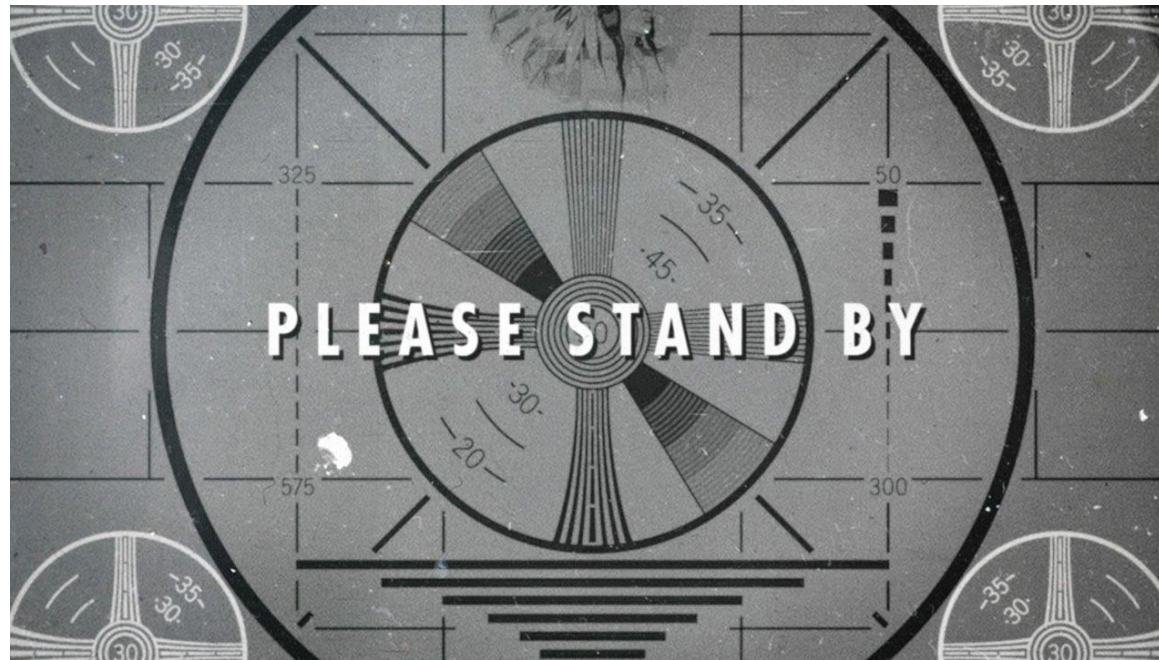


5G App Optimization: GSMA Internet Working Group Proposal

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Problem Statement – Learning from the Past

- When mobile applications exploded in at launch of 4G, **developers did not understand fundamental concepts of mobile networks.**
- Many popular apps were **highly inefficient** and created poor user experiences and overloading of mobile networks.

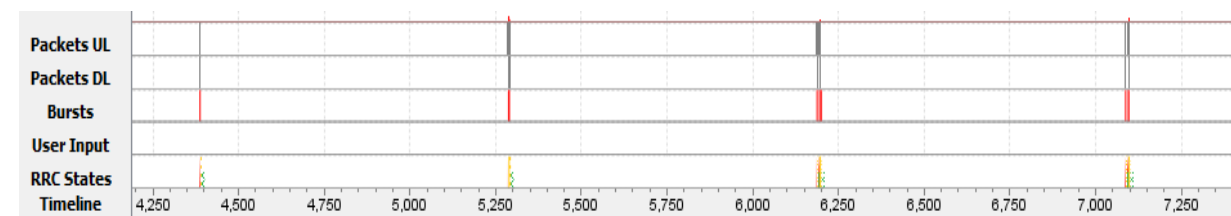


Cautionary Tales

- A very popular streaming application was **not compressing text files** that contained subtitles – OPTIMIZED to get 17% data savings on iOS.
- A very popular music streaming app was **not compressing** and repeatedly sending down metadata files that listed every song on every channel – OPTIMIZED to reduce the 45% metadata.
- A very popular video streaming application sent down **oversized 1MB thumbnails** of movie posters when users browsed – OPTIMIZED to increase load time by 3 seconds.
- A very popular sports application was **not caching** the logos for certain sports teams – OPTIMIZED to reduce data use and improve load time.
- A very popular social application was **turning the radio on seven times** for every background update – OPTIMIZED to saver user battery life.



Radio on for ~75 seconds every 30 minutes



Radio on for ~37 seconds every 30 minutes

Daylighting Best Practices for 4G

- AT&T Labs-Research team studied a number of applications and worked with a developers to understand problems and create an evolving set of Best Practices for Mobile Applications
- The work was widely publicized through the AT&T Developer Program starting in 2011.
- Examples:

Suggested Best Practices for File Download		
Text File Compression	Provides background on the different methods for text file compression, looks at the issue of when it is most beneficial to use compressions, and provides a recommendation for using text file compression to make your app pages render faster.	View
Duplicate Content	Looks at how content becomes duplicated, how that effects an application, and offers recommendations for developing a caching strategy to reduce duplicate content.	View
Cache Control	Describes the caching mechanisms and Cache-Control directives that are specified in the HTTP/1.1 Protocol, discusses why caching is important, and provides recommendations for implementing a cache in an application.	View

Text File Compression

Introduction

Compressing text files makes them smaller and faster to send, and unzipping files on a mobile device has low overhead. So, it is recommended that you compress text files while they are being sent over wireless networks.

When compressing text files under 850 bytes, however, the extra overhead is not worth the effort, so the Best Practice recommendation is to compress text files over 850 bytes. This will speed downloads and text will render faster for users.

Background

Compression is a technique for reducing the number of bits needed to store or transmit data. There are number of methods for compression available. The most broadly supported is gzip, which is very fast and has a small memory footprint.

Text files include a variety of different file types, including HTML, JavaScript, CSS, txt, etc. Text compression typically works by finding similar strings within a text file, and replacing those strings with a temporary binary representation to make the overall file size smaller.

Research has shown that compressing text files over 850 bytes will improve downloading enough to overcome overhead incurred in decompressing the files.

Here is the W3C Mobile Best Practice recommendation for transfer compression:

*HTTP 1.1 compression, which uses the gzip and DEFLATE algorithms, is widely supported. Web servers should be configured to serve appropriately compressed responses.

*Note however, that the cost (in time and battery usage) of decompressing data should be balanced against the gains in transport efficiency. When configuring HTTP 1.1 compression, note that:

- Most image formats (especially JPEGs) do not benefit from compression, but SVG does;
- Most other media formats (e.g. audio, video) do not benefit from compression;
- Very small files (e.g. <1k) generally do not benefit from compression.

Video Optimizer has a test that measures for uncompressed text files. If over 5% of an app's text files are not compressed, Video Optimizer flags it.

The Issue

A large percentage of mobile apps are serving text files uncompressed, which affects the app's performance.

In order to compress the files, compression needs to be supported, and there needs to be an agreement that it's alright to exchange compressed files. The agreement has two parts:

- The app sends a header telling the server it accepts compressed content. `Accept-Encoding: gzip, deflate`
- The server sends a response if the content is actually compressed: `Content-Encoding: gzip`

If the server doesn't send the content-encoding response header, it means the file will not be compressed, which is the default on many servers. The 'Accept-encoding' header is just a request, not a demand. If the server does support compressed content, the app will accept the uncompressed version.

The most common compression schemas are 'gzip' and 'deflate'. Major mobile platforms support for gzip and deflate, but implementation will differ.

Best Practice Recommendation

Compressing large files will speed download, thus making the page render faster. The Best Practice Recommendation is to compress text files whenever possible.

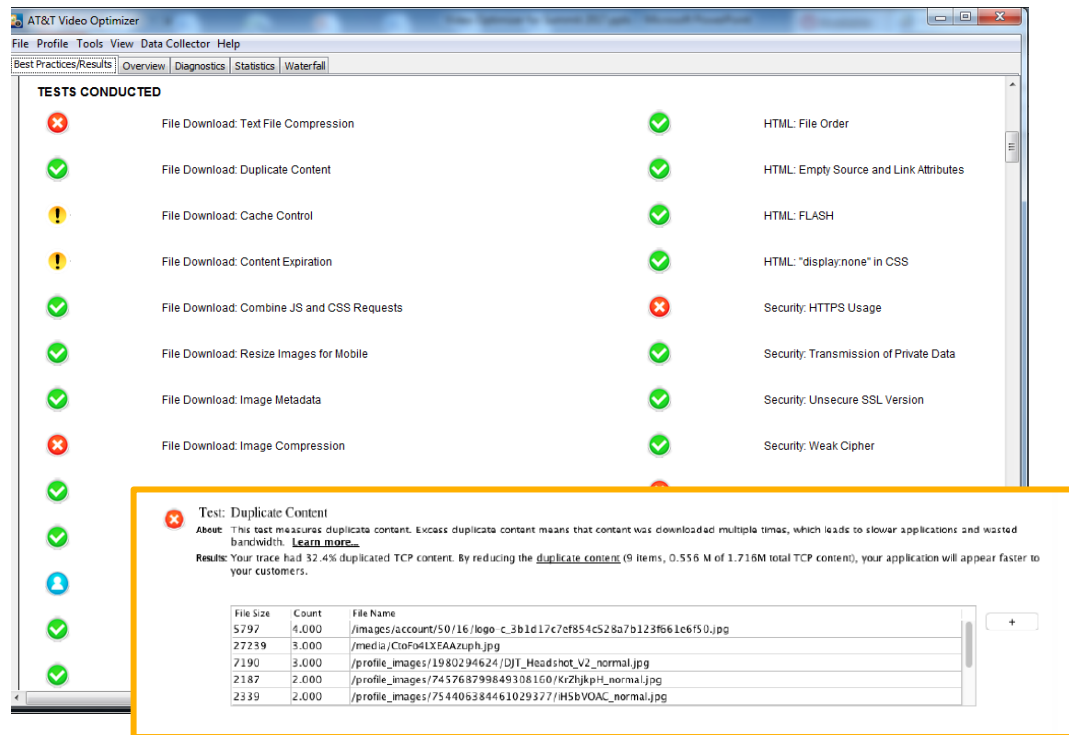
You can use Video Optimizer to make sure you are compressing text files correctly. Video Optimizer runs automated tests for uncompressed text files:

If total size of all the uncompressed files in a trace < 8 -> Pass for Best Practice test
If 8 < total size of all the uncompressed files a trace < 100 -> Warning for Best Practice test
If total size of all the uncompressed files a trace >= 100 -> Fails the Best Practice test

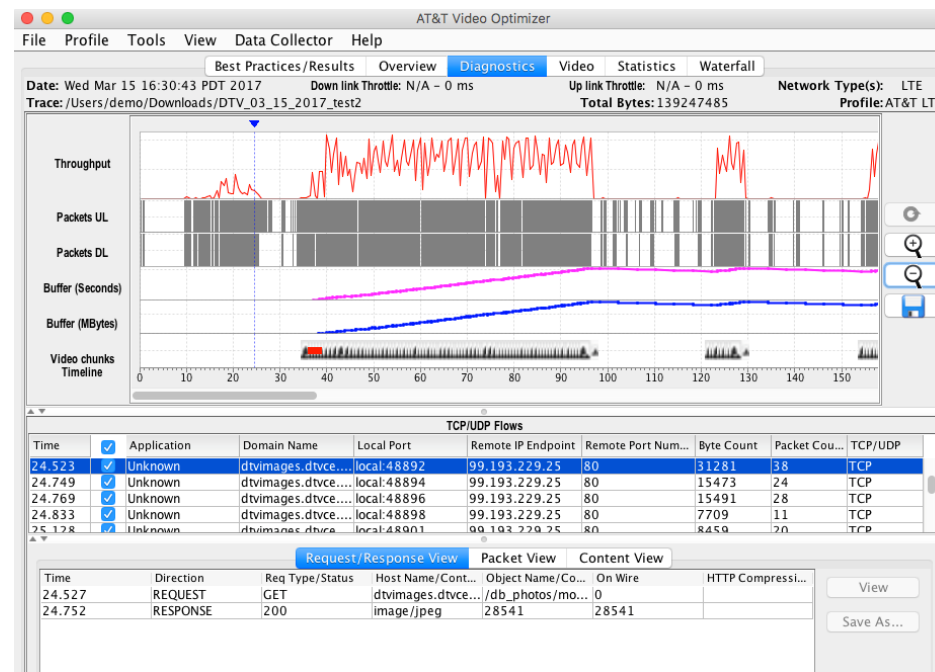
<https://developer.att.com/video-optimizer/docs/best-practices>

Instrumenting Best Practices

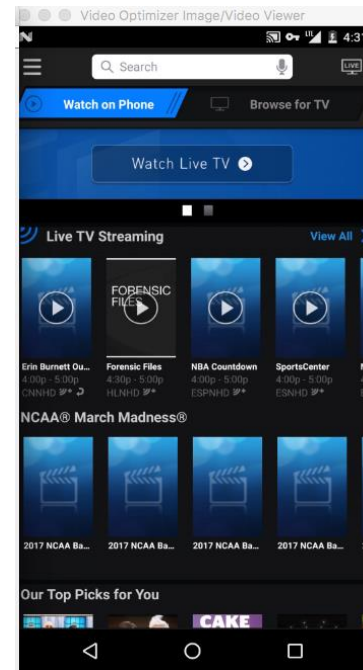
- AT&T Labs-Research team created a tool, initially known as **AT&T Application Resource Optimizer (ARO)** and later rebranded as **AT&T Video Optimizer (VO)**.
- This Open-Source tool captures application traces, determines if Best Practices are followed, and enables visual analysis of issues.



Best Practices Results Pane



Analysis Pane



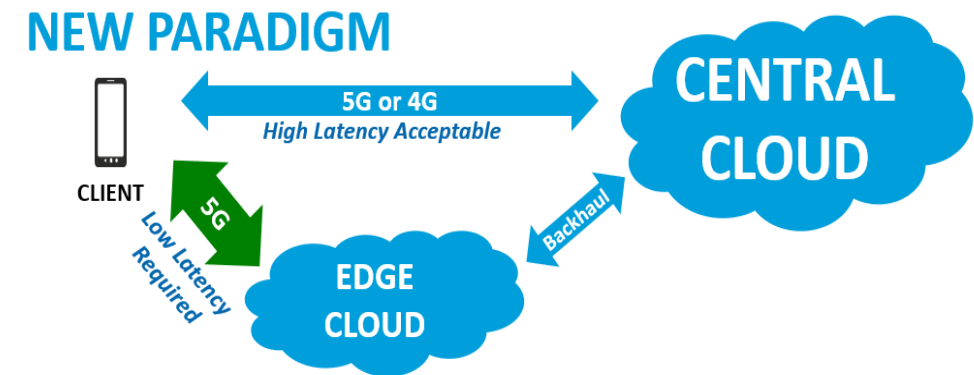
Screen Capture

Accelerating the 5G Ecosystem

The **4G/LTE** App Ecosystem has matured - **most major apps have optimized.**

However, **5G will present significant new challenges** for developers:

- **Ultra-low latency** use cases (inter-vehicle communication, 'real-time' kinesthetic apps, XR)
- Balancing **Edge vs Central** Cloud Architectures



GSMA Work Item Proposal

Initiate a work activity focused on:

- 1. Best practices** for a new class of applications that will take advantage of the ultra-low latency provided by emerging 5G Networks.
 1. Identify and document high level 5G application patterns
 2. Map the discovered patterns to recommended best practices highlining potential benefits/gains

- 2. Tools and Test techniques** that will enable developers of these ultra-low latency applications to more easily take advantage of 5G network capabilities and deploy these applications in a way that creates a predictable user experience and minimizes negative impacts on mobile networks.

5G Application Best Practices

Emerging 5G networks and edge computing will enable classes of mobile applications that have been **previously impossible**. These previously unimagined applications will utilize ultra-low latency to respond in ‘human’ time, enabling a new class of kinesthetic and XR applications.

With few real “5G Applications” deployed, **there has not been adequate time or focus to create a cannon of Best Practices.**

The work item will investigate learnings from 5G applications that have been or expected to be deployed across the globe and develop a set of Best Practices that can be then shared openly across the ecosystem.

5G Application Tools and Test Techniques

This Work Item will **evaluate tools available in the application ecosystem and develop a strategic plan** for how these tools could be extended to test applications for the 5G Best Practices developed in the first work item.

In particular, **the work item will focus on tools that will help assure that 5G applications utilize the network efficiently**, without causing issues that would impact other users.

