

ip cameras

Service Summary: The DrHeck Camera Hub (`https://cam.drheck.dev`) provides automatic LAN discovery, low-latency live video and MP3 audio streaming, two-way RTSP ONVIF backchannel voice talk, YOLOv8n + hardware AI event capture with a web-viewable timeline and text metadata log, optical 3D click-to-zoom and optional auto-zoom on moving objects, smart floodlight/IR/LED controls, privacy sleep mode, bandwidth adaptation, and a sideloadable Google TV interface for the Reolink PoE IP cameras on `10.0.0.0/24` . Access is restricted via Authentik ForwardAuth to members of the `camera_access` group (`luke` , `ikura` , and `haruka`).

Hardware Inventory & Detected Cameras

Two **Reolink RLC-811A** (`P430`) 4K 8MP PoE Spotlight IP cameras are connected to the `10.0.0.0/24` LAN on interface `eth77` of host `ul` with static DHCP leases on `danknasty` :

Property	Camera 1 (<code>RLC-811A (122)</code>)	Camera 2 (<code>RLC-811A (123)</code>)
IPv4 Address (Static Lease)	<code>10.0.0.122</code> (<code>host cam1</code>)	<code>10.0.0.123</code> (<code>host cam2</code>)
MAC Address	<code>ec:71:db:f1:25:5a</code>	<code>ec:71:db:6d:84:ce</code>
Vendor / OUI	Reolink (<code>ec:71:db</code>)	Reolink (<code>ec:71:db</code>)
Model / Item No.	<code>RLC-811A / P430</code>	<code>RLC-811A / P430</code>
Hardware Revision	<code>IPC_560B158MP</code>	<code>IPC_560B158MP</code>
Firmware Version	<code>v3.1.0.4695_2504301440</code>	<code>v3.1.0.4695_2504301440</code>
Serial Number	<code>141484731968753</code>	<code>141484731989233</code>
Ethernet Link	<code>100M_FULL</code> (<code>802.3af PoE</code>)	<code>100M_FULL</code> (<code>802.3af PoE</code>)
Optical Zoom Range	<code>5X</code> Motorized (<code>ZoomPos 0..28</code> , <code>FocusPos 0..238</code> , <code>3D Box Zoom</code>)	<code>5X</code> Motorized (<code>ZoomPos 0..28</code> , <code>FocusPos 0..238</code> , <code>3D Box Zoom</code>)
Illumination	IR Night Vision (<code>auto</code> / <code>close</code>) + <code>450 lm</code> Warm Floodlight (<code>1..100%</code>)	IR Night Vision (<code>auto</code> / <code>close</code>) + <code>450 lm</code> Warm Floodlight (<code>1..100%</code>)

Property	Camera 1 (RLC-811A (122))	Camera 2 (RLC-811A (123))
Audio	Live Mic (16 kHz AAC -> MP3) + Two-Way Backchannel (8 kHz G.711 PCMU) + Siren	Live Mic (16 kHz AAC -> MP3) + Two-Way Backchannel (8 kHz G.711 PCMU) + Siren
Time Sync (NTP)	time.google.com:123 (America/New_York EDT / EST)	time.google.com:123 (America/New_York EDT / EST)

Camera Services, Network Ports & Internal Operation

On firmware `v3.1.0.4695_2504301440`, Reolink cameras lock down legacy plaintext web/streaming ports out of the box and expose only the proprietary **Baichuan** management port (`9000/tcp`) until explicitly instructed to enable standard streaming protocols.

1. Port & Service Matrix (`cmd_id = 37` `GetNetPort` / `cmd_id = 36` `SetNetPort`)

Service	Protocol / Port	Factory Default	Active State on <code>uL</code>	Purpose & Operation
Baichuan (<code>server</code>)	<code>9000/tcp</code>	Enabled	Enabled	Proprietary binary + XML control, telemetry, snapshot, PTZ/zoom, AI/motion alarm, and configuration bus.
RTSP (<code>rtsp</code>)	<code>554/tcp</code> , <code>554/udp</code>	Disabled	Enabled (Auto-enabled by <code>cam</code>)	Real-Time Streaming Protocol serving hardware-encoded <code>main</code> (H.265 4K) and <code>sub</code> (H.264 360p) video, <code>16 kHz</code> AAC microphone audio, and ONVIF Backchannel (<code>track3 PCMU/8000</code>) speaker talkback.
ONVIF (<code>onvif</code>)	<code>8000/tcp</code>	Disabled	Disabled (Toggleable)	Open Network Video Interface Forum profile for third-party NVR integration.
RTMP (<code>rtmp</code>)	<code>1935/tcp</code>	Disabled	Disabled (Toggleable)	Flash/RTMP H.264 sub-stream (<code>rtmp://<ip>:1935/bcs/channel0_sub.bcs</code>).
HTTP (<code>http</code>)	<code>80/tcp</code>	Disabled	Disabled (Toggleable)	Embedded camera web UI and <code>/cgi-bin/api.cgi</code> JSON endpoint.
HTTPS (<code>https</code>)	<code>443/tcp</code>	Disabled	Disabled (Toggleable)	Self-signed TLS embedded camera web UI and <code>/cgi-bin/api.cgi</code> JSON endpoint.

2. How the Baichuan Protocol (9000/tcp) Works

All discovery, hardware control, and instantaneous snapshots are performed over TCP port 9000 using Reolink's **Baichuan** protocol:

- Binary Framing Header:** Every Baichuan packet begins with a 20-byte or 24-byte little-endian binary header starting with magic bytes `0xf0debc0a`, followed by `cmd_id` (uint32), payload length (uint32), `channel_id` (uint8), status code (`200` OK, `400` Bad Request), and payload offset.
- Modern Nonce Authentication (`cmd_id = 1`):**
 - The client sends an initial unauthenticated `cmd_id = 1` request.
 - The camera replies with an XML `<Encryption>` challenge containing a random `<nonce>`.
 - The client computes uppercase MD5 digests of `username + nonce` and `password + nonce` (truncated to 31 characters) and submits the authenticated login frame.
 - Once authenticated, payload bodies are encrypted using AES-128-CFB (or XOR stream cipher depending on message class) keyed from the session nonce.
- Complete Baichuan Command IDs Used by `cam.drheck.dev`:**
 - `cmd_id = 80` (`GetDevInfo`): Model (`RLC-811A`), item number (`P430`), firmware version, serial number.
 - `cmd_id = 37 / 36` (`GetNetPort / SetNetPort`): Inspects and enables `rtsp` (`554/tcp`), `onvif` (`8000/tcp`), `rtmp` (`1935/tcp`), `http` (`80/tcp`), and `https` (`443/tcp`).
 - `cmd_id = 76 / 75` (`GetLocalLink / SetLocalLink`): Reads or writes DHCP vs. static IPv4 settings and MAC address.
 - `cmd_id = 182` (`Snap`): Captures an immediate hardware-encoded JPEG frame (`main` 4K or `sub` 640x360) directly over the control socket in `~110 ms`.
 - `cmd_id = 56 / 57` (`GetEnc / SetEnc`): Reads and updates H.265/H.264 resolution, frame rate (`frame`), target bitrate (`bitRate` in kbps), and audio track embedding (`<audio>1</audio>`) for `mainStream` and `subStream`.
 - `cmd_id = 26 / 25` (`GetImage / SetImage`): Reads and updates ISP sensor parameters (`bright`, `contrast`, `saturation`, `hue`, `sharpen`, `DayNight/mode` `auto|color|black&white`, `nr3d`, `mirror`, `flip`).
 - `cmd_id = 44 / 45` (`GetOsd / SetOsd`): Reads and updates On-Screen Display overlays, including the Reolink logo watermark (`<OsdChannelName><enWatermark>0|1</enWatermark></OsdChannelName>`), camera name overlay, and timestamp overlay.
 - `cmd_id = 288` (`SetWhiteLed` manual) & `cmd_id = 289 / 290` (`FloodlightTask`): Controls manual spotlight toggle (`0|1`), brightness (`1..100`), automatic lighting mode (`0` Off/Manual, `1` Smart Night AI Trigger, `3` Night Schedule), duration (`60..600s`), and AI trigger classes (`people,vehicle,dog_cat`).
 - `cmd_id = 208 / 209` (`LedState`): Controls Infrared Night Vision LEDs (`<state>auto|close</state>`) and the front power status LED (

<lightState>open|close</lightState>).

- `cmd_id = 263` (`AudioAlarmPlay`) & `cmd_id = 232` / `231` (`GetAudioAlarm` / `SetAudioAlarm`): Triggers manual 1x siren or configures automatic siren on AI/motion alarm (`<AudioTask><enable>0|1</enable></AudioTask>`, **disabled 0 by default**).
- `cmd_id = 264` / `265` (`GetAudioCfg` / `SetAudioCfg`) & `cmd_id = 439` / `440` (`GetAudioNoise` / `SetAudioNoise`): Controls speaker volume (`0..100`) and microphone 3D AI noise reduction (`level 0..3`).
- `cmd_id = 574` / `575` (`get_privacy_mode` / `set_privacy_mode`) & `cmd_id = 52` / `53` (`GetMask` / `SetMask`): Toggles hardware Privacy / Sleep mode (`<sleepState><sleep>0|1</sleep></sleepState>`) and hardware privacy masks (`<Shelter><enable>0|1</enable></Shelter>`).
- `cmd_id = 295` (`StartZoomFocus`), `cmd_id = 445` (`Set3DPos`), & `cmd_id = 224` / `225` (`GetAutoFocus` / `SetAutoFocus`): Steps the 5X motorized varifocal lens (`ZoomPos 0..28`, `FocusPos 0..238`), executes 3D area click-to-zoom (`posX`, `posY`, `posWidth`, `posHeight` in `0..1000` normalized coordinates), and locks/unlocks autofocus (`disable 0|1`).
- `cmd_id = 342` / `343` (`GetAiAlarm` / `SetAiAlarm`) & `cmd_id = 46` / `47` (`GetMdAlarm` / `SetMdAlarm`): Configures per-class on-camera AI sensitivity (`0..100`) and stay-time (`0..8s`) for `people`, `vehicle`, `dog_cat`, `face`, plus general motion sensitivity (`1..50`).
- `cmd_id = 38` / `39` (`GetNtp` / `SetNtp`), `cmd_id = 104` / `105` (`SystemGeneral`), `cmd_id = 106` / `107` (`Dst`), & `cmd_id = 23` (`reboot`): Configures NTP synchronization (`time.google.com:123`), US Daylight Saving Time, EDT/EST clock sync, and device reboot.

3. RTSP Stream Endpoints & ONVIF Two-Way Audio Backchannel (`554/tcp`)

Once `rtspEnable = 1` is set via Baichuan `cmd_id = 36`, each camera serves two RTSP streams plus an ONVIF two-way audio backchannel track:

- **Sub Stream (Low-Latency H.264 + AAC Audio + PCMU Backchannel):**

```
rtsp://admin:<password>@10.0.0.122:554/h264Preview_01_sub
```

```
rtsp://admin:<password>@10.0.0.123:554/h264Preview_01_sub
```

- `track1`: **H.264 High Profile** (`yuv420p`, `640x360`, default `10 fps` at `256 kbps`, `GOP = 4`, `recvonly`).
- `track2`: **MPEG4-GENERIC AAC-hbr** (`16 kHz` mono audio, `recvonly`).
- `track3` (when negotiated with `Require: www.onvif.org/ver20/backchannel`): **G.711 PCMU** (`PCMU/8000`, **payload type 0**, `sendonly`) for transmitting two-way voice audio directly to the camera's built-in speaker.

- **Main Stream (4K UHD H.265/HEVC):**

```
rtsp://admin:<password>@10.0.0.122:554/h265Preview_01_main
rtsp://admin:<password>@10.0.0.123:554/h265Preview_01_main
```

Encoded as **HEVC / H.265** (yuvj420p , 3840x2160 , default 25 fps at 6144 kbps , GOP = 2)
with 16 kHz mono AAC audio.

Architecture of cam.drheck.dev

The web service on host ul (/data/docker/cam) bridges the isolated IPv4 camera LAN (10.0.0.0/24) to an authenticated, browser-compatible HTTPS service at https://cam.drheck.dev .

Component	Configuration on Host ul
Service Directory	/data/docker/cam (app.py , static/index.html , static/tv.html , tests/app_test.py)
Persistent State & Models	/data/docker/cam/data/cameras.json , /data/docker/cam/data/yolov8n.onnx (13 MB) , /data/docker/cam/data/events/ (events.json + <event_id>.jpg)
Container Name	cam (cam:latest , Python 3.12 + FastAPI + reolink-aiio + onnxruntime + Pillow + numpy + espeak-ng + FFmpeg 7.1)
ULA IPv6 Binding	[fd77:7777:5010:0:1337:flac:d00d:ca30]:8000 on eth77
Nginx Reverse Proxy	/etc/nginx/sites-available/cam (X-Accel-Buffering: no , proxy_buffering off , X-Authentik- Groups forwarding)
Authentik SSO & Group	ProxyProvider (cam-provider , ForwardAuth) -> Application (cam) bound to Group (camera_access)
Backup & Restore	/home/luke/git/backups/ul/scripts/backup/cam & /home/luke/git/backups/ul/scripts/restore/cam (.tar.xz + par2 -r10)

Key Subsystems Implemented in app.py

1. Zero-Config Discovery (discover_cameras):
- Reads the host kernel ARP table (/proc/net/arp mounted read-only at /host_proc_arp), matches Reolink OUIs (ec:71:db , 9c:8e:cd), queries all Baichuan settings (cmd_id 80 , 37 , 76 , 56 , 26 , 264 , 44 , 289 , 208 , 232 , 439 , 574 , 52 , 224 , 38 , 46 , 342), and auto-enables RTSP (554/tcp) and audio encoding (<audio>1</audio>).
2. Motion & YOLOv8n AI Event Capture + Web-Viewable Timeline (event_monitor_loop , record_camera_event):
- A background monitor coroutine (event_monitor_loop) samples sub-stream snapshots from online, non-sleeping cameras every 3.5 seconds , computing downscaled 160x90 grayscale pixel frame-differences (compute_frame_motion).

- Whenever motion (`>= 2.2%` of frame pixels) or a manual capture (`POST /api/cameras/{ip}/capture_event`) occurs, `classify_snapshot_yolo` runs the 80-class COCO **YOLOv8n** model (`yolov8n.onnx` via `onnxruntime`, `~62 ms` CPU inference on letterboxed `640x640` input with IoU `0.45` Non-Maximum Suppression).
 - **Clean Unannotated Snapshots + Text Metadata:** The raw JPEG snapshot is saved **without drawn bounding boxes** to `/data/docker/cam/data/events/<event_id>.jpg`, while the detected class labels, confidence percentages (`confidence_pct`), normalized target coordinates (`box_norm`), trigger types (`people`, `vehicle`, `dog_cat`, `motion`, `manual`), frame motion percentage, and `EDT/EST` timestamp (`format_edt_timestamp`) are recorded in `/data/docker/cam/data/events/events.json` and displayed in the **Detection Event Timeline & Metadata Log** on `https://cam.drheck.dev/`.
3. **Optional Auto-Zoom on Moving Objects** (`apply_auto_zoom_on_box`):
- Each camera has an optional **Auto-Zoom on Moving Objects** toggle (`auto_zoom_motion`, **off by default**).
 - When enabled, detecting a moving person/object or motion region (`[x, y, w, h]` in `0..1000` normalized coordinates) automatically issues Baichuan `cmd_id = 445` (`Set3DPos` `set_ptz_3d_zoom`) to zoom the 5X motorized lens onto the moving target, marks the timeline event with an `Auto-Zoomed` badge, and restores the lens to `baseline_zoom` after `20 seconds` of inactivity.
4. **Two-Way Audio Talk** (`POST /api/cameras/{ip}/talk`):
- Supports both **Push-to-Talk (Browser Microphone)** (recording `audio/webm` via `MediaRecorder` in the browser) and **Speak Text (TTS)** (synthesizing speech via `espeak-ng --stdout`).
 - `transcode_to_mulaw` converts the audio stream via `ffmpeg -i pipe:0 -ar 8000 -ac 1 -f mulaw pipe:1` into `8 kHz` G.711 mu-law (`PCMU/8000`), and `stream_rtsp_backchannel_mulaw` negotiates an RTSP Digest session on `554/tcp` with `Require: www.onvif.org/ver20/backchannel`, sets up `track3` (`Transport: RTP/AVP/TCP;unicast;interleaved=0-1`), and transmits `160-byte` (`20 ms`) RTP packets directly to the camera's speaker.
-

Static DHCP Reservations on danknasty & IPv6 Support

1. Static DHCP Reservations (`/etc/dhcpd.conf` & `~/git/router_config/dhcpd.conf`)

Both cameras have permanent static DHCP leases configured in `/etc/dhcpd.conf` (and synced to `~/git/router_config/dhcpd.conf`) on `danknasty`:

```
host cam1 {
    # RLC-811A (141484731968753)

    hardware ethernet ec:71:db:f1:25:5a;
    fixed-address 10.0.0.122;
}

host cam2 {
    # RLC-811A (141484731989233)

    hardware ethernet ec:71:db:6d:84:ce;
    fixed-address 10.0.0.123;
}
```

2. IPv6 Support

- **Camera Hardware** (`RLC-811A` **Firmware** `v3.1.0.4695_2504301440`): No native IPv6 stack on the camera SoC (`10.0.0.0/24` IPv4 only).
- **Service Frontend** (`cam.drheck.dev`): Full dual-stack IPv4 and IPv6 support via Nginx -> `[fd77:7777:5010:0:1337:f1ac:d00d:ca30]:8000`.

Complete Camera Controls & Settings Matrix

All settings are available interactively in `https://cam.drheck.dev/` or via `POST /api/cameras/{ip}/control`:

Category	Setting	Supported Range / Values	Default on <code>ul</code>	Baichuan <code>cmd_id</code>	Web UI / API Action
Events & AI	Auto Event Capture to Timeline	<code>true</code> / <code>false</code>	<code>true</code> (Enabled)	Local + <code>182</code>	Auto Event Capture (<code>action: "auto_zoom_config"</code>)
Events & AI	Manual Event Capture & Classify	Captures JPEG + YOLOv8n text metadata	On-demand	<code>182</code> + ONNX	Capture Event (<code>POST /api/cameras/{ip}/capture</code>)
Events & AI	Person / Vehicle / Pet AI Sensitivity	<code>0 .. 100</code> (stayTime <code>0..8s</code>)	<code>60</code>	<code>342</code> / <code>343</code> (<code>SetAiAlarm</code>)	Person / Vehicle / Pet Sensitivity (<code>action: "ai_sensitivity"</code>)

Category	Setting	Supported Range / Values	Default on ☐	Baichuan cmd_id	Web UI / API Action
Events & AI	Motion Detection Sensitivity	1 .. 50	10	46 / 47 (SetMdAlarm)	Motion Sensitivity (ai_sensitivity)
Optics & PTZ	Optical Zoom (ZoomPos)	0 .. 28 (1X .. 5X optical)	0	295 (StartZoomFocus)	Zoom slider (action: zoom)
Optics & PTZ	Optical Focus (FocusPos)	0 .. 238	Auto	295 (StartZoomFocus)	Focus slider (action: focus)
Optics & PTZ	3D Click-to-Zoom (Set3DPos)	posX , posY , posWidth , posHeight (0 .. 1000)	Interactive	445 (set_ptz_3d_zoom)	3D Click-Zoom button (zoom_3d)
Optics & PTZ	Auto-Zoom on Moving Objects	false (Off) or true (On) + baseline_zoom	false (Off)	445 + 295	Auto-Zoom on Moving Objects (action: auto_zoom_configure)
Optics & PTZ	Autofocus Lock	false (Auto) or true (Locked)	false (Auto)	224 / 225 (SetAutoFocus)	Autofocus Lock (action: autofocus)
Lighting	Floodlight Manual Toggle & Brightness	state: true	false , brightness: 1..100	Off , 85%	288 (SetWhiteLed)
Lighting	Floodlight Auto Behavior (FloodlightTask)	Mode 0 (Manual), 1 (Smart Night AI), 3 (Schedule); Duration 60 .. 600 s ; Triggers people,vehicle,dog_cat	Mode 1 , 180 s	289 / 290 (FloodlightTask)	Spotlight Automatic Mode / Triggers / Duration (action: floodlight_configure)
Lighting	IR Night Vision LEDs	auto (Auto Night IR) or close (Off)	auto	208 / 209 (LedState)	IR Night Vision LEDs (leds)
Lighting	Front Status Power LED	open (On) or close (Off / Stealth)	open	208 / 209 (LedState)	Front Status Power LED (action: leds)
Lighting	Day / Night Sensor Mode	auto , color (24/7 Color), black&white	auto	26 / 25 (SetImage)	Day / Night Sensor Mode (action: image)
Deterrents & Audio	Auto-Siren on Detection	false (Off) or true (On)	false (Off)	232 / 231 (SetAudioAlarm)	Auto-Siren on Detection (action: audio_alarm)
Deterrents & Audio	Manual Security Siren	Trigger 1x	Off	263 (AudioAlarmPlay)	Siren (1x) (action: siren)
Deterrents & Audio	Live Microphone Audio Stream	16 kHz AAC -> 64 kbps MP3	Enabled	57 + RTSP	Audio: Muted / LIVE (action: /api/cameras/{ip}/audio)
Deterrents & Audio	Two-Way Audio Talk (Mic & TTS)	Browser MediaRecorder or espeak-ng -> 8 kHz G.711 PCMU	On-demand	RTSP track3 (554)	Push-to-Talk (Mic) & Text (POST /api/cameras/{ip}/talk)
Deterrents & Audio	Mic 3D Noise Reduction	Level 0 (Off), 1 (Low), 2 (Med), 3 (High)	3 (High)	439 / 440 (SetAudioNoise)	Mic 3D Noise Reduction (action: audio_noise)

Category	Setting	Supported Range / Values	Default on ☐	Baichuan cmd_id	Web UI / API Action
Deterrents & Audio	Speaker Volume	0 .. 100 (%)	92	265 (SetAudioCfg)	Speaker Volume (action: volume)
Privacy	Privacy / Sleep Mode	☐ false (Awake) or ☐ true (Sleeping)	☐ false (Awake)	574 / 575 (set_privacy_mode)	Privacy Sleep button (action: privacy_mode)
Privacy	Hardware Privacy Mask (Shelter)	☐ false (Off) or ☐ true (On)	☐ false (Off)	52 / 53 (SetMask)	Hardware Privacy Mask "privacy_mask")
Image & OSD	Mounting / Orientation (mirror , flip)	Normal , 180° Upside-Down , Flip , Mirror	Normal	25 (SetImage)	Flip 180° button (action: image)
Image & OSD	Reolink Logo Watermark	☐ false (Hidden) or ☐ true (Visible)	☐ false (Hidden)	45 (Set0sd)	Reolink Logo Watermark action: "osd")
Time & System	NTP Server & Clock Sync	time.google.com:123 (EDT / EST)	time.google.com	38 / 39 (SetNtp) & 105	Set time.google.com & EDT Clock (action: nt action: "sync_time")
Time & System	Reboot Camera	Hardware reboot	On-demand	23 (reboot)	Reboot Camera (action: reboot)

Bandwidth Adjustments for Unreliable or Slow Internet

When viewing two cameras simultaneously over a slow, high-latency, or lossy internet connection, total downstream bandwidth for \$N\$ cameras is governed by:

$$B_{\text{total}} = N \times f_{\text{fps}} \times S_{\text{frame}}(W, H, q) \times 8 \text{ bits/sec}$$

where \$f_{\text{fps}}\$ is the frame rate, \$W \times H\$ is the scaled resolution, and \$q \in [2, 24]\$ is the FFmpeg MJPEG quantization factor ().

Preset Mode	Resolution	Frame Rate	JPEG q	Avg Frame Size	Per-Camera Bitrate	2-Camera Total WAN Bitrate	Best For
HD Main Stream	1280x720	10 fps	5	~25 KB	~2.0 Mbps	~4.0 Mbps	Fast fiber / LAN full-screen inspection

Preset Mode	Resolution	Frame Rate	JPEG q	Avg Frame Size	Per-Camera Bitrate	2-Camera Total WAN Bitrate	Best For
Standard Live (Default)	640x360	10 fps	5	~6.2 KB	~500 kbps	~1.0 Mbps	Normal broadband / Wi-Fi
Low Bandwidth	480x270	5 fps	10	~4.0 KB	~160 kbps	~320 kbps	Congested Wi-Fi / mobile hotspot
Ultra-Low WAN	320x180	2 fps	15	~3.1 KB	~50 kbps	~100 kbps	Throttled cellular / international roaming
Unreliable WAN Snapshot (2s)	640x360	0.5 fps (1 / 2s)	Native	~9.0 KB	~36 kbps	~72 kbps	High packet loss / TCP reset prone links
Minimal WAN Snapshot (5s)	640x360	0.2 fps (1 / 5s)	Native	~9.0 KB	~14 kbps	~28 kbps	Extreme low-speed satellite / 2G fallback

Authentik Access Control (camera_access Group) & Google TV App

- **Authorized Group (camera_access):** luke , ikura , haruka . Enforced at both the Nginx ForwardAuth edge (PolicyBinding on cam) and inside check_camera_access_headers() in app.py .
- **Google TV Sideloadable App (dev.drheck.cam):**
 - Built APK on ul : /data/docker/cam/googletv_src/cam-googletv.apk
 - 10-Foot TV Interface: https://cam.drheck.dev/tv (authenticated automatically via baked-in 256-bit TV_AUTH_TOKEN).