ADVANCE MULTIMEDIA SERVICES

COURSE 2025

PRACTICE 2

Reference Manual System for a Streaming Platform (*MultiAdvancedFlow*)

Alberto López Casanova

Manuel Ángel Vega Gómez

INDEX

INDEX OF FIGURES

1 Introduction

MultiAdvancedFlow is a full-stack web application for uploading, live-restreaming, viewing, recording and organizing video. Built with React + Vite, Node/Express, Node-Media-Server (NMS) and MongoDB, it targets educational and leisure scenarios where users need to mix on-demand uploads with low-latency live playback. It also provides the ability to interact with live and recorded content anytime

2 System Requirements

Layer	Minimum	Recommended
Operating System	Linux/macOS/Windows 10	Windows 10
CPU	2 cores, 4 GB RAM	4 cores, 8 GB RAM
Frontend	Modern browser, 1280×720	Chrome / Firefox / Edge latest
Backend	Node.js ≥ 20.x	Node.js 20.5.0
Database	MongoDB ≥ 5.0	MongoDB 6.0
Media	MPEG ≥ 6.1	Same
Container	Docker 24+, docker-compose v2	—

2.1 MAIN SOFTWARE CORE VERSIONS

Technology	Versions used in repo	Minimum supported
React	18.3.1	18.x
Vite	5.4.1	5.x
Express	4.21.2	4.18
Node-media-Server	2.6.1	2.6.0
Mongoose	8.12.1	8.x (Requires MongoDB ≥ 5.0)
Video.js (player)	8.10	8.x

3 Architecture

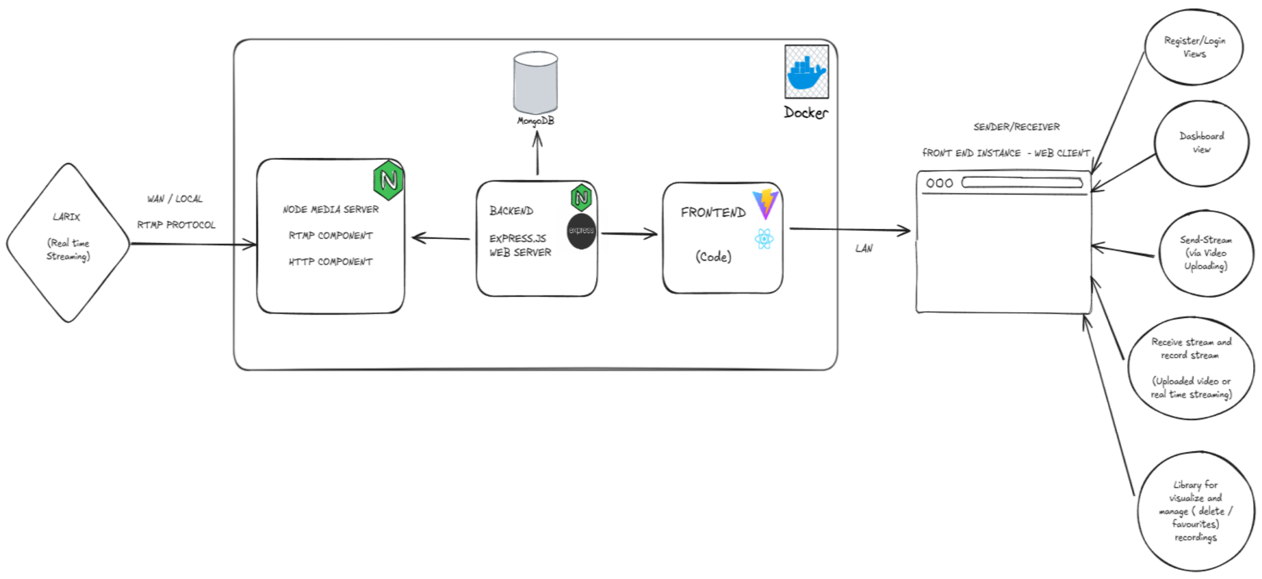


Figure 3-1 Basic Diagram

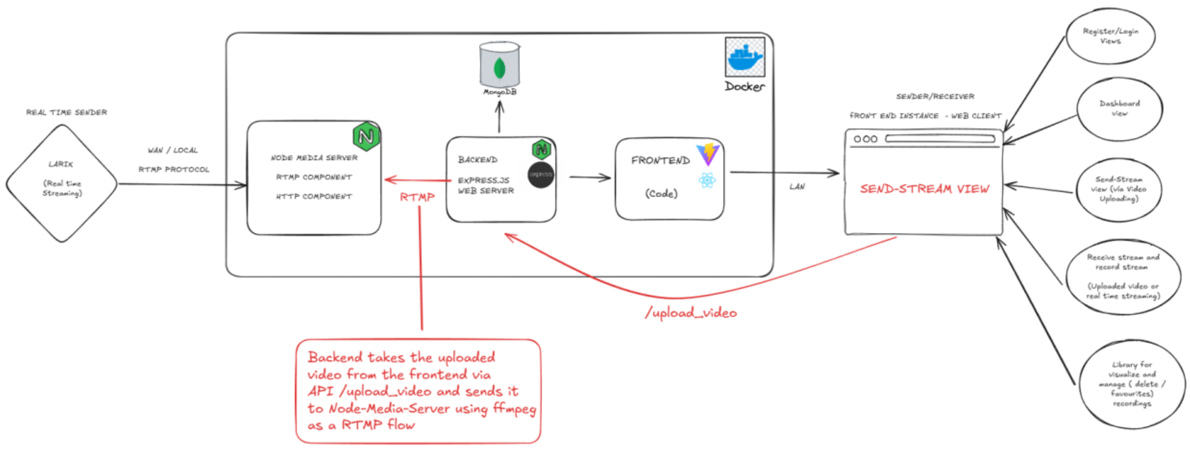
3.1 COMPONENT RESPONSIBILITIES

The global responsibilities or functions of each component are:

- **Frontend** – UI, JWT handling, HLS playback (video.js), recording library management.
- **Backend** – Auth (JWT), REST APIs, MPEG, save recordings, MongoDB.
- **Node-Media-Server** – RTMP ingestion, on-the-fly HLS packaging.

3.2 UPLOAD-TO-LIVE SEQUENCE

The sending of the streaming can be done by uploading a video from the frontend as the following diagram shows:

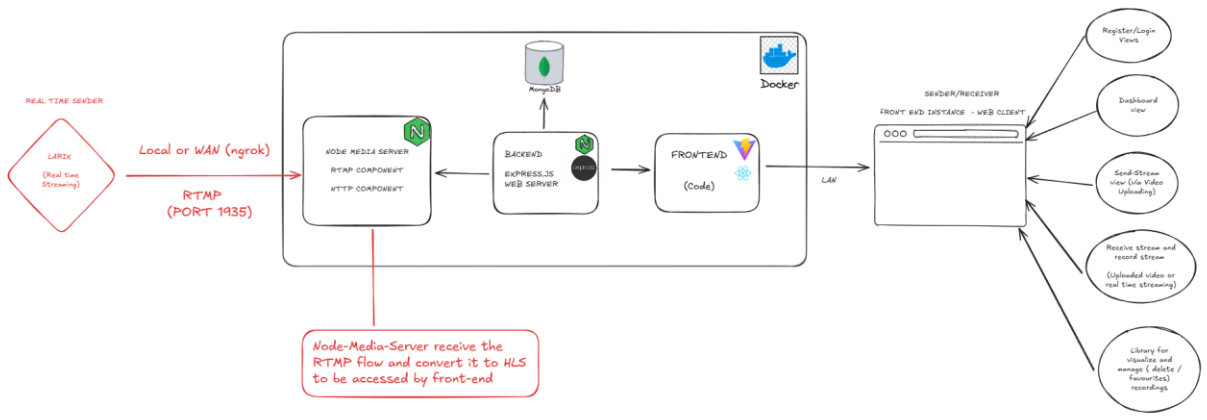


REAL TIME SENDER
LARIX
(Real time Streaming)
WAN / LOCAL
RTMP PROTOCOL
NODE MEDIA SERVER
RTMP COMPONENT
HTTP COMPONENT
RTMP
MongoDB
BACKEND
EXPRESS.JS WEB SERVER
FRONTEND
(Code)
Docker
LAN
SENDER/RECEIVER
FRONT END INSTANCE - WEB CLIENT
SEND-STREAM VIEW
/upload_video
Backend takes the uploaded video from the frontend via API /upload_video and sends it to Node-Media-Server using ffmpeg as a RTMP flow
Register/Login Views
Dashboard view
Send-Stream view (via Video Uploading)
Receive stream and record stream (Uploaded video or real time streaming)
Library for visualize and manage (delete / favourites) recordings

Figure 3-2 upload to live diagram

3.3 UPLOAD LIVE STREAMING SEQUENCE

It is also possible to send a streaming (real-time flow) from an external device (e.g. Larix Client) to the Node-Media-Server directly via RTMP as the following diagram shows:



REAL TIME SENDER
LARIX
(Real time Streaming)
Local or WAN (ngrok)
RTMP
(PORT 1935)
NODE MEDIA SERVER
RTMP COMPONENT
HTTP COMPONENT
MongoDB
BACKEND
EXPRESS.JS WEB SERVER
FRONTEND
(Code)
Docker
LAN
SENDER/RECEIVER
FRONT END INSTANCE - WEB CLIENT
Node-Media-Server receive the RTMP flow and convert it to HLS to be accessed by front-end
Register/Login Views
Dashboard view
Send-Stream view (via Video Uploading)
Receive stream and record stream (Uploaded video or real time streaming)
Library for visualize and manage (delete / favourites) recordings

Figure 3-3 upload to live streaming

4 Installation & Deployment

4.1 QUICK START (DOCKER)

Prerequisites: docker & docker-compose v2 installed.

```
$ git clone https://github.com/DotCSanova/nms_multadvser_epsl
$ cd nms_multadvser_epsl/web-server
$ cp .env.example .env  # edit variables if needed
$ cd ..
$ docker compose up -d --build
```

Services start on:

- **Frontend :** http://localhost
- **Web-server (Backend APIs) :** http://localhost:3000
- **NMS HTTP/HLS :** http://localhost:8000
- **NMS RTMP :** rtmp://localhost:1935/live

4.2 RUNNING WITHOUT DOCKER

1. Install Node 20+ and MongoDB.
2. `npm install` inside `/frontend`, `/web-server`, `/node-media-server`.
3. Lunch in separate terminals:

```
# database
mongod --dbpath ./mongodb_data
# node-media-server
node index.js
# backend
pnpm start
# frontend
pnpm start
```

Important Note: Please note that this app is intended and designed to run inside Docker. Therefore, running it outside Docker may require additional modifications to the code, particularly concerning URIs used to connect to different services.

4.3 ENVIRONMENT VARIABLES

The following table shows the different environment variables used in the app, some are included in the '.env' file of the 'web-server' directory and other (majority) are included in the 'docker-compose' file of the app, which is located in the main/general directory.

Variable	Default	Description
`VITE_BACKEND_URI`	http://localhost:3000	Injected in frontend, needed to send requests to the web-server backend.
`MONGO_URI`	mongodb://root:multimedia@db:27017/NMS_MULTIMEDIA_DB?authSource=admin	MongoDB connection.
`JWT_SECRET`	**change-me**	Token signing key. Please change for your case.
`NMS_URI`	http://multimedia_server:8000	NMS HTTP URL with respect the docker container name (ID). It is injected in the backend to make requests to the node media server.
`NMS_RTMP_URI`	rtmp://multimedia_server:1935	RTMP ingest URL. It is injected in the backend to send RTMP traffic to the node media server.

5 Technical Flows

The flows below describe runtime interactions among components. UI navigation details are intentionally omitted—see the User Manual for step-by-step screen guidance.

#	Flow	Entry Point / Protocol	Backend Action	NMS Action	Result
1	**User Registration**	`POST /api/auth/register`	Validate →hash (bcrypt) → store in MongoDB	—	201 Created
2	**Login & JWT issuance**	`POST /api/auth/login`	Verify credentials → sign JWT (HS256)	—	200+ token
3	Upload video-> Live Stream Visualization	`POST /api/upload_video`		Package HLS segments	Clients pull /live/<stream_name>/index.m3u8
4	**Enumerate Active Streams**	`GET /api/streams/active_streams`	Proxy & format `GET /api/streams` (NMS)	—	JSON list of Streams URLs available in NMS

5	**Start Recording**	`POST /api/record/start-recording`	FFmpeg pulls RTMP (NMS)→ save MP4, index MongoDB	—	`recordingId` returned
6	**Stop Recording**	`POST /api/record/stop-recording`	Stop FFmpeg, persist duration	—	200 OK
7	**Fetch Recordings**	`GET /api/record/recordings`	Query MongoDB	—	Array of recordings
8	**Delete Recording**	`DELETE /api/record/recordings/:id`	Remove MP4 + DB doc	—	200 OK
9	**Toggle Favourite**	`PATCH /api/record/recordings/:id/favorite`	Update favourite flag	—	200 OK
10	**Playback Recording**	`GET /api/record/recordings/:id/stream`	Stream MP4 w/ `Accept-Ranges`	—	Progressive playback

6 WEB SERVER BACKEND REST API REFERENCE

6.1 CONVENTIONS

- Auth – send Authorization: Bearer <JWT> header.
- All bodies are application/json unless file upload.

6.2 ENDPOINTS

POST /api/auth/register

```
curl -X POST http://localhost:3000/api/auth/register \
  -H "Content-Type: application/json" \
  -d '{"username":"alice","password":"Passw0rd!"}'
```

Success 201

```
{ "message": "User created" }
```

Errors `400 Validation`, `409 Conflict`, `500 Server`.

POST /api/auth/login

```
curl -X POST http://localhost:3000/api/auth/login \
  -H "Content-Type: application/json" \
  -d '{"username":"alice","password":"Passw0rd!"}'
```

Success 200

```
{ "token": "<jwt>", "expiresIn": 3600 }
```

Errors `401 Invalid credentials, 500.`

GET /api/streams/active_streams

```
curl -H "Authorization: Bearer $JWT" \
  http://localhost:3000/api/streams/active_streams
```

Success 200

```
[{ "streamId":"alice","url":"http://localhost:8000/live/alice/index.m3u8" }]
```

POST /api/upload_video

```
curl -X POST http://localhost:3000/api/upload_video \
  -H "Authorization: Bearer $JWT" \
  -F file=@video.mp4
```

Success 200

```
{ "message":"Upload correctly" }
```

Errors `500 Upload failed`.

POST /api/record/start-recording

```
curl -X POST http://localhost:3000/api/record/start-recording \
  -H "Authorization: Bearer $JWT" \
  -H "Content-Type: application/json" \
  -d '{"streamId":"alice"}'
```

Success 200

```
{ "message":"Recording started" }
```

Errors `400 Parameters left`, `404 User not found`, `500 Upload failed`.

POST /api/record/stop-recording

(similar body).

Returns

```
{ "message":"Recording stopped" }.
```

Errors `500 Server`.

GET /api/record/recordings

```
curl -H "Authorization: Bearer $JWT" \
  http://localhost:3000/api/record/recordings
```

Success 200 – Array of recording metadata.

DELETE /api/record/recordings/:id

```
curl -X DELETE -H "Authorization: Bearer $JWT" \
  http://localhost:3000/api/record/recordings/6632...
```

PATCH /api/record/recordings/:id/favorite

```
curl -X PATCH -H "Authorization: Bearer $JWT" \
  -H "Content-Type: application/json" \
  -d '{"favorite":true}' \
  http://localhost:3000/api/record/recordings/6632/favorite
```

GET /api/record/recordings/:id/stream

Returns MP4 with Accept-Ranges for seeking.

7 Security

- **Authentication** – stateless JWT (HS256). Default expiry 1 h.
- **Token rotation** – client should refresh shortly before expiry.
- **Authorization** – middleware validates user tokens.
- **CORS** – frontend origin whitelisted via env `CORS_ORIGIN`.
- **Secrets** – store in `.env`, never commit.

8 Monitoring and maintenance

Aspect	Tool/Command	Purpose
Logs	`Docker logs nms_multimedia_server`	API Requests, NMS status & FFmpeg events
Metrics	`docker stats`	CPU/RAM/Net usage
Stream list	`curl http://localhost:8000/api/streams`	Active NMS streams

9 Troubleshooting

Error Message	Likely Cause	Fix
`Invalid or expired token`	JWT expired	Login again
`Recording not found`	Wrong ID / deleted	Verify ID, check MongoDB
`Error fetching streams`	NMS down	`docker compose restart multimedia_server`
`Recording file not found`	Disk clean-up removed MP4	Restore from backup

10 Glossary

Term	Meaning / Use in This Project
AAC	Advanced Audio Coding, audio codec used in HLS segments.
bcrypt	Password-hashing algorithm used when creating accounts.
CORS preflight	Browser OPTIONS request that checks cross-origin permissions before the actual call.
CRUD	Create, Read, Update, Delete – core operations exposed by the REST API.
Docker & Docker Compose	Container runtime and orchestration tool used for one-command deployment.
FFmpeg	Command-line tool that encodes uploads to RTMP and records HLS back to MP4.
FFprobe	Companion CLI from FFmpeg suite for probing/diagnosing media streams.
Fluent-ffmpeg	Node.js wrapper around FFmpeg used by the backend for recording.
GOP	Group Of Pictures; complete frame cycle transmitted by RTMP and re-packaged into HLS.
H.264	Video codec used inside MP4/HLS segments for maximum browser compatibility.

HLS	HTTP Live Streaming, adaptive protocol used by browsers to fetch `.m3u8` playlists and `.ts` segments.
JWT	JSON Web Token that carries the user identity; signed with HS256 in this app.
LL-HLS	Low-Latency HLS; achieved here with 1-second segments and playlist size 2.
Mongoose	ODM library that maps MongoDB collections to JavaScript models.
MSE	Media Source Extensions, browser API leveraged by video.js to append HLS segments.
MP4	Container format used for archived recordings on disk.
NMS (Node-Media-Server)	Node.js streaming server that ingests RTMP and produces HLS.
Playlist (.m3u8)	Index file listing the order of HLS segments for a given stream.
React	Front-end JavaScript library powering the SPA.
REST	Representational State Transfer – style followed by all HTTP APIs.
RTMP	Real-Time Messaging Protocol used by the backend to push live video into NMS.
Segment (.ts)	1-second video chunk referenced from the HLS playlist.
Vite	Front-end build tool providing hot module reload.
video.js	HTML5 player library used to render HLS in the browser.

11 License & Contact

- Code released under **MIT License**.
- Report issues or submit PRs at https://github.com/DotCSanova/nms_multadvser_epsl.