

Developing a Solution for Multimedia Home Networking

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Outline

- Motivation and Aims
- Background
- Available standards
- Implementation
- Results
- Conclusion
- Future Work and Future of Home networking

Motivation and Aims

Motivation and Aims (1/2)

- People's lives are being digitalized. This digitalization can be seen in the increasing number of home multimedia devices, such as digital TVs, smart phones, digital cameras, tablets, PCs, laptops and NAS (Network Attached Storage).
- Networking is being rapidly adopted at homes. In a typical home scenario, most of these devices are connected to a local network, such as a Wi-Fi hot spot, in order to allow music, pictures, videos and other content to be ported across different devices.

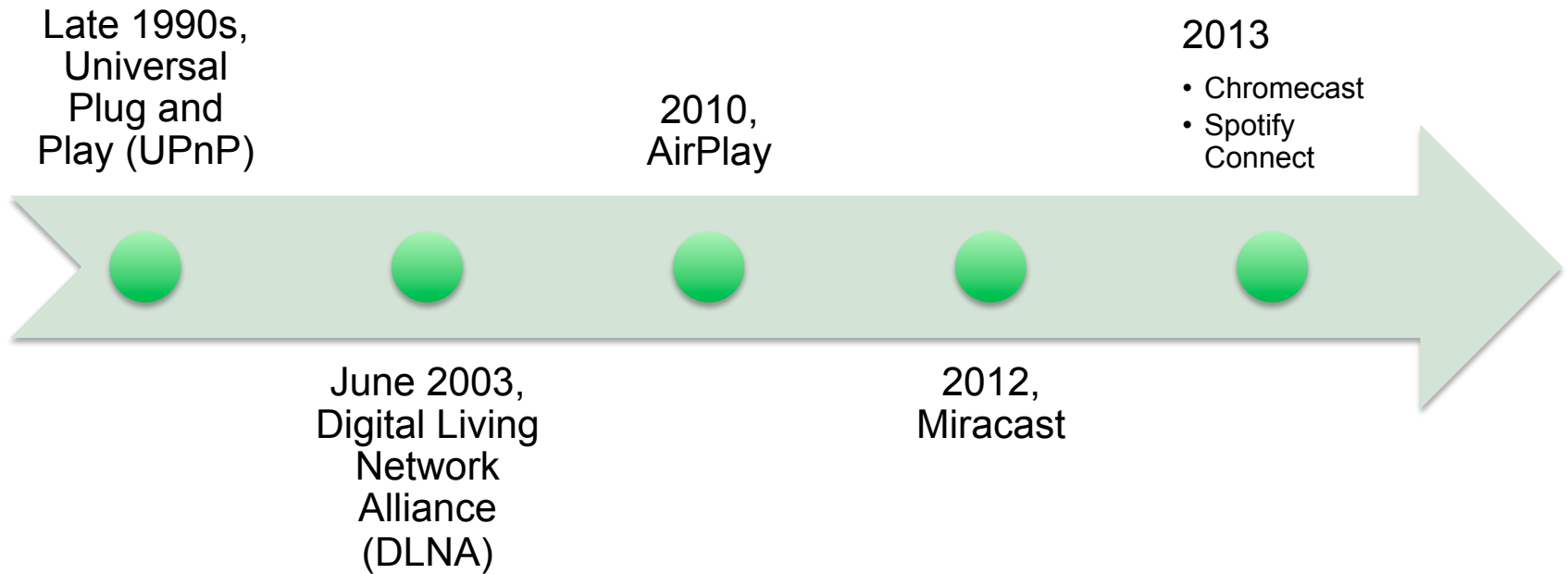
Motivation and Aims (2/2)

- Although several widely used multimedia-streaming solutions have become available in the market, they are not compatible with each other. Moreover, even devices using the same standard are not always compatible with each other, since the implementation approaches may vary from device to device.
- These compatibility issues have motivated the need to determine the technological features common to the popular standards and to develop a more easy-to-use multimedia home networking solution based on more advanced technologies.

Background

Background

- History of home networking development and five most popular home networking solutions.



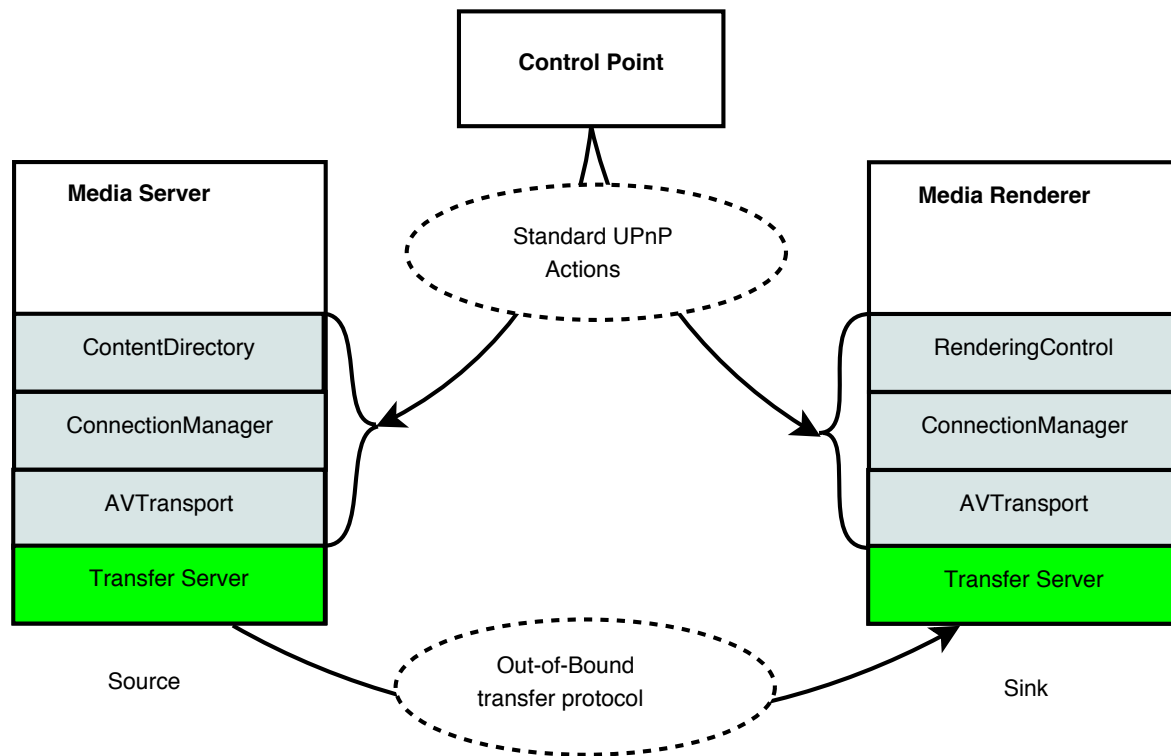
Available standards

Universal Plug and Play (UPnP) (1/2)

- UPnP Device Architecture
 - Addressing
 - Discovery
 - Description
 - Control
 - Eventing
 - Presentation

Universal Plug and Play (UPnP) (2/2)

- UPnP Audio/Video Architecture



Digital Living Network Alliance (DLNA)

- Key Technology Ingredients

Functional Components	Technology Ingredients
Connectivity	Ethernet, 802.11 (including Wi-Fi Direct) MoCA, HPNA and Bluetooth
Networking	IPv4 Suite
Device Discovery and Control	UPnP* Device Architecture v1.0
Media Management and Control	UPnP AV and UPnP Printer:1
Media Formats	Required and Optional Format Profiles
Media Transport	HTTP(Mandatory), HTTP Adaptive Delivery(DASH) and RTP
Remote User Interface	CEA-2014-A

AirPlay (1/2)

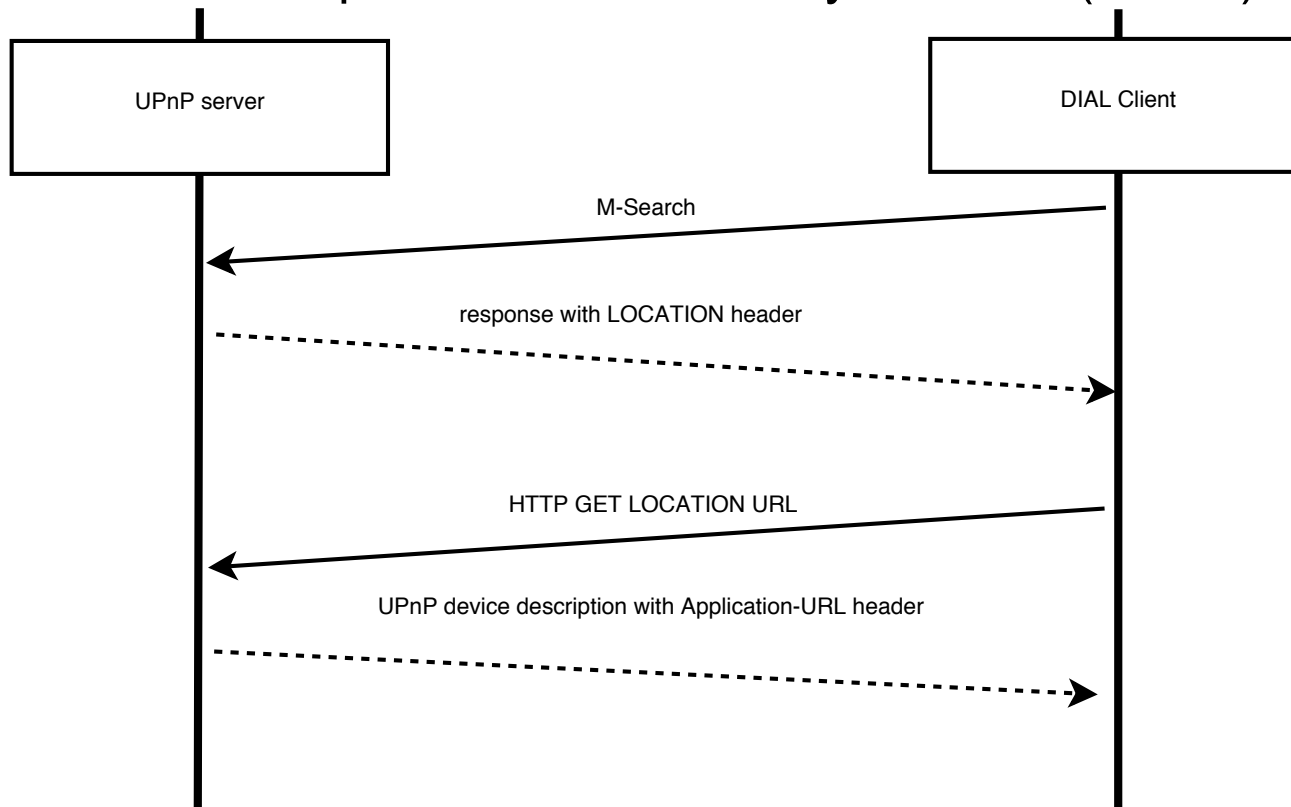
- Service discovery
 - Multicast DNS (RFC 6762)
- Video streaming
 - HTTP POST/GET for control channel
 - HTTP / Adaptive HTTP for streaming
- Photo streaming
 - HTTP POST/GET for control channel
 - HTTP PUT for sending image (photo as HTTP body)
- Music streaming
 - Remote Audio Output Protocol (RAOP) (RTP-like protocol)

AirPlay (2/2)

- Screen mirroring
 - Transmitting an H.264 encoded video stream over a TCP connection
 - Network time protocol (NTP) is used for synchronization
- Authentication
 - Implemented using standard HTTP Digest Authentication (RFC 2617), over RTSP for AirTunes, and HTTP for everything else.

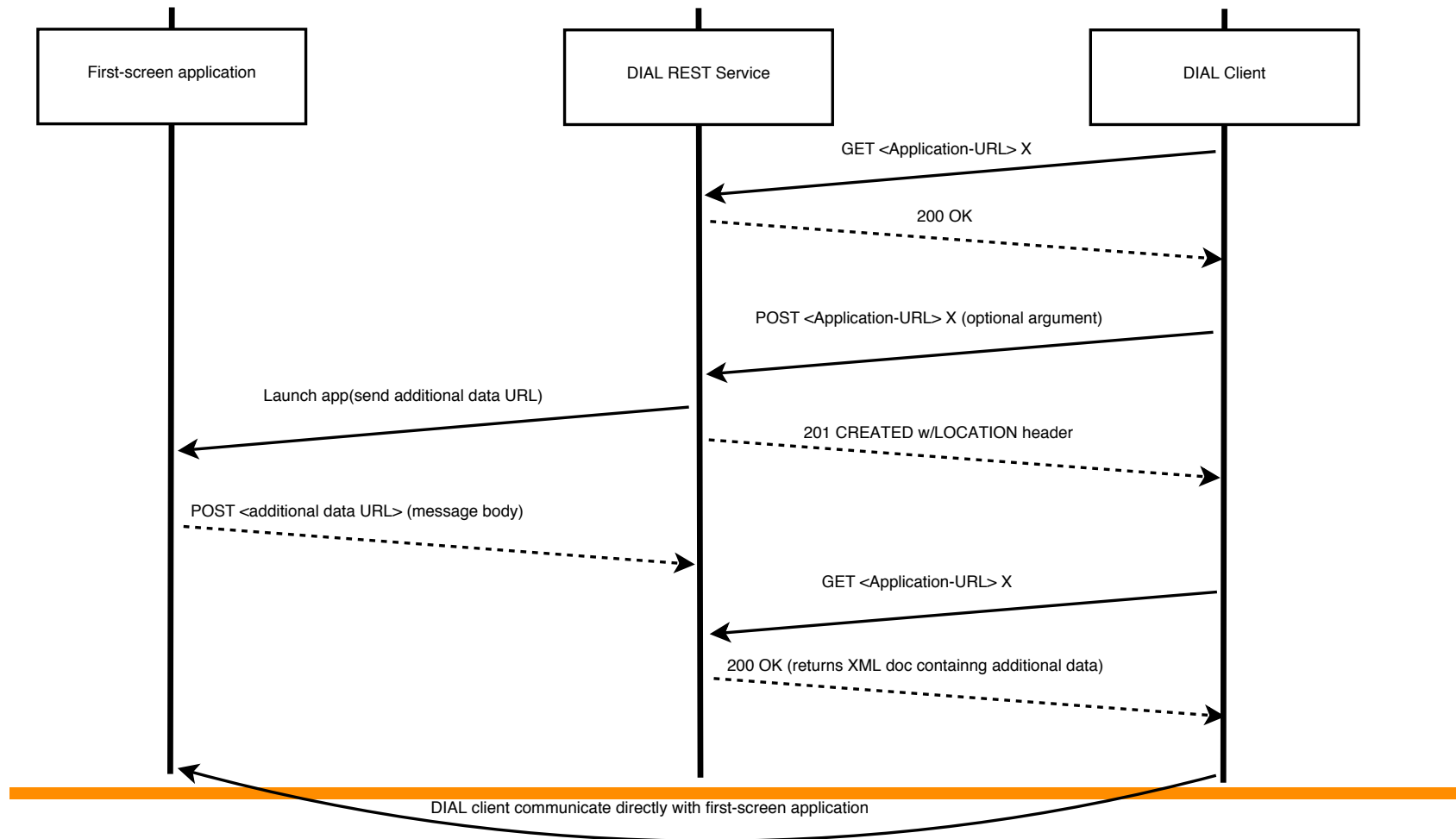
Discovery And Launch (DIAL) (1/2)

- DIAL discovery service
 - Based on Simple Service Discovery Protocol (SSDP)



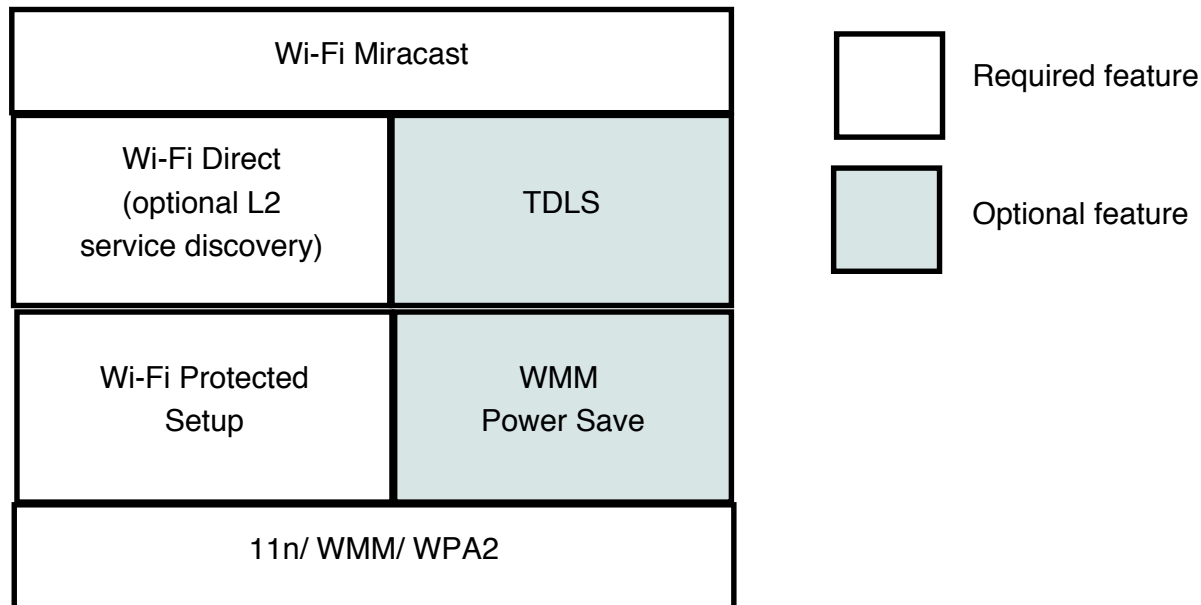
Discovery And Launch (DIAL) (2/2)

- DIAL REST service



Miracast

- Proposed by Wi-Fi Alliance in 2012
- Utilize Wi-Fi alliance building blocks developed over the years



Comparison of four standards (1/2)

- Technology used

Standards	Device discovery	Control Protocol	Streaming protocol
DLNA	SSDP	UPnP/HTTP	HTTP
AirPlay	Multicast DNS	HTTP/RTSP	HTTP/RTP
DIAL	SSDP	DIAL/HTTP	HTTP
Miracast	Wi-Fi direct	RTSP	RTP

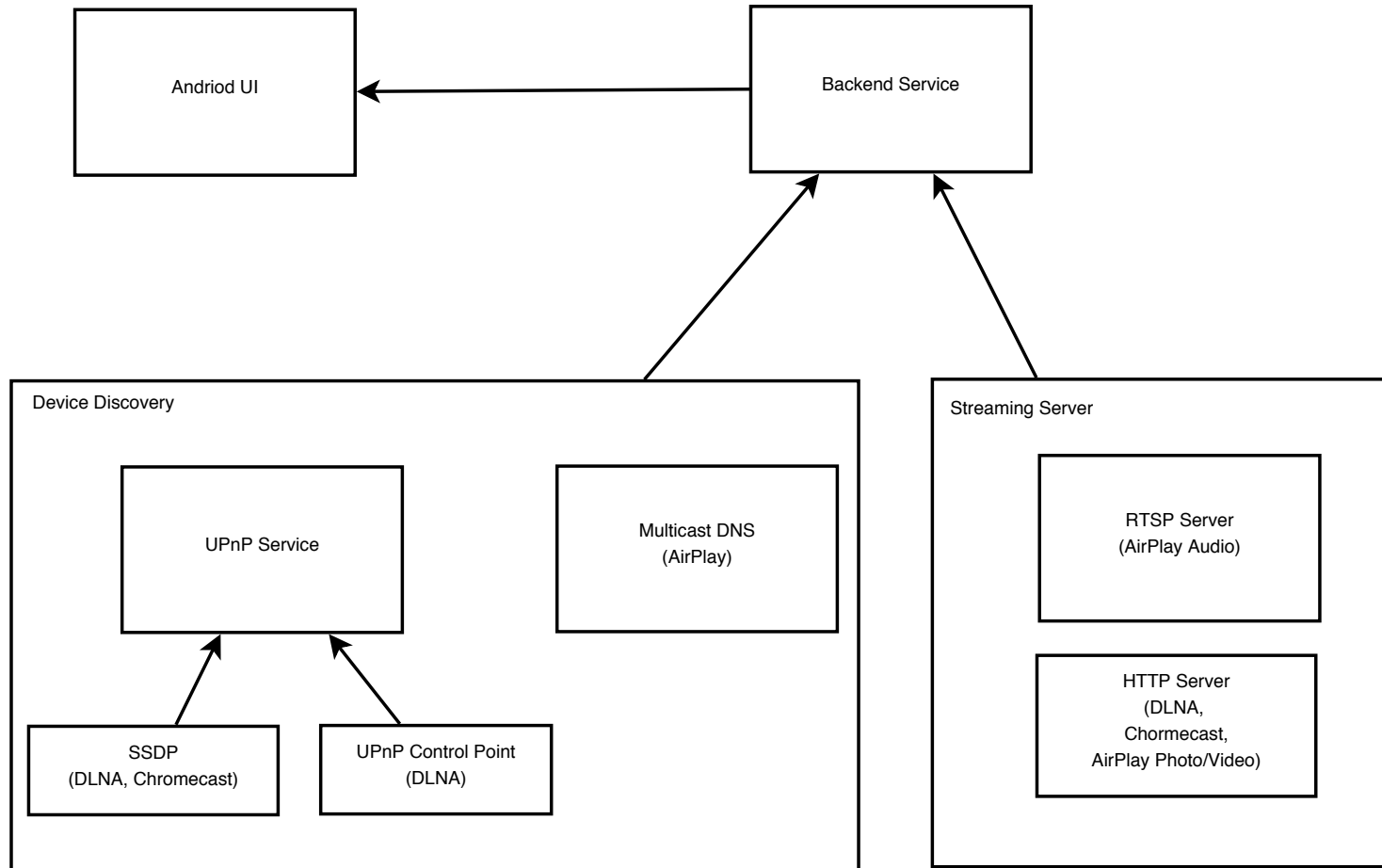
Comparison of four standards (2/2)

- Advanced features

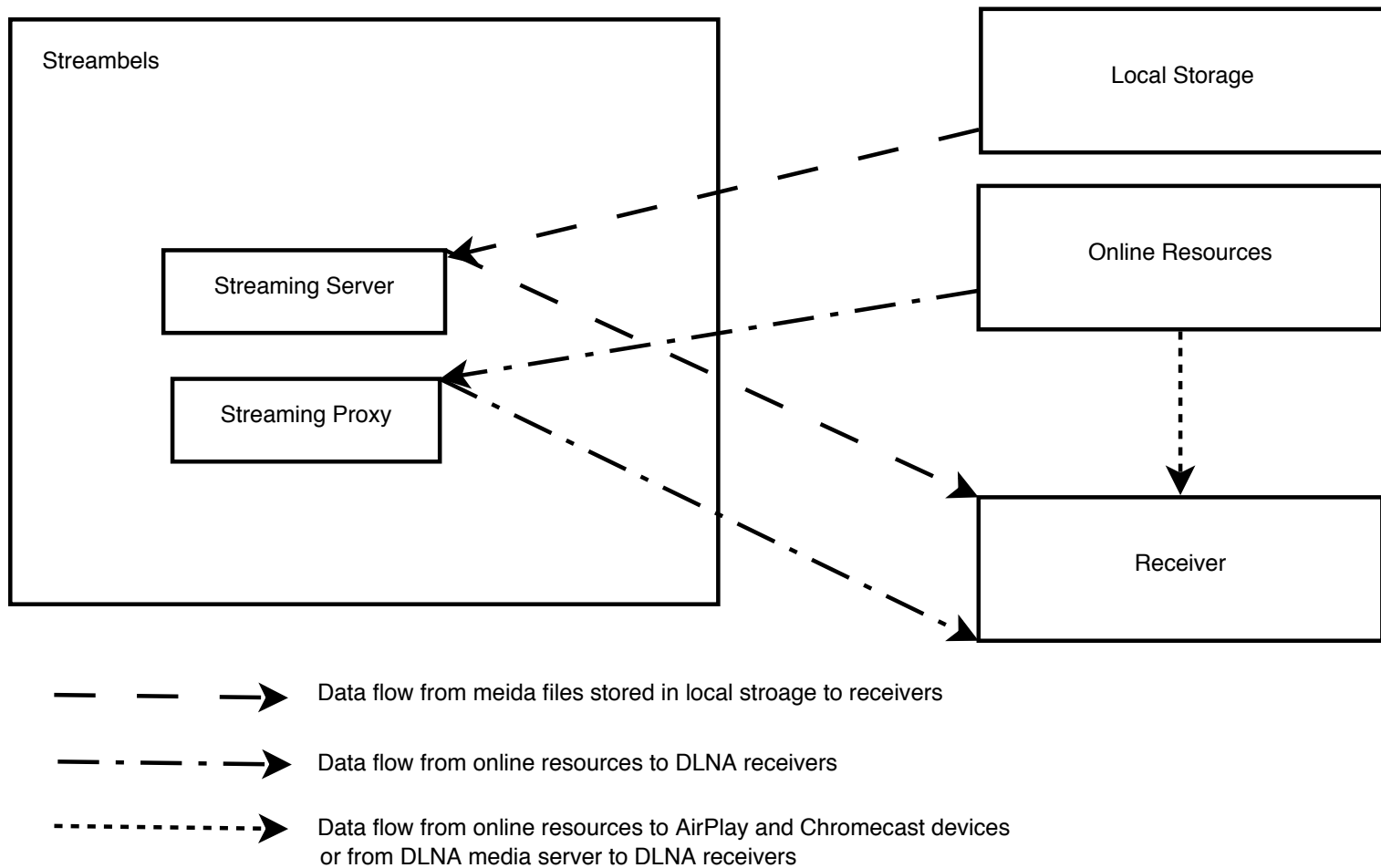
Feature	DLNA	AirPlay	DIAL	Miracast
Screen mirroring	No	Yes	No	Yes
Multiple connection	Yes	No	No	No
Authentication	No	Yes	No	Yes

Implementation

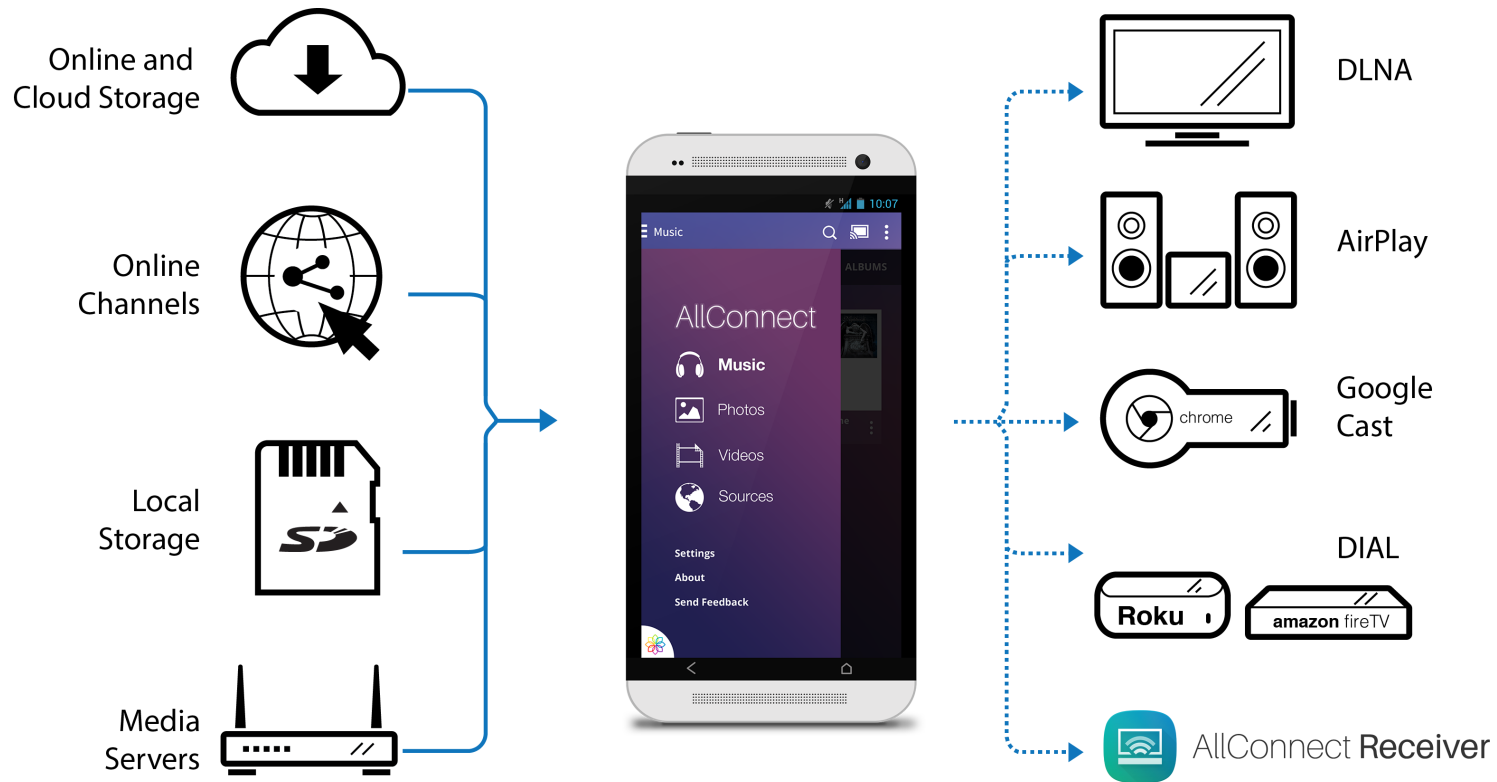
Architecture



Data flow



UX Design



Ref: <http://www.allconnectapp.com>

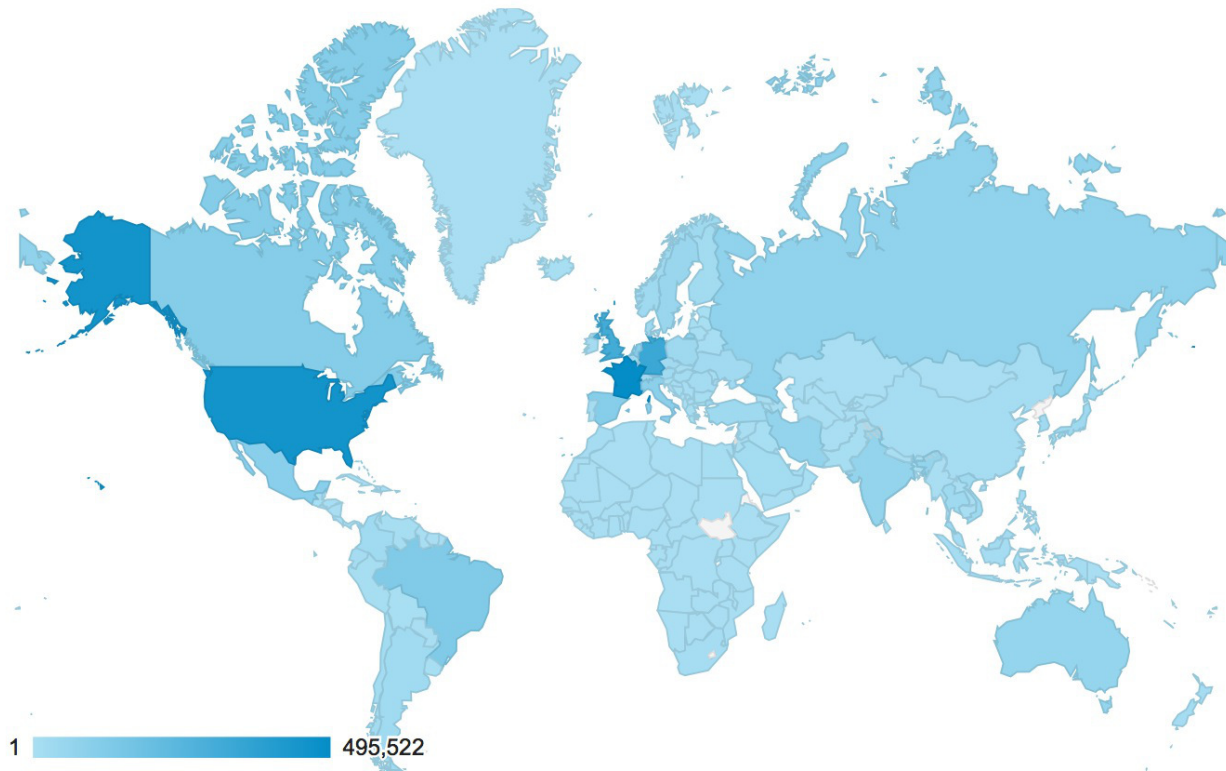
Features

- Play local contents on phone (multimedia player).
- Compatible with AirPlay, DLNA, Chromecast and FireTV receiver devices.
- Stream from DLNA media server to any kind of receivers, regardless of their standard.
- Stream from online channels, such as YouTube, Vimeo, and Facebook.

Results

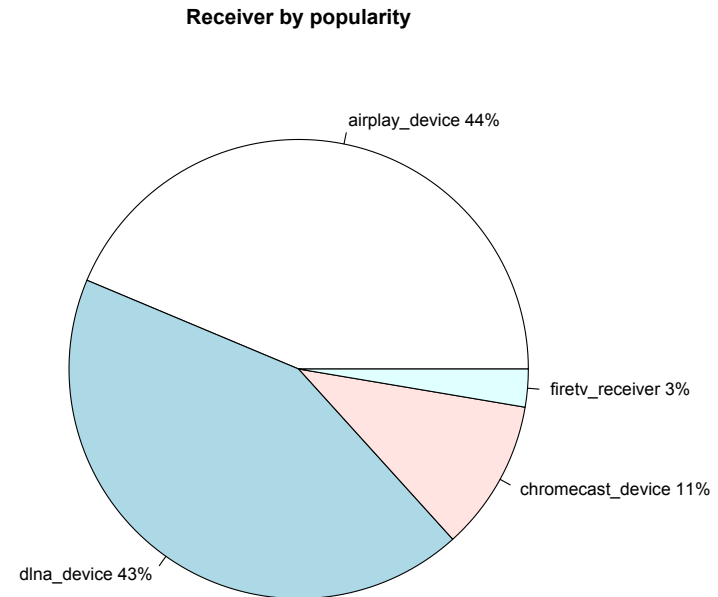
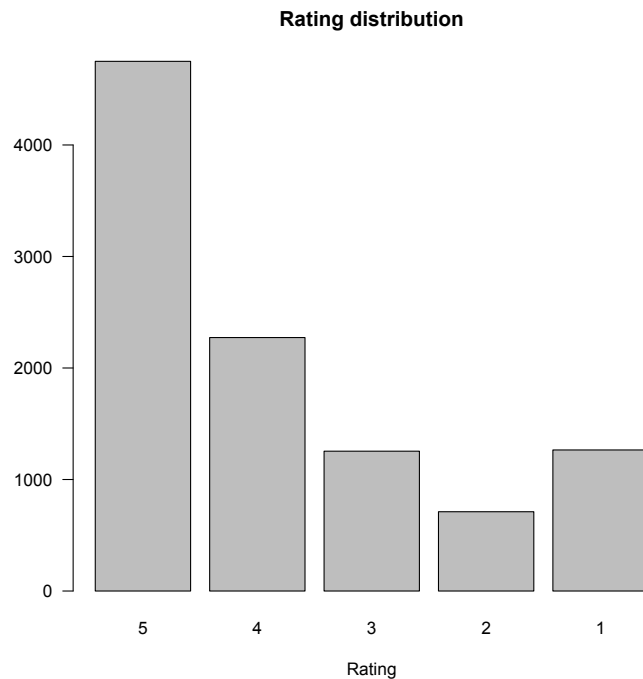
Statistics (1/2)

- User map
 - One million Downloads over 16 months



Statistics (2/2)

- User rating
 - Average 3.9, with half of total users gave 5 stars
- Receiver popularity



Conclusion

Conclusion

- Since its initial launch, this application has received over one million downloads and a daily active user total of over 15000. People from 99% percent of all the countries worldwide have downloaded and tried this solution. All these statistics have proven that this solution is competitive for multimedia home networking.
 - As more manufacturers are involved in the development of home networking, new standards are being pushed on the market constantly. It may not be possible to develop a single system that support all future protocols. The problem of multimedia home networking is still not completely solved.
-

Future Work and Future of Home networking

Further development

- Support for more platforms
- Developing an Software Development Kit
- Integration of receiver functionality
- Support for multi-session
- Optimization for codec
- In-kernel media server

Future of multimedia home networking (1/2)

- Device discovery
 - It seems mDNS will finally overtake SSDP due to its flexibility.
 - There is still a long way to go since UPnP has a strong alliance, including hundreds of companies.
- Information exchange
 - Future development of a home networking solution might opt for RESTful rather than SOAP, in order to provide higher flexibility and lower overhead.

Future of multimedia home networking (2/2)

- Streaming protocol
 - Both HTTP and RTSP will be used in future home networking. For the streaming of recorded media, HTTP streaming has an advantages over RTSP due to the buffer system. On the other hand, for screen mirroring and other usages where the content needs to be synchronized precisely, RTP would be a better solution.
- Internet of Things
 - The multimedia home networking might move towards the Internet of Things, and all the data could be aggregated and accessed anywhere in the world.

Thank you!

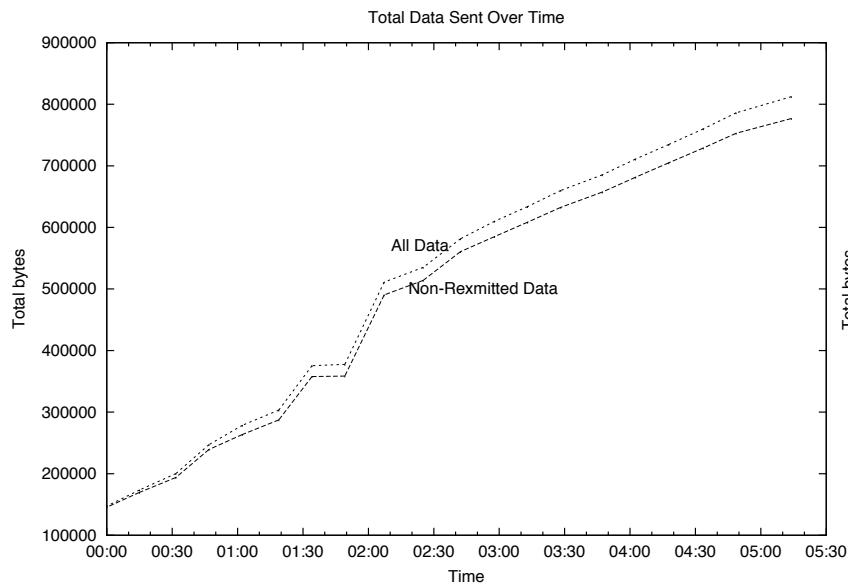
Questions and comments?

Appendix

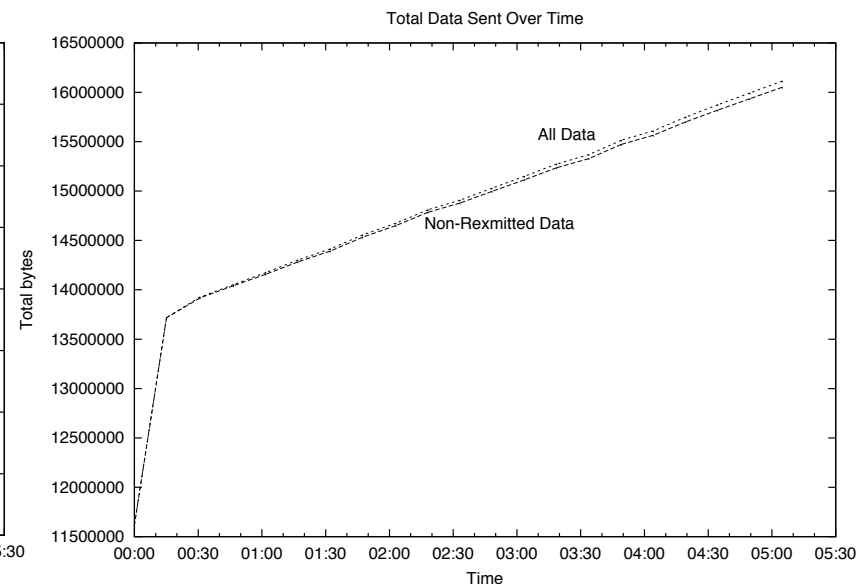
Streaming performance evaluation -HTTP vs RAOP

Streaming performance evaluation

- DLNA(HTTP) and AirPlay(RAOP) Music streaming



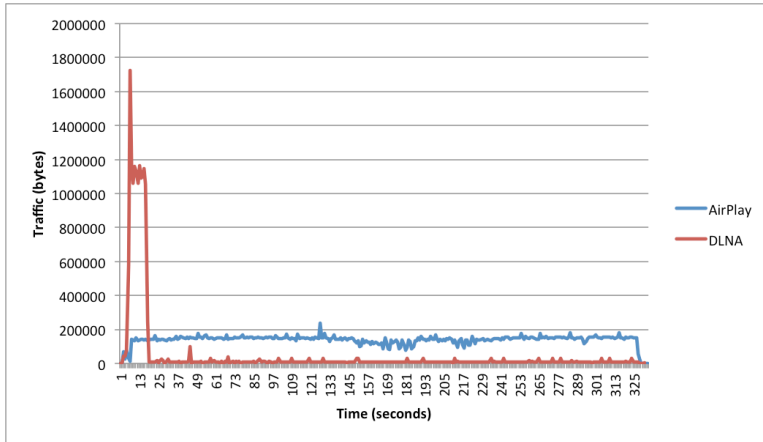
AirPlay



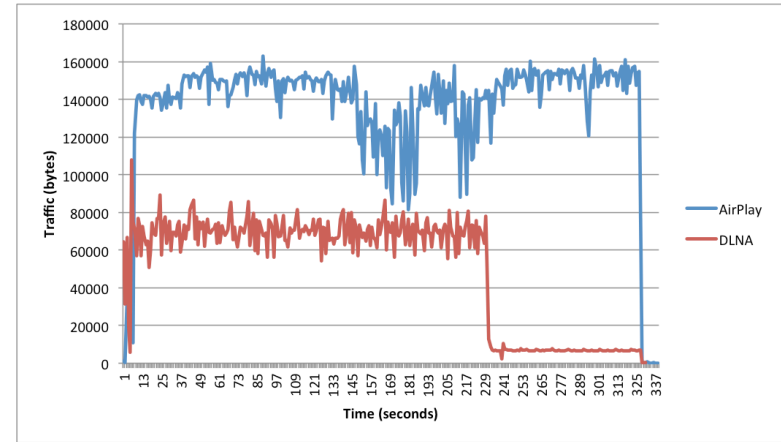
DLNA

Streaming performance evaluation

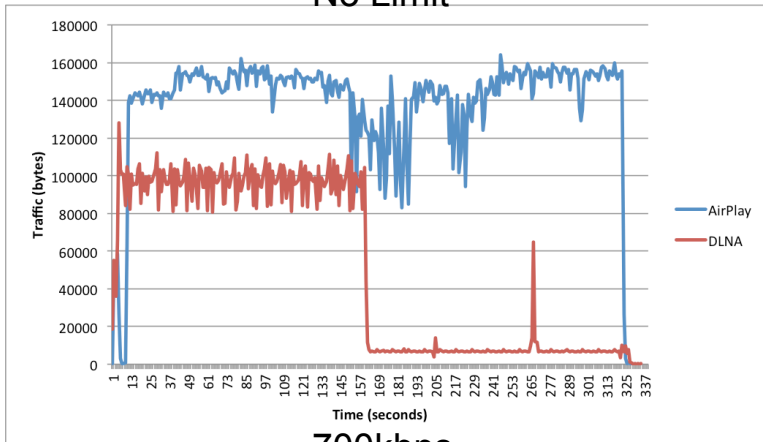
- Bandwidth limited scenario



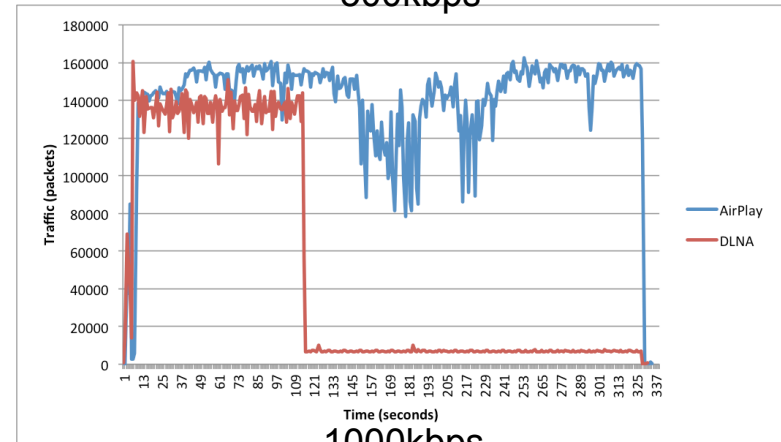
No Limit



500kbps



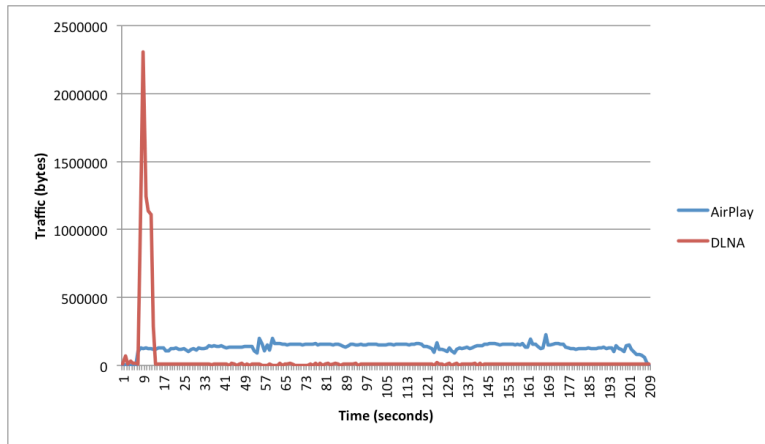
700kbps



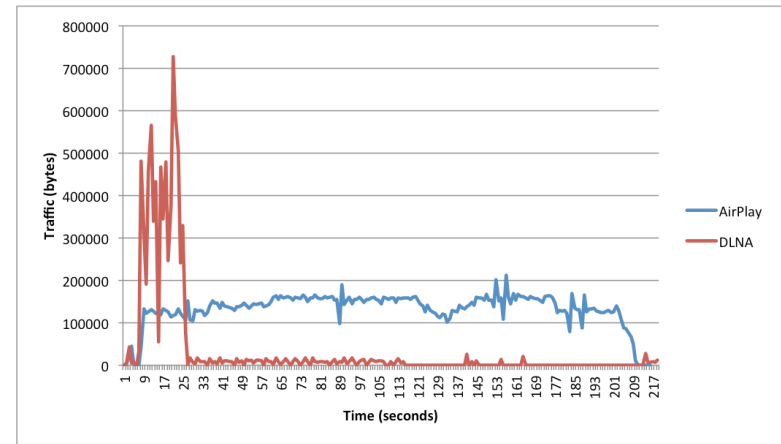
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Streaming performance evaluation

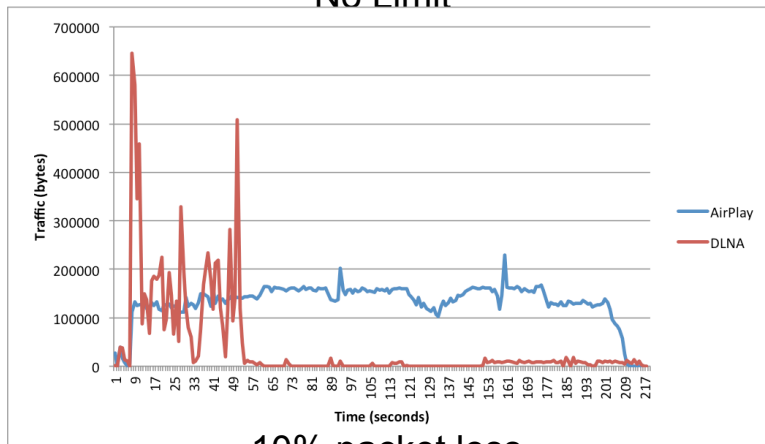
- Packet loss scenario



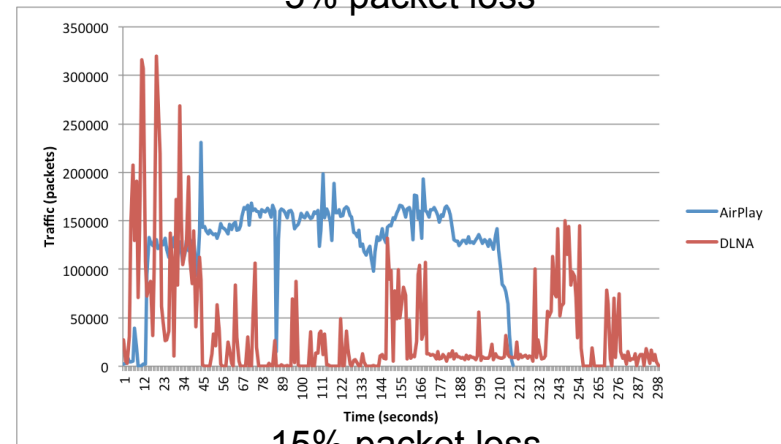
No Limit



5% packet loss



10% packet loss



15% packet loss