An ns-3 distribution supporting MPTCP and MPEG-DASH obtained by merging community models
Vitalii Poliakov, Damien Saucez, Lucile Sassatelli

To cite this version:

HAL Id: hal-01825592
https://hal.archives-ouvertes.fr/hal-01825592
Submitted on 11 Jul 2018

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
An ns-3 distribution supporting MPTCP and MPEG-DASH
obtained by merging community models

Vitalii Poliakov
Université Côte d’Azur, CNRS, I3S, France
poliakov@i3s.unice.fr

Damien Saucez
Université Côte d’Azur, Inria, France
damien.saucez@inria.fr

Lucile Sassatelli
Université Côte d’Azur, CNRS, I3S, France
sassatelli@i3s.unice.fr

ABSTRACT
MPEG-DASH and MPTCP are two technologies growing in interest and put together they promise greater quality of experience for video consumers and better network resource usage. However, while independent MPEG-DASH and MPTCP implementations exist for ns-3, they are not directly usable together as they suffer from incompatibilities. In this work, we introduce a new ns-3 distribution that packages the AMuSt Framework DASH implementation and the ns-3 MPTCP implementation from University of Sussex such that they can be used together to nourish the flourishing research on Internet video streaming.

1 INTRODUCTION
As volumes of online video streaming continue to grow, researchers seek ways to make it more efficient. Apart from developing better client- or server-side solutions, the research on the video delivery over the network remains a difficult-to-approach domain owing to the need to run large-scale experiments. Such experiments should involve modern video delivery technologies like HTTP Adaptive Streaming (HAS) [1, 6] and Content Delivery Networks (CDN), as well as complex network topologies. For these reasons, most of the research in this domain remains done by teams in collaboration with large CDNs and content providers (e.g., Akamai and Netflix).

Despite that ns-3 is an alternative to having a real deployment, existing ns-3 models are quite diverse and have a rather loose compatibility between each other. It results that researchers often have to spend efforts to make several ns-3 modules gleaned from the Internet work together.

MPEG-DASH and MPTCP are two technologies that one would naturally study together. However, even though ns-3 community provides MPEG-DASH and MPTCP implementations, it happens that they are not directly usable due to incompatibilities. In this work, we present an ns-3 distribution that packages the AMuSt Framework DASH implementation [5] and the ns-3 MPTCP implementation from University of Sussex [4] such that they can be used together to nourish the flourishing research on Internet video streaming.

3 PUTTING MPTCP AND MPEG-DASH TOGETHER
In the following we describe the main manipulations that we did to make our two models work together.

3.1 Modifications for MPTCP
The selected implementation of MPTCP seems to be focused on making the connection initiator to be the transmitting entity, therefore some of the features of the socket do not work when the other party has to transmit data as well. In addition to that, the implementation does not directly allow

1https://github.com/bitmovin/libdash
one to send real data from applications. Here we discuss modifications which mitigate those limitations; unless otherwise noted, they only concern the file

```
src/internet/model/mp-tcp-socket-base.cc (together with its header file)
```

(1) MSS as it is done for the connection initiator methods; note that it is, however, not an optimal value [2].

The `SendPendingData` method checks whether the currently selected MPTCP subflow has already been established; otherwise, the next subflow is selected. However, in the latter case the connection receiver’s socket fails to change the subflow and hence ceases to transmit. We have not been able to identify the cause of this, though calling `getSubflowToUse` method inside of the (mentioned above) conditional clause solves the issue without any side effects.

### 3.2 Modifications for AMuSt-DASH

The selected implementation of MPTCP does not replace the stock TCP socket, but instead comes in complement to it. Therefore, all applications written willing to use MPTCP must be updated to use this specific multipath socket – including the AMuSt-DASH model. As mentioned before, the MPTCP we use makes it fairly easy to convert applications for multipath; though the API itself is rather different, the specifics of MPTCP protocol – like subflow establishment – are done entirely by the socket itself without any need to program them in the application. As a result, the application will follow exactly the same steps for establishing/receiving an MPTCP connection than for TCP but with minor differences in methods called, as explained below.

First, each method of the application handling a socket has to cast it to an MPTCP socket using a `DynamicCast` directive.

Second, the selected implementation of MPTCP does not have a `Send(Ptr<Packet>...)` method. Instead, one needs to fill the TX buffer with data using `FillBuffer`, and then call the `SendBufferData` method to initiate data transmission.

### 4 COMPILING THE MERGED DISTRIBUTION

The two models mentioned above have been developed for different ns-3 versions which are not fully compatible with each other. This leads to compilation errors once the files are merged together; here we discuss them and explain fixes.

Since the implementation of MPTCP is rather complicated and spans across multiple files, we have decided to use its distribution as a substrate and merge the AMuSt-DASH (which is an application) into it. This requires copying the AMuSt-DASH-specific files (i.e., models, headers, and helpers) from `applications` module into the distribution supporting MPTCP, without forgetting to update `src/applications/wscript` and `src/wscript` scripts to correctly build the modified modules.

The header file `src/internet/model/tcp-socket.h` has been changed between ns-3.19 and ns-3.24 as the TCP states declaration has been rethought; the version included in ns-3.19 (MPTCP) declares the states outside of the `TcpSocket` class, while the one in ns-3.24 (DASH) has them inside. We have adopted the newer version of the file, which hence required updating seldom references to the TCP states in the TCP/MPTCP socket of the substrate distribution such that they are accessed from the `TcpSocket` namespace.

Next, AMuSt-DASH requires custom string handling functions: `string_ends_width()`, `zlib_compress_string()`, and `zlib_decompress_string()`. These functions are implemented in file `src/core/model/string.cc` of the original AMuSt-DASH distribution and can safely be added in the module. It has to be noted, however, that two last functions depend on ZLib library², so its support has to be added in the `src/core/wscript` (exactly as it is done in the DASH distribution).

²https://zlib.net/
5 CONCLUSION

In spite of the several unclear points (that we have mentioned above), and the fact that the resulting distribution is based on ns-3.19, our tests until this moment suggest that the distribution is rather stable and usable for performing experiments involving MPEG-DASH and MPTCP.

Ultimately, we would like to create a stand-alone module holding the mentioned implementations of MPEG-DASH and MPTCP, that could be used with an ns-3 distribution of choice. Unfortunately, the implementation of MPTCP requires modifications to essential files such as tcp-l4-protocol.cc, which might differ between releases of ns-3. Therefore, creating a proper module of this kind will most likely require having MPTCP supported by the official releases of the simulator.

REFERENCES