5G MAG REFERENCE TOOLS

6G Testbed and AI Traffic Characterization

3GPP A GLOBAL INITIATIVE

Qualcomm

6G Testbed and AI Traffic Characterization

Overview on the 5G-MAG Reference Tools

Main scope of the project

- 6G AI Traffic Characterization
- Measure traffic characteristics of generative AI services (LLMs, image/video generation)
- Analyze agentic AI patterns such as multi-step tool calling and tool server workflows
- Evaluate QoE under emulated network conditions like latency, loss, and bandwidth

Additional Scope:

- Open-source testbed for AI/media traffic evaluation
- Targets 5G, 6G, and realistic UE-observed network conditions
- Supports 3GPP SA4 studies and broader media delivery evaluations
- Can be extended and may be used for other purposes

3GPP TR 26.870 V0.2.1 (2026-02)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Study on Media Aspects for 6G System
(Release 20)

More information at developer.5g-mag.com

Evaluation of media delivery protocols (HTTP, QUIC, WebRTC)

- **QUIC-based streaming** (FS_QStream_MED) - S4-252112.zip
  - aims to evaluate the performance of QUIC-based streaming technologies against traditional TCP-based approaches (HTTP/1.1, HTTP/2) for various media services in 5G and future 6G contexts. The study builds upon initial explorations from FS_AMD (TR 26.804).
- **Real-time communication** (FS_Q4RTC_MED) - S4-252139.zip
  - The primary goal is to investigate the benefits and integration of QUIC-based media delivery protocols for Real-time Communication (RTC) within the 3GPP framework.
- Usage of **Dynamically Changing Traffic Characteristics and Enhanced QoS Support in Media Applications and Services** - S4-251588.zip
- Generic media and application testing under 3GPP network profiles

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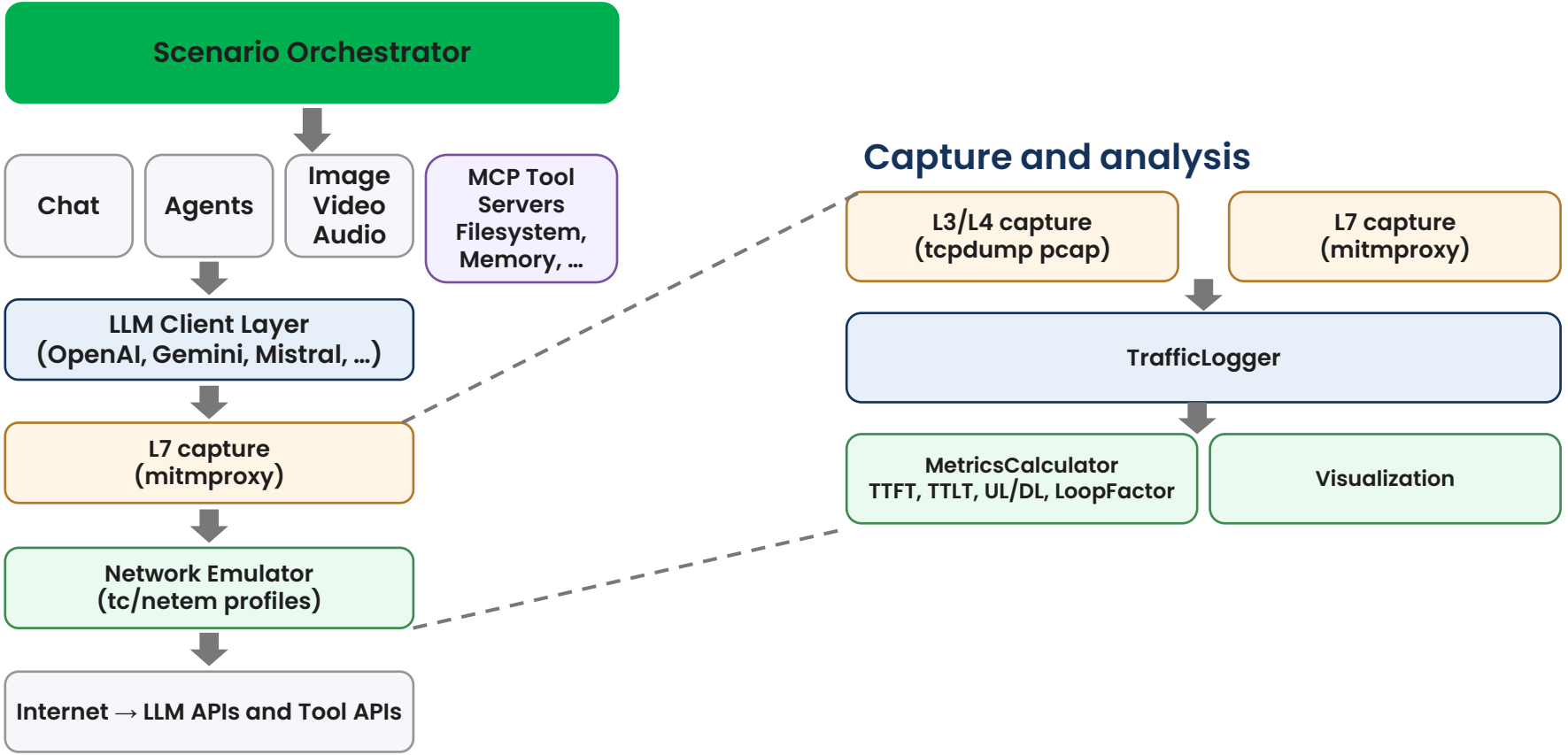

More information at developer.5g-mag.com

netemu/ – Network Emulation Library

- A lightweight Python wrapper around Linux traffic control (tc/netem) used to emulate realistic network conditions.

Features:

- Emulates delay, jitter, packet loss, and bandwidth limits
- Supports bidirectional shaping via IFB devices
- Includes 27+ predefined profiles, aligned with 3GPP concepts (e.g., 5QI-like mappings)
- Context-manager design for automatic setup and cleanup
- Can be used independently of the AI testbed

Network Profiles

- The repository includes predefined network profiles representing real-world and future scenarios, such as:
  - Ideal 6G (near-zero latency, no loss)
  - 5G Urban
  - Good Wi-Fi
  - Cell Edge / Poor Coverage
  - Satellite / NTN (LEO-like latency)

- These profiles allow repeatable experimentation across vastly different network conditions

```
# Example Network Profiles for netemu
# These profiles demonstrate common network condition emulations

profiles:
  # Ideal conditions - no impairments
  ideal:
    description: "Ideal network - no impairments"
    delay_ms: 0
    jitter_ms: 0
    loss_pct: 0
    rate_mbit: null  # Unlimited

  # Good WiFi connection
  good_wifi:
    description: "Good WiFi connection"
    delay_ms: 30
    jitter_ms: 10
    loss_pct: 0.1
    rate_mbit: 50

  # Poor cellular connection
  poor_cellular:
    description: "Poor cellular signal / cell edge"
    delay_ms: 120
    jitter_ms: 30
    loss_pct: 1.0
    rate_mbit: 5

  # Satellite link (high latency)
  satellite:
    description: "Satellite connection - high latency"
    delay_ms: 600
    jitter_ms: 50
    loss_pct: 0.5
    rate_mbit: 10
```

6G Testbed and AI Traffic Characterization

Overview on the 5G-MAG Reference Tools

aitestbed/ - Key capabilities:

- **11+ AI scenario types**, including:
  - Chat-based LLM interaction
  - Agentic AI using Model Context Protocol (MCP) tools
  - Image generation
  - Multimodal (text, audio, image, video)
  - Video understanding
  - Real-time AI via **WebSocket** and **WebRTC**
- **8+ LLM providers**, including OpenAI, Gemini, DeepSeek, vLLM, and real-time variants
- **60+ metrics**, such as:
  - Time to First Token (TTFT)
  - Time to Last Token (TTLT)
  - Latency percentiles
  - Uplink/downlink traffic ratios
  - Token throughput rates
  - Agent loop factors
- **Multi-layer traffic capture:**
  - L3/L4 via `tcpdump`
  - L7 via `mitmproxy`
- **Structured logging** using SQLite for post-analysis and reproducibility.

More information at developer.5g-mag.com

Key parameters

Scenario	Expected pattern
TTFT	Time to first token
TTLT	Time to last token
L_session	Total session duration
B_UL, B_DL	Uplink and downlink bytes
R_UL	UL ratio B_UL / (B_UL + B_DL)
Latency	Audio latency
CallsPerPrompt	API calls per user prompt (agents)
Success rate	Completion rate per profile
Token rate	Tokens per second in streaming

6G Testbed and AI Traffic Characterization

Overview on the 5G-MAG Reference Tools

Scenarios

Scenario	What it tests	Expected pattern
Chat (Basic)	Single turn text	Low UL, moderate DL, latency sensitive
Chat (Streaming)	Token streaming	Continuous small chunks, TTFT critical
Chat (conversational)	Real-time audio via WebRTC	Real-time audio
Shopping Agent	MCP tools: search + fetch	Multi-burst, multi-hop requests
Web Search Agent	Research workflow	Variable latency, multi-stage
General Agent	Full MCP toolset	Tool diversity and bursts
Image/Video Generation	Prompt + binary output	Small UL then large DL Progressive output?
Direct Web Search	Parallel HTTP (no MCP)	Burst traffic, concurrent requests

The Media Connectivity Association

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