you are right, for this particular experiment, giving the speed at which visuals move in pixels/s instead of m/s might have been a good idea.”
User can only trust his own device
  - Easier to implement
Display cloud model well suited for public displays
No obvious limit to growth unless many end up using same network and display
  - Network: increase the bandwidth
  - Display: not many users can fit visuals in one display
How secure is cloud display model?

- The mobile device and display need to trust each other
- Tracking users in a public place will be discouraged by the users
- Visual or frames being transmitted secure enough?
  - Encrypting data across network will add a huge overhead to an already expensive approach
Thank you

- Questions?