# Network Bandwidth Requirements Guide

This document outlines recommended network bandwidth requirements for deploying the Turing Surveillance ecosystem. It provides guidance based on camera count, resolution, framerate, bitrate, and expected event activity. It also clarifies proper use of dual NIC NVR models to ensure secure and reliable system performance.

## 1. Key Factors Affecting Bandwidth

Several variables influence total network load:

**Resolution**

Higher resolution increases bitrate and overall bandwidth consumption.

- 720p (HD)
- 1080p (Full HD)
- 4MP / 5MP
- 4K (8MP)

**Framerate (FPS)**

Higher framerates increase bitrate proportionally.

- Typical deployments: 10–20 FPS
- High motion areas: 20–30 FPS

**Bitrate**

Bitrate is the most direct driver of bandwidth usage.

- VBR (Variable Bitrate) recommended for most deployments
- Typical ranges:
    - 1080p: 2–4 Mbps
    - 4MP/5MP: 4–8 Mbps
    - 4K: 8–16 Mbps

**Event Activity**

Events impact WAN bandwidth by transmitting 5-second clips to Turing cloud servers.

- Low activity: <10 events/camera/hour
- Medium activity: 10–30 events/camera/hour
- High activity: >30 events/camera/hour

Turing events are classified as People, Vehicle, Non-Motor Vehicle, Access & Sensor.

## 3. Clarifying LAN vs WAN Bandwidth Requirements

**LAN Bandwidth:** This refers to the total bandwidth required within your local network to handle all camera streams. It is calculated by summing the bitrate of all cameras. Ensure your network switches and uplinks can support this aggregate camera traffic.

**WAN Bandwidth:** This is the bandwidth needed for remote viewing or cloud access outside your local network. WAN bandwidth is typically lower than LAN bandwidth because it often involves streaming fewer cameras or lower resolution streams. It is important to plan WAN capacity based on expected remote user load and streaming quality.

**Event-Driven Bandwidth Impact with Turing**

Turing's event-driven system sends a 5-second 720p video clip to the cloud server whenever an event such as a person or vehicle detection occurs. This clip temporarily increases WAN bandwidth usage.

Impact:

- Each event clip requires 0.768Mbps (0.768 x 5-second = 3.84 Megabits)
- Each event clip requires approximately 3.84 Megabits of data sent to the cloud.
- Frequent events can cause noticeable spikes in WAN bandwidth usage.

Planning for WAN bandwidth should account for these event-driven bursts in addition to continuous streaming requirements.

Include a **25–30% overhead buffer** for peak activity.

## 4. Recommended Minimum Network Requirements

**Per-Camera Minimums (applies to LAN, as well as WAN when remote live-viewing)**

| Resolution | FPS | Typical Bitrate | Recommended Per-Camera Bandwidth |
|---|---|---|---|
| **1080p** | 15 | 2-4 Mbps | 5 Mbps |
| **4MP/5MP** | 15 | 4-8 Mbps | 8-10 Mbps |
| **4K** | 15 | 8-16 Mbps | 15-20 Mbps |

**System-Level Infrastructure Minimums**

| NVR Size | Cameras | Avg Bitrate | Total Bandwidth | Recommended Switch/Uplink |
|---|---|---|---|---|
| **16-CH** | 16 | 4 Mbps | 64 Mbps | 1 Gbps |
| **32-CH** | 32 | 5 Mbps | 160 Mbps | 1 Gbps |
| **64-CH** | 64 | 6 Mbps | 384 Mbps | 1–10 Gbps (stacked or LAG) |

**Event-Driven WAN Requirements (applies only to WAN) (estimates based on 16-camera system)**

| Activity Level | Events per Hour per Camera | Estimated WAN Bandwidth | Notes |
|---|---|---|---|
| **Low** | < 10 | 1.23 Mbps (16 cameras × 0.768 Mbps × 5 sec × 10 events/hr ÷ 3600 sec) | Minimal event clips; mostly continuous streaming |
| **Medium** | 10-30 | 3.69 Mbps (16 cameras × 0.768 Mbps × 5 sec × 30 events/hr ÷ 3600 sec) | Moderate event clip bursts |
| **High** | 50 | 6.15 Mbps (16 cameras × 0.768 Mbps × 5 sec × 50 events/hr ÷ 3600 sec) | Frequent event clips; significant WAN spikes |
| **Very High** | 100 | 12.3 (16 cameras × 0.768 Mbps × 5 sec × 100 events/hr ÷ 3600 sec) | Extremely frequent event clips; major WAN bandwidth spikes |

## 4. Dual NIC NVR Architecture (32 CH & 64 CH Models)

Turing NVRs with dual NICs are designed for **network segmentation and performance isolation.**

**NIC 1 — External / Corporate Network**

Used for:

- Accessing the NVR from Turing Vision
- Remote viewing
- Cloud communication
- Traffic Management

**NIC 2 — Dedicated Camera Network**

Used for:

- Direct camera connections
- Isolating camera traffic from corporate LAN
- Ensuring predictable bandwidth for video streams

**Best Practices**

- Cameras should not be placed on the corporate LAN.
- NIC 2 should connect to a dedicated PoE switch or camera only VLAN.
- NIC 1 should connect to the customer's main network.
- Avoid routing between NIC 1 and NIC 2 unless explicitly required.
- Use static IP addressing for cameras.

This architecture prevents camera traffic from congesting business networks and enhances security.

## 5. Network Segmentation Recommendations

**Create a Dedicated Camera VLAN**

- Prevents broadcast storms
- Reduces cross traffic interference
- Improves security posture

**Use Managed Switches**

- Enable QoS for video traffic
- Monitor port utilization
- Support LACP for uplink aggregation

**Avoid Mixing Camera Traffic With:**

- VoIP systems
- High volume file transfers
- Guest Wi Fi
- IoT devices
- POS Systems

## 6. Example Deployment Scenarios

**Scenario A — 32 Cameras @ 4MP, 12 FPS**

- Avg bitrate: 6 Mbps
- LAN Total: 192 Mbps
- WAN Total: 32 Mbps (viewing 16 cameras remotely)
- Recommended uplink: 1 Gbps
- NIC 2: Dedicated Camera Network
- NIC 1: Corporate LAN

**Scenario B — 64 Cameras @ 4MP, 20 FPS**

- Avg bitrate: 6 Mbps
- LAN Total: 384 Mbps
- WAN Total: 48 Mbps (viewing 16 cameras remotely)
- Recommended uplink: 1–10 Gbps
- NIC 2: Dedicated Camera Network
- NIC 1: Corporate LAN

## 7. Summary

- Bandwidth depends on resolution, FPS, bitrate, and event activity.
- Use the per camera and system level tables for planning.
- Dual NIC NVRs must be deployed with NIC 1 = external network and NIC 2 = isolated camera network.
- Always segment camera traffic from all other network traffic.
- Provide at least a 25–30% overhead buffer for peak usage.

This structure ensures reliable performance, predictable bandwidth, and a secure surveillance environment.

## 8. Online Bandwidth Calculator