ERASER: Experimenting with real application-specific QoS guarantees in a large-scale RINA demonstrator

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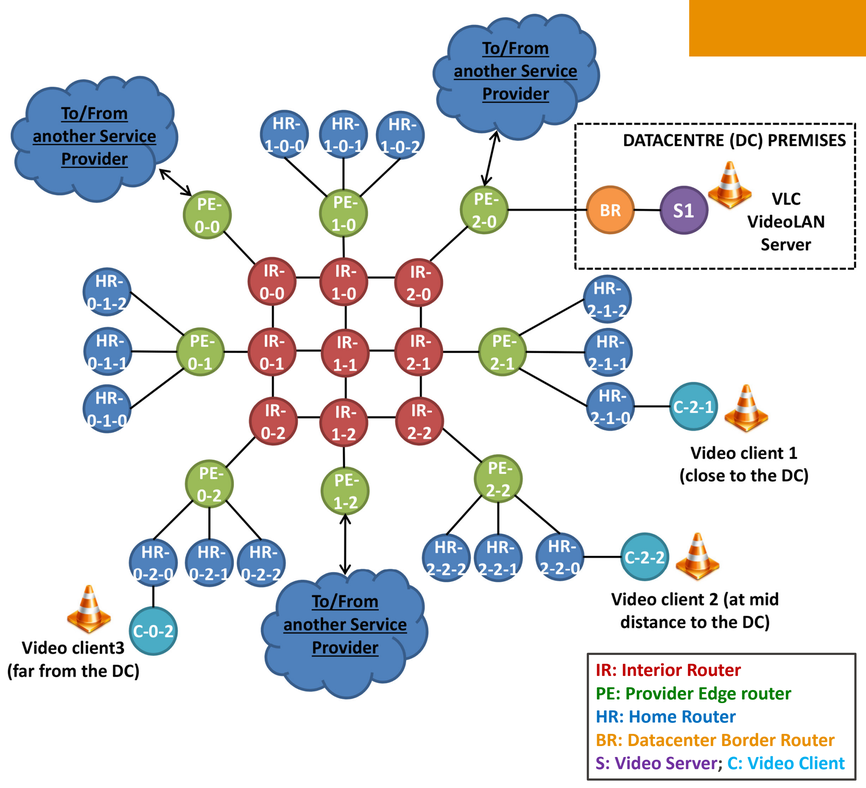
GOALS

1. **To define QTA-Mux deployment scenarios** and QoS cubes to be ensured in a large-scale metro/regional RINA network
2. **To emulate a realistic large-scale metro/regional RINA network** injecting synthetic application traffic flows
3. **To evaluate the RINA QoS support** measuring the QoS metrics perceived by such synthetic traffic flows end-to-end
4. **To perform a real HD video (1080p) streaming demo** to better show the RINA QoS support under high congestion

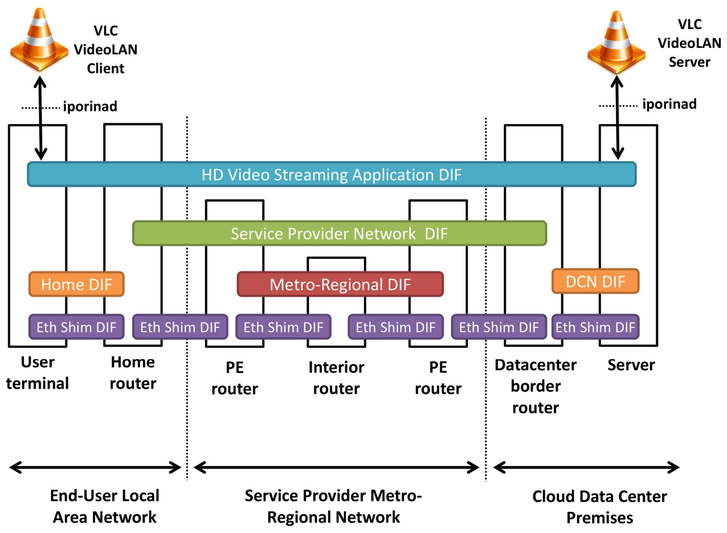
CHALLENGES

- **Besides JFed**, several open source RINA prototypes have been employed, requiring their initial integration & testing:
  - **IRATI RINA Stack for OS/Linux**
  - **Rumba**
  - **QTA-Mux scheduling policy**
  - **RINA t-gen**
  - **rina-echo-time**
  - **iporinad**

DEMO SETUP



37-Node emulated metro/regional RINA network at Fed4FIRE+ Virtual Wall facility hosted by imec in Ghent



Configured DIFs in the emulated scenario

Offered QoS cubes at SPN and MR DIFs:

Urgency \ Cherished	+	-
+	Gold	-
	Silver	Sensitive BE
-	Bronze	BE

QoS Cubes offered by the SPN DIF

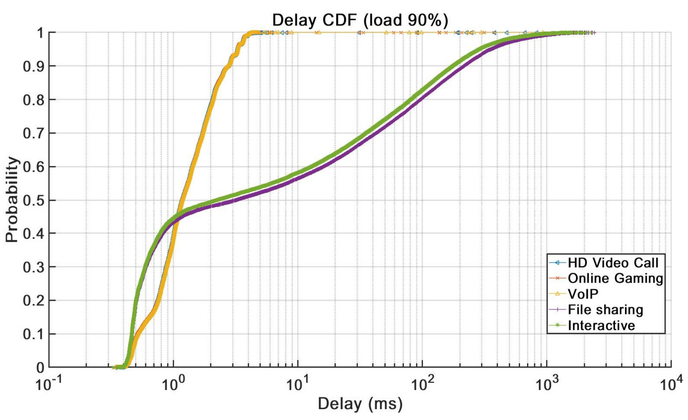
Urgency \ Cherished	+	-
+	A1	A2
-	B1	B2

QoS Cubes offered by MR DIF

Synthetic application traffic flow characteristics:

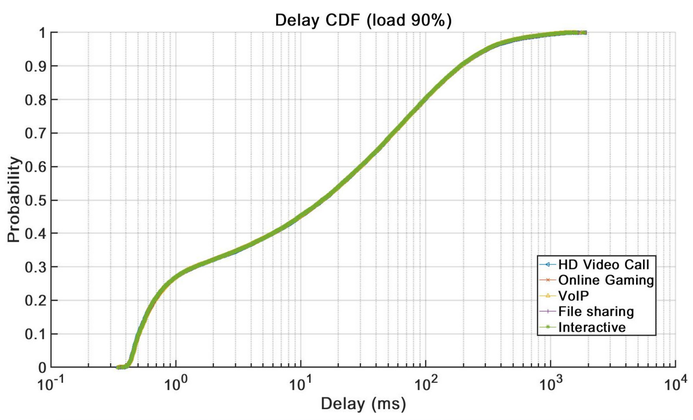
Application flow	Traffic distribution	Traffic direction	Details	Assigned to QoS Cube
HD Video Call	CBR	Bidirectional	CBR bitrate: 1.5 Mbps	Gold
Online Gaming	ON-OFF	Bidirectional	ON-OFF period avg. duration: 4s – 2s CBR bitrate during ON period: 4 Mbps	Silver
VoIP	ON-OFF	Bidirectional	ON-OFF period avg. duration: 3s – 3s CBR bitrate during ON period: 64 kbps	Sensitive BE
File Sharing	ON-OFF	Bidirectional	ON-OFF period avg. duration: 2s – 1s CBR bitrate during ON period: 5 Mbps	Bronze
Interactive traffic	Poisson	Bidirectional	Avg. bitrate: 2 Mbps	BE

RESULTS



Traffic type	Min. latency (ms)	Max. latency (ms)	Avg. latency (ms)	Avg. packet loss (%)
HD Video Call	0.345145	830.5	1.483987	0.001659
Online Gaming	0.3626	375.76	1.468362	0.002339
VoIP	0.345375	924.95	1.469585	0.001342
File Sharing	0.354075	2408.85	72.310218	0.231222
Interactive	0.32893	2276	58.650972	3.469220

QTA-Mux at both SPN & MR DIFs (90% load)



Traffic type	Min. latency (ms)	Max. latency (ms)	Avg. latency (ms)	Avg. packet loss (%)
HD Video Call	0.342600	1889.6	69.764187	0.139793
Online Gaming	0.343865	1893.9	70.126824	0.173666
VoIP	0.345180	1846.05	69.738218	0.150003
File Sharing	0.351630	1876.3	70.223907	0.155559
Interactive	0.346925	1865.15	69.441732	0.185567

QTA-Mux at the SPN DIF only (90% load)

A **synthetic traffic matrix composed of 75 bidirectional flows** (15 of each type) is injected into the network, subsequently **limiting the capacity of NICs between IRs** so as to **reproduce 70%, 80% and 90% offered load scenarios**

QoS Cube assigned at HD Video Streaming DIF	S1 -> C-2-1 (1 hop at MR DIF)	S1 -> C-2-2 (2 hops at MR DIF)	S1 -> C-0-2 (4 hops at MR DIF)
Gold	5 (perfect quality)	5 (perfect quality)	5 (perfect quality)
Best Effort	2 (severe stuttering & frames lost)	1 (completely frozen)	2 (severe stuttering & frames lost)

QoS Cube assigned at HD Video Streaming DIF	S1 -> C-2-1 (1 hop at MR DIF)	S1 -> C-2-2 (2 hops at MR DIF)	S1 -> C-0-2 (4 hops at MR DIF)
Gold	5 (perfect quality)	3 (moderate stuttering & frames lost)	5 (perfect quality)
Best Effort	2 (severe stuttering & frames lost)	1 (completely frozen)	1 (completely frozen)

HD video streaming demo: Video qualities at destination in 80% (top) and 90% (bottom) load scenarios

CONCLUSIONS

- When **configured at both SPN & MR DIFs**, **QTA-Mux** provides **effective QoS differentiation based on both delay and loss requirements**, even under high congestion (90% offered load)
- Conversely, **when configured at the SPN DIF only**, the underlying default FIFO scheduling at the MR DIF thwarts it, **receiving all flows identical treatment, eventually**.
- **Final demonstration results** show **appropriate QoE of the received HD video streaming session** in almost all situations **when assigning flows the Gold QoS Cube**

POST MORTEM

- **Experience gained in ERASER** with open-source RINA implementations and tools will be **leveraged to deploy a small-scale RINA network test-bed at the UPC** in the context of the Spanish National project ALLIANCE, so as to open new research lines around RINA
- Interesting **proposals yielding good results at small-scale** might be good candidates for **large-scale evaluation over Fed4FIRE+**
- **Dissemination of the ERASER results** and how **Fed4FIRE+ has allowed us to obtain them** will also be targeted