EnergYT: Energy Efficient YouTube Player

Khaled Ziyaeen
Michail Giannakopoulos
Miroslav Cupak

Outline

- Problem
- Motivation
- Approach
- Architecture
- Implementation
- Future Work
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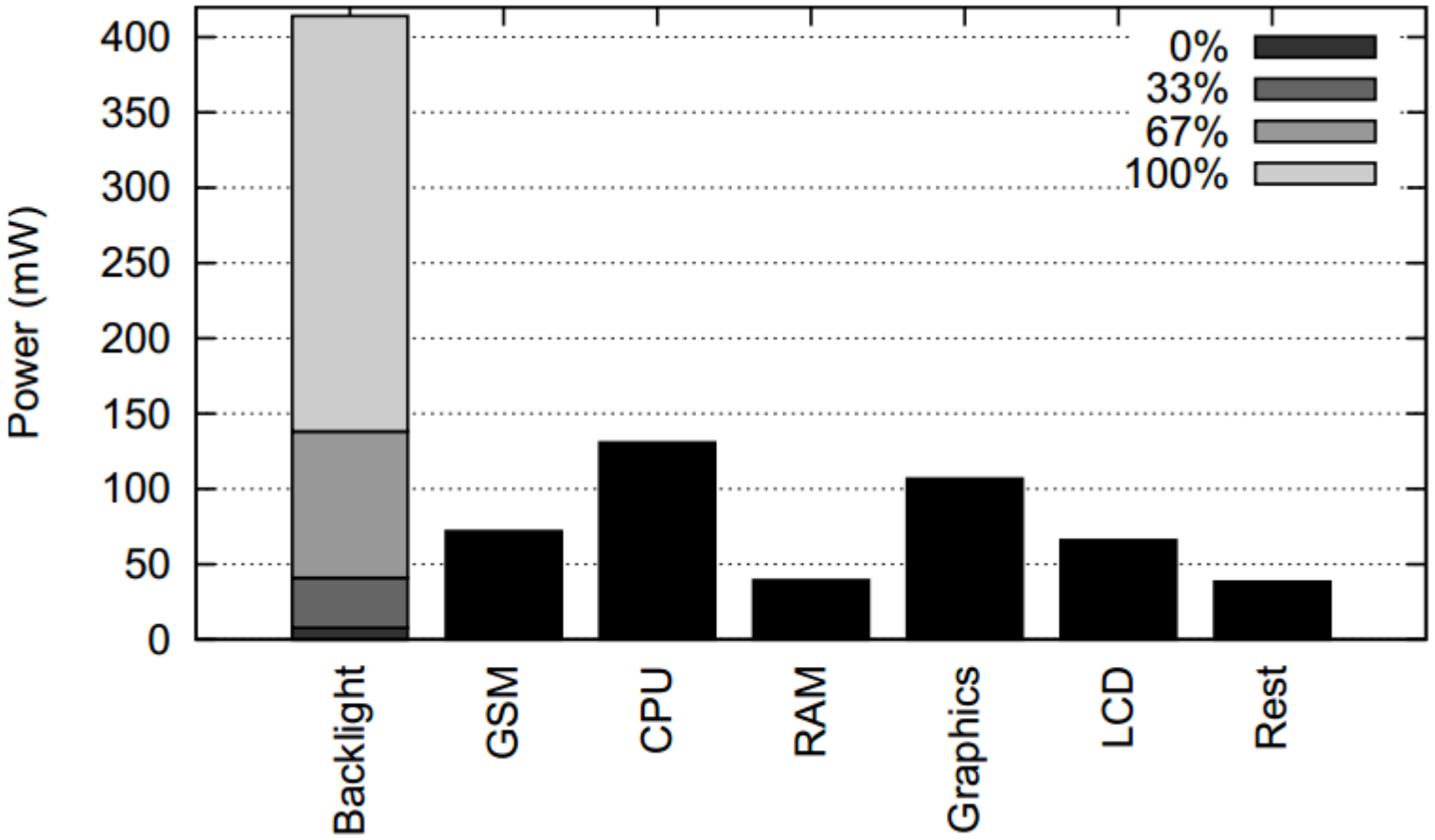
- Conclusion

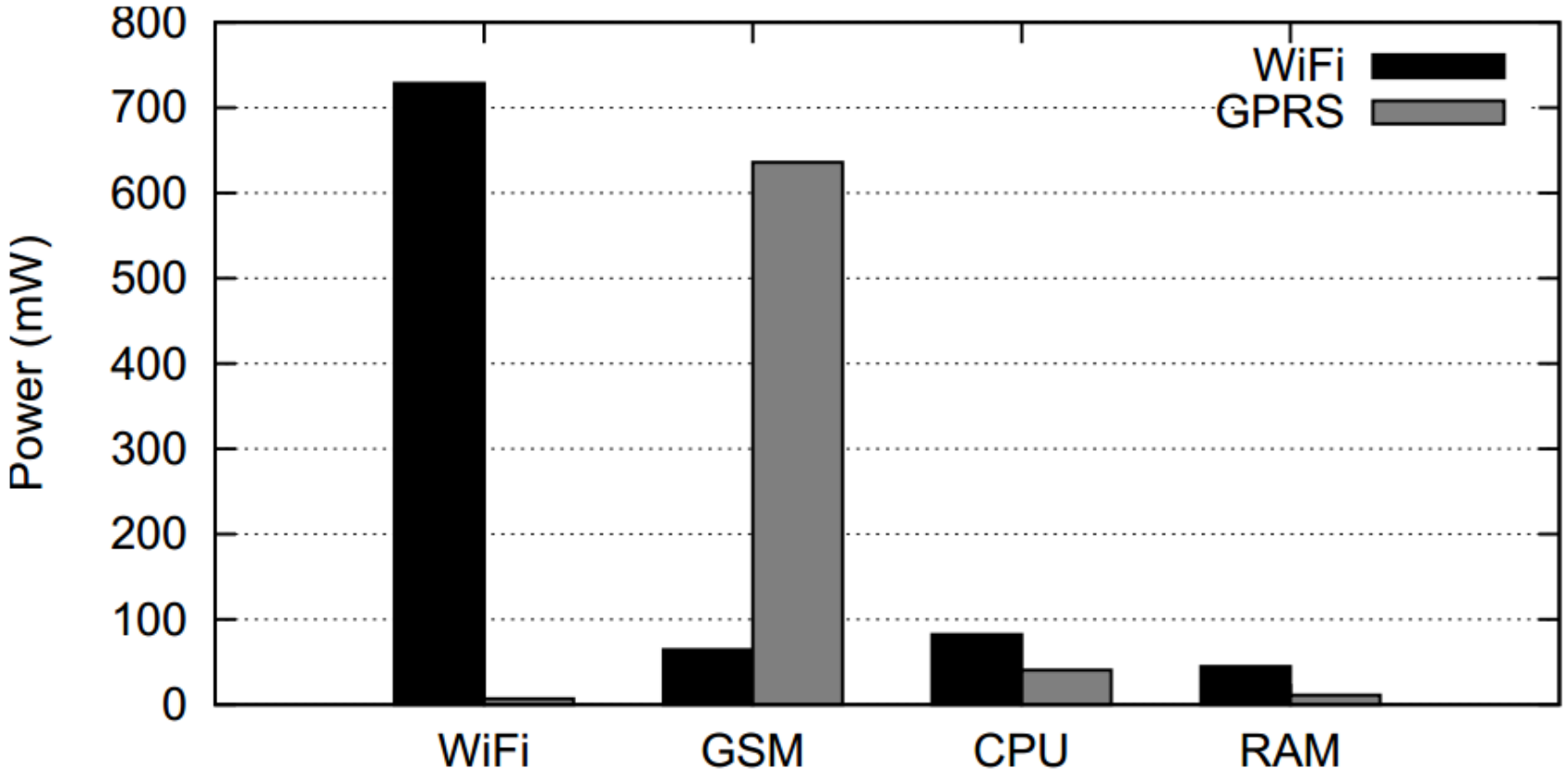
Problem

- Energy is scarce on mobile phones.
- One of the most energy consuming tasks on a mobile phone is streaming and playing video content
  - GSM (WiFi) and backlight are two highest energy consumers

Video Playback Consumption



Network Data Download Consumption



Signal Strength vs. Energy Use

- Higher Signal Strength results in lower energy consumption
  - Energy Consumption increased by 30% when signal strength lowered by 10dBm over 3G data download
- 3G data download suffers more severely than WiFi data download when signal strength is lowered

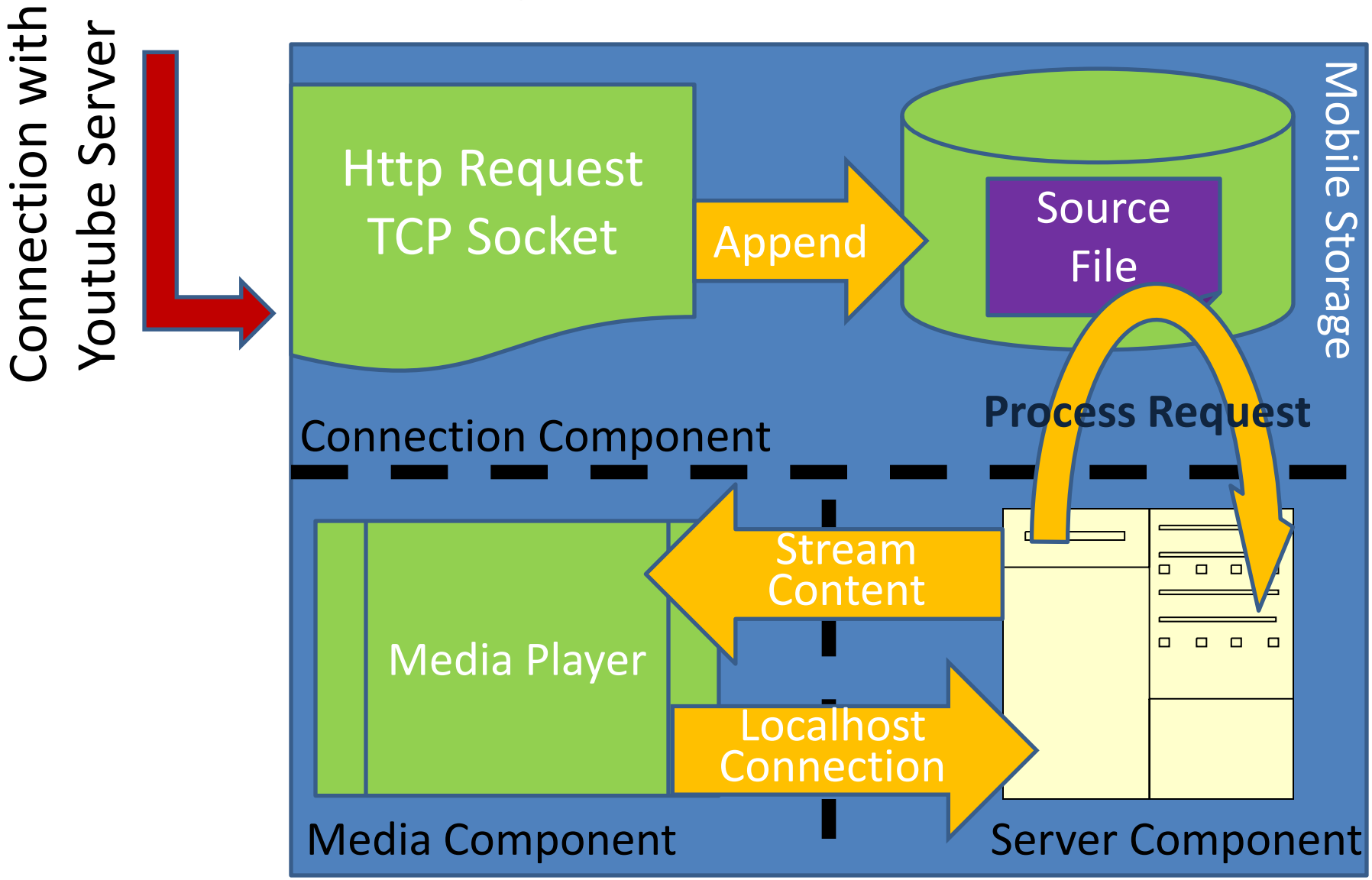
Motivation

- Opportunity to save energy during YouTube video streaming
  - Particularly, backlight and data download
- Backlight energy consumption is set by the user
- Data Download energy consumption can be controlled by app developer

Approach

- Save energy during video streaming without interrupting user experience in any way
- Schedule data downloads during periods of high signal strength
- Implement this energy-aware feature into a new Android YouTube media player
  - Download a YouTube video from a YouTube link

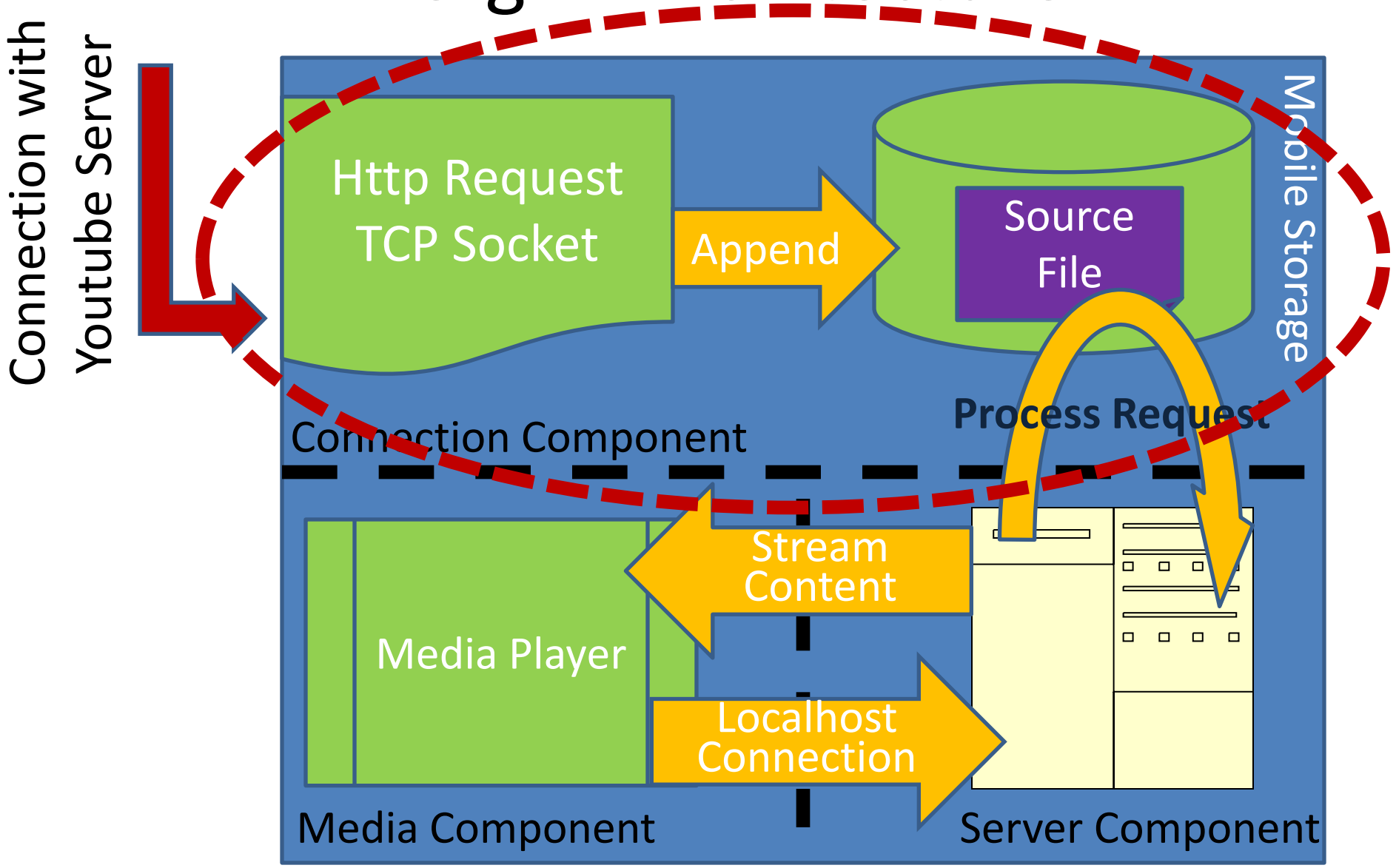
EnergYT Architecture



Implementation

- Connection Component
- Server Component
- Media Component

EnergYT Architecture



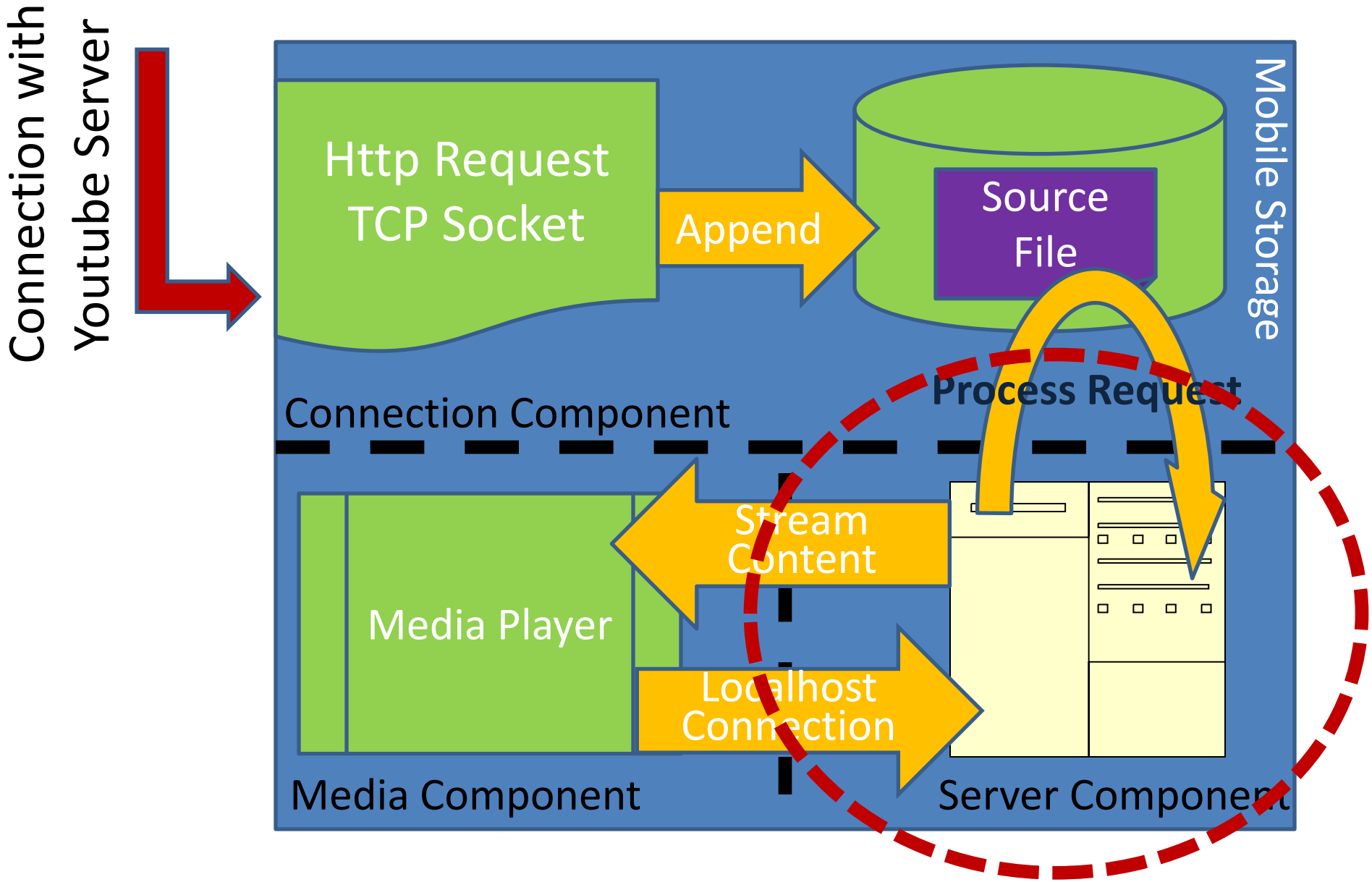
Connection Component

- Determines actual video URL from YouTube link
- Downloads video data in chunks
- Stores video data into local file
- Signal strength is monitored
  - Connection closed when
    1. Signal strength drops below threshold
    2. Remaining buffer allows delaying next chunk download
  - Connection reopened when signal is strong again

Energy-Aware Algorithm

```
while (video file is being downloaded) {
    if (bufferSize > DISCONNECT_THRESHOLD
        &&  currSignal < prevSignal
        &&  connection is on)
            disconnect();
    if ((bufferSize > CONNECT_THRESHOLD
        &&  connection is off)
        || (currSignal > prevSignal)) {
            prevSignal <- getSignal();
            connect();
            downloadVideoChunk();
    } }
```

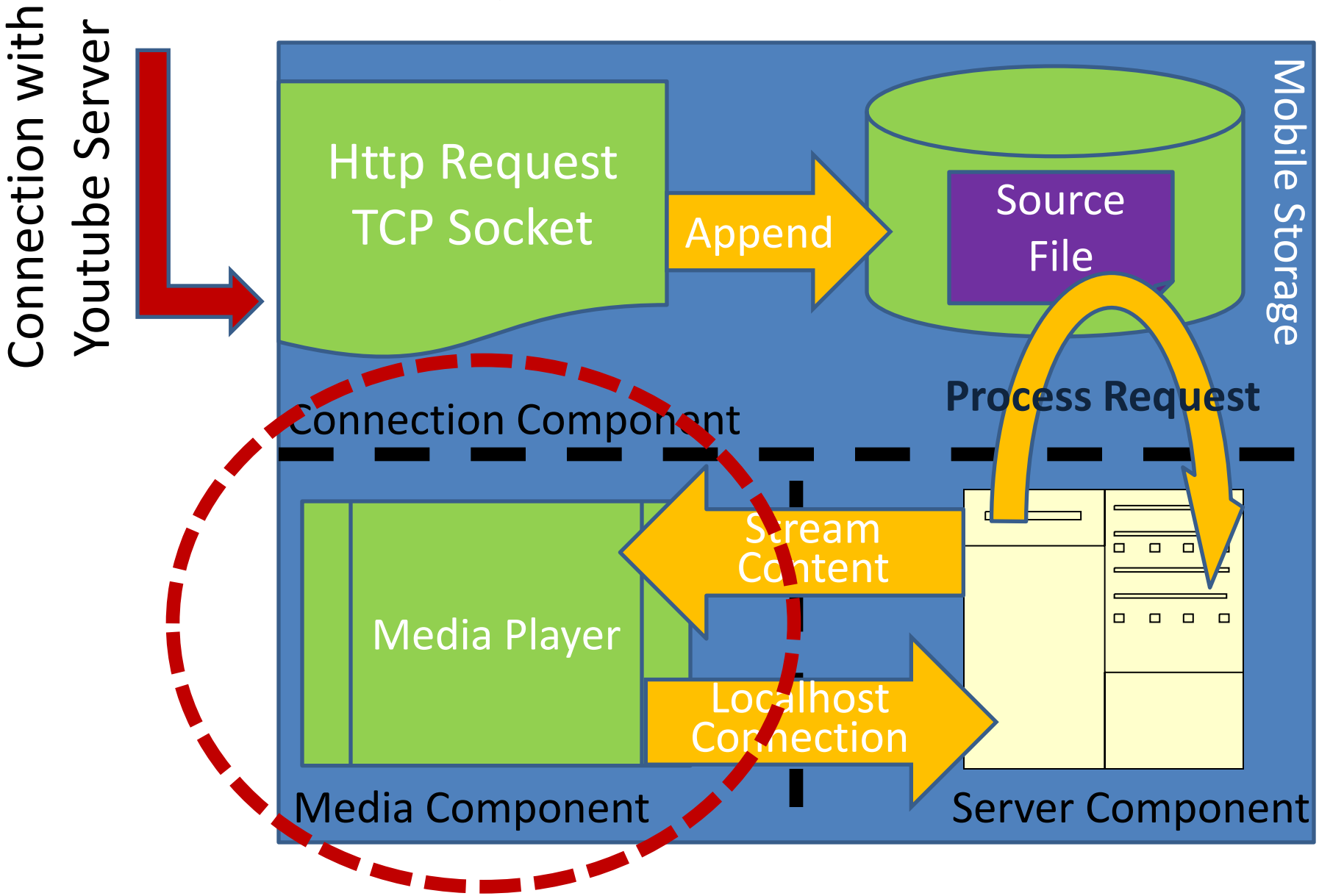
EnergYT Architecture



Server Component

- Listens for local client connection
- Streams video content to Media Component
  - Reads and transmits local file created by Connection Component
- Reads file **while** video content is being downloaded by Connection Component

EnergYT Architecture



Media Component

- Connects to Server Component
  - setVideoURI(“127.0.0.1:8893/file”);
- Plays video as soon as it receives content from Server Component
- Performs local buffering
  - Allows video playback even when connection is closed by Connection Component
  - Waits for video content if none available
- Enables user to control playback

Major Issues

- Reverse engineering approach to retrieve the actual Youtube streaming URL
- Reconnecting to continue download from a specific point
- Getting video in an encoding supported by Android's VideoView widget
- Enabling playback of incomplete files
- Turning off radio from the application (Fast Dormancy)

Future Work

- Evaluation process:
  - Energy consumption comparing simple version of our media player versus energy-aware one
  - Use AIRPLANE_MODE to simulate radio shutdown
    - Cannot be enabled from the application layer
- Develop a more sophisticated method for predicting the threshold values

Related Work

- *"Envi: Energy Efficient Video Player for Mobiles",* **S.Suneja, V.Navda, R.Ramjee, E.DeLara**
- *"Bartendr: a practical approach to energy-aware cellular data scheduling"*, **A.Schulman, V.Navda, R.Ramjee, N.Spring, P.Deshpande, C.Grunewald, K.Jain, V.N.Padmanabhan** – MobiCom, 2010
- *"Energy Consumption in Mobile Phones: A Measurement Study and Implementations for Network Applications"*, **N.Balasubramanian, A.Balasubramanian, A.Venkataramani** – ICM, 2009
- *"Energy Consumption of Mobile YouTube: Quantitative Measurement and Analysis"*, **Y.Xiao, R.S.Kalyanaraman, A.Yla-Jaaski** – NGMAST, 2008
- *"An analysis of Power Consumption in a Smartphone"*, **A.Carroll, G.Heiser –** USENIX, 2010

Conclusion

- We developed the infrastructure for an energy aware YouTube player on the Android Platform
- We developed an energy aware algorithm for streaming YouTube videos.

Thank you!

Questions/Remarks?