Factors Limiting the Modularity of xTFA

Dagstuhl Seminar on Network Calculus

Ludovic Thomas (CNRS/LORIA)

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Experimental modular Total-Flow Analysis (xTFA) in a few words

xTFA is a Python tool (GPLv3) for computing network-calculus delay bounds in networks. Arrival-curve oriented

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Why a new tool? Origin of xTFA.

Packet Replication and Elimination Functions [Thomas, Mifdaoui, Le Boudec 2022]
Or TSN FRER: Frame Replication and Elimination for Reliability

January 2021: “Implementing FRER in TFA looks easy because it is very similar to the input shaping. But for this reason, both steps look incompatible”

“Towards a unification of NC improvements applied on TFA”

```python
def compute_aggregate_arrival_curve(output_port, network_info):
    if input_shaping_activated:
        # do some stuff...
    if frer_is_active:
        # do some other stuff...
```

Closed-form expressions 😞

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Fast foward...

Not from a maximum service curve
Greedy shaping not clear

Packetization
Packet elimination
Packet ordering
Interleaved regulator

CBS
Shaping

f_1 → CBQS Pack.
g_1 → CBQS Pack.
f_2 → CBQS Pack.
g_2 → CBQS Pack.

Optional
CBQS
Output port

functions

Effect depends on accumulated jitter
No (useful) service curve
Except if input link rate is known

[Thomas, Le Boudec 2023]
The shaping-for-free property of the IR cannot be explained by a service-curve property

Cyclic dependencies
Non-ideal clocks

 Except if shaping-for-free
 It depends on FIFO property
 And clock properties

The reality

- The effects of some network elements on arrival curves and end-to-end latencies **do not derive** from service-curve properties.
- Some service-curve properties and most non-service-curve properties of network elements depend on various, sometimes non-local assumptions.
- Experimental modular 😞 TFA

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What could be useful for xTFA

- A hierarchy/terminology of service curves with respect to their assumptions.

Packetized input?  
\( L_{\text{min}}, L_{\text{max}} \) ?  
Input rate \( c \) ?

FIFO upstream systems?  
Output rate \( c \) ?

In [Thomas, Le Boudec 2023], concept of context-agnostic service curves.

- More locally available information for flows. Exemple, current xTFA:
  - Arrival curve
  - Packet sizes \( L_{\text{min}}, L_{\text{max}} \)
  - List of key ancestors
  - Vector of RTO (Reordering Time Offset) values with respect to key ancestors
  - Vector of \( D_{\text{min}}, D_{\text{max}} \) values from key ancestors
  - Observing clock

- Some model for the service of “weird” network elements?
Bibliography I


