Face Recognition in Surveillance - One-Page Reference

How recognition works, how accurate it really is outside the lab, how a face event surfaces in the VMS, and where the law draws the line. Representative 2025-2026 figures - all move with image quality, pose, lighting, and the people on camera.

A. Detection is not recognition

- Face DETECTION only finds that a face is present (a box) - anonymous, light, runs on the camera, almost no privacy weight.
- Face RECOGNITION measures the face into a template and decides WHOSE face it is - this is the step that is biometric and legally gated.
- The test: does the system try to tell people apart and put a name or persistent identity to them? If yes, the legal gate applies.
- Vendors blur the two. 'Face AI' may mean only detection (harmless) or full recognition (heavily regulated). Always ask which.

B. The four-step pipeline

- 1 Detect: find and crop the face. 2 Align: use landmarks (eyes, nose, mouth) to straighten the face to a standard pose.
- 3 Embed: a neural net turns the aligned face into a template - a vector of ~512 numbers (e.g. ArcFace). The template is numbers, NOT a stored photo.
- 4 Match: compare templates by similarity (cosine) against a THRESHOLD. Clear it = match. The threshold is a dial; no setting is right for everyone.
- 1:1 verification (cooperative; access control, unlock) is accurate. 1:N identification (watchlist; surveillance) is the hard case.

C. Accuracy is a range, and it collapses outside the lab

- Cooperative NIST portraits (1:1): the best algorithms exceed ~99% (sub-0.1% error on visa-quality). That is the LAB number.
- Real CCTV (1:N): the SAME algorithm commonly falls to ~65-85% - angle, motion, low resolution, distance. Never 100%.
- 1:N false hits scale with the gallery: 1,000,000 screened x 0.1% false-positive rate = ~1,000 wrong hits per day.
- Error is higher for women, the elderly, children, and some demographic groups (NIST FRVT Part 3). A hit is a LEAD, never proof.

D. How a face event surfaces - and where it runs

- ONVIF Profile M standardizes the face-event/metadata channel into the VMS (over the stream, the ONVIF event service, or MQTT).
- ONVIF standardizes the EVENT, not the accuracy or the algorithm - the model, gallery, and threshold live in the vendor SDK. Conformance is a baseline.
- Detection runs at the EDGE (camera NPU). Recognition runs on a SERVER/CLOUD - it needs the gallery of templates in one place.
- That central gallery is a concentrated store of biometric templates - the most regulated asset in the system. Keep it minimal and access-controlled.

E. The legal gate: a face template is biometric data

- EU GDPR Art. 9: biometric data processed to uniquely identify a person is special-category, prohibited absent a narrow exception; DPIA under Art. 35 (EDPB Guidelines 3/2019).
- EU AI Act Art. 5: real-time remote biometric identification in public spaces is a prohibited practice for most uses (in force 2 Feb 2025); other biometric ID is high-risk.
- US Illinois BIPA (740 ILCS 14): written consent first; private right of action; $1,000/$5,000 statutory damages (Facebook settled for $650M).
- US Texas CUBI: AG-enforced; $1.4B Meta settlement (2024). Patchwork - the strictest applicable rule governs. Engineering guidance, not legal advice.

The clean rule: face recognition is a legal gate you pass through before it is a feature you ship - confirm the lawful basis and consent regime, run the DPIA, keep the gallery minimal and access-controlled, set retention to the legal maximum, treat every hit as a confirmable lead, and get qualified counsel for your jurisdiction. The recognition MODEL (embedding architectures, ArcFace margin training) is engineered in the AI for Video Engineering section; this is the surveillance APPLICATION. Sources: ONVIF Profile M; GDPR Reg. (EU) 2016/679 Art. 4(14), 9, 35; EDPB Guidelines 3/2019; EU AI Act Reg. (EU) 2024/1689 Art. 5; Illinois BIPA 740 ILCS 14; Texas CUBI / $1.4B Meta settlement; NIST FRVT Part 3 (NISTIR 8280) and FRTE; ArcFace (arXiv 1801.07698); ACLU Williams v. City of Detroit.