Smart Spaces | Accelerated Computing Solutions

Cloud Reference Architecture for Railways

imotion Analytics Making Spain's National Railway Terminals Safe & Efficient

For RENFE (Red Nacional de los Ferrocarriles Españoles), the safety of passengers and staff is critical for maintaining operation of 5,000 high-speed trains and over 500 million passengers annually. Small incidents can lead to major downstream delays, but AI is helping to reduce the reaction time or catch maintenance issues early. From detecting slips-and-falls, to notifying staff about blocked crossings, overcrowded platforms or trains. AI automation is improving service operations in all areas of the rail and metro network.

Business Challenges

- **Safety & Security**: Poor visibility of safety and security concerns across stations delays response and service resolution.
- **Staff Deployment**: Optimizing staff deployment based on real-time demand insights is essential for efficient operations.
- **Passenger Satisfaction**: Maintaining comfortable conditions on public transport is difficult, especially during peak hours with high passenger volumes.

Solution

- **imotion Analytics Transport 1.0**
  The imotion solution manages video at the edge and sends inference results to centralized servers for visual analysis. It includes modules for video analytics, data visualization, and integration. Real-time KPIs and occupancy data support decision-making at client control centers.

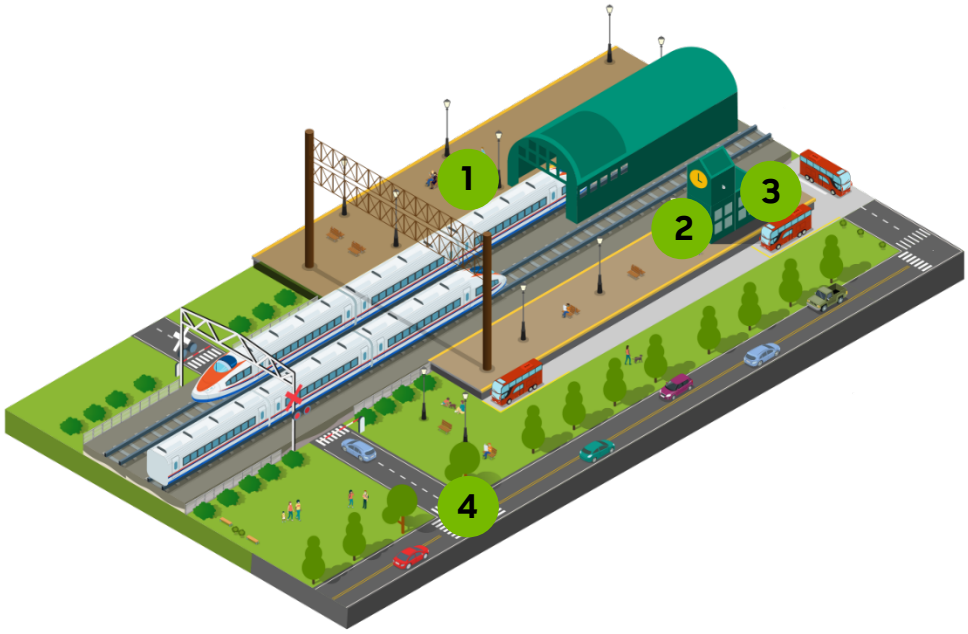
Benefits

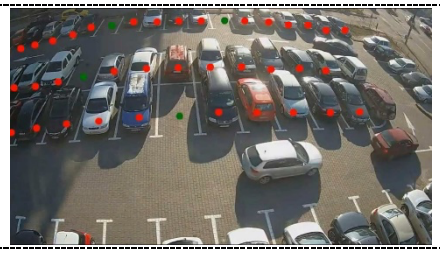
- **Understand real-time station usage by area, concourse, and platform**
  Capture real-time and historical occupancy data across the station for passenger safety alerts, site planning, and demand forecasting.
- **Cut loss & fraud with turnstile and access monitoring**
  Get immediate alerts for barrier jumping, tailgating, and other events to reduce fare evasion.
- **React in seconds with instant security alerts across stations**

  Detect and respond to critical events with centralized, customizable management of all security events. Capture anonymized visual data for fast and compliant incident validation

Solution Overview

Video analytics for rail station cameras enhance safety, security, and efficiency by delivering real-time insights. These support incident response, crowd management, resource use, and service planning.





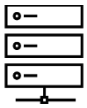
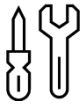
Station Operation & Management	Turnstile Monitoring	Road & Parking Management
1. Platforms > Fall Detection > Abandoned baggage detection & owner search > On-demand search > Passenger Counting (Standing/Seated Area) > Heatmaps > Person/Object on Track > Urban Mobility Objects use detection	**3. Turnstiles** > Turnstile Jumping Detection > Crawling Detection > Soft Mobility Vehicle Counting > Person with Reduced Mobility (PRM) Support > Passenger Counting (Entry/Exit) > Abandoned baggage detection & owner search > On-demand search	**4. Parking & Roadways** > Fire/Smoke Detection > Wrong Way Detection > Illegal Parking/Stopping > Speeding Vehicle > Vehicle/Object on Track > Vehicle Type Detection by Parking Space > Vehicle Counting & Classification > Congestion Detection > Parking Space Occupancy
2. Station Ticket Hall & Concourse > Loitering detection > Fall Detection > Baggage Profile Analysis (BPA) > Abandoned baggage owner search > On-demand search > Antisocial behavior detection > Heatmaps > Fight detection		

About imotion Analytics

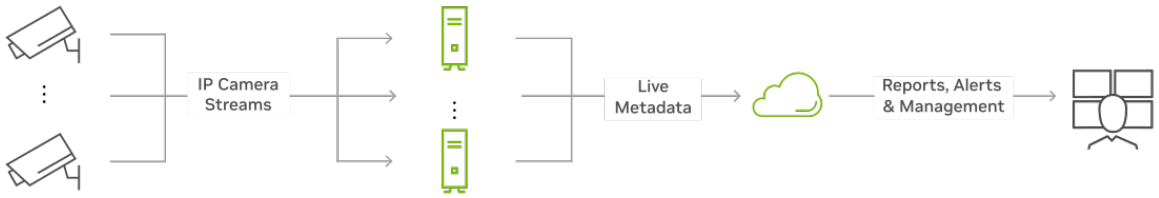
imotion Analytics, founded in 2015, improves safety and profitability in public spaces through machine vision and AI. The Platform uses existing camera infrastructure to detect and classify objects and behaviors in real time. The platform delivers analytics for retail, banking, transportation, and critical infrastructure.

Company Details	Core Products	Quick Facts
imotion Analytics® Founded: 2015 HQ: Barcelona, Spain	iA Smart Parking iA Traffic Analyzer iA Transport iA Counter PRO	430+ railway stations monitored 6,000+ cameras processing in real time 440 TB/h data processed per hour

Solution Components

Installed Components	
IP Camera Infrastructure Use your existing camera infrastructure or install new, high quality, low bandwidth cameras to maximize coverage and visibility.	
	
Video Analytics | imotion Analytics imotion processes IP camera streams from existing cameras with AI to identify and track people, objects, and behaviors. *Video Analytics uses either video direct from the cameras (second stream or multicast) or restreamed from the VMS. Ensure you have enough network capacity and VMS hardware overhead to support.*	imotion. Analytics
	
Video and Alarm Management View, manage, and retrieve video from cameras across your site in a unified interface. Secure video data integrity for search. Integrate multiple systems including video analytics and access control systems. *Check VMS compatibility or install a new system from recommended partners. For large sites with custom PSIM platforms, check supported versions/development costs with your provider.*	
Supporting Components	
GPU Accelerated Hardware Use NVIDIA certified servers and GPU accelerated hardware for maximum performance, reliability, and scalability. *Check datacenter space, power, and cooling capacity for new servers. Consider far-edge, workstation, or cloud deployment alternatives if appropriate. Review disaster recovery plans and requirements.*	
System Integration, Installation and Maintenance Deploy and maintain the full system from multiple independent vendors. Provide on-site support and monitoring.	
Solution Aggregation, Build and Distribution Supply and build server infrastructure needed, including pre-installation of software and support services.	

Cameras and Sensors	Video Analytics	Management



Video Analytics					
imotion	**Edge Server**			**Database Server**	**Management Server**
	(Small)	**(Medium)**	**(Large)**		
	1 server per 50 cameras	1 server per 80 cameras	1 server per 110 cameras	imotion Cloud Hosted	imotion Cloud Hosted
GPU	2x NVIDIA RTX A5000 Ampere 24 GB	2x NVIDIA RTX 5000 ADA 32 GB	2x NVIDIA RTX 6000 ADA 48 GB	—	
CPU	Intel® Xeon® Gold 6430 Dual	Intel® Xeon® Platinum 8460Y+	Intel® Xeon® Platinum 8580	Intel® Xeon® Silver 4314	
Memory	96GB	128 GB	192 GB	64GB	
Storage	1TB RAID 1 (OS) 5TB RAID 1 (Storage)	1TB RAID 1 (OS) 8TB RAID 1 (Storage)	1TB RAID 1 (OS) 11TB RAID 1 (Storage)	16TB	
OS	Windows 11 Pro, Windows Server 2019 or higher				

*** Specifications are provided as installed on a successful reference project. Specific components may be unavailable or discontinued. Edge server storage assumes 2 weeks retention of video (50GB per camera per week). Specifications assume Frame Rate processing at 10 FPS. Higher resolutions, framerates, or retention may require additional hardware.**

	Small Deployment	Medium Deployment	Large Deployment
Criteria	> 50 cameras connected to VMS > 50 partner software licenses	> 600 cameras connected to VMS > 600 partner software licenses	> 2000 cameras connected to VMS > 2000 partner software licenses > Full N:N Redundancy
imotion Analytics	> 50 partner software licenses > 1 Processing Server (small) > 1 Processing server for Database & Management > Training/configuration services	> 600 partner software licenses > 8 Processing Server (Medium) > 3 Database & Management Servers > Training/configuration services	> 2000 partner software licenses > 18 Video Processing Server (Large) > 18 Database & Management Servers > Training/configuration services

*** Video analytics server sizing assumes RSTP protocol at a uniform 10 FPS stream in Full HD resolution with a 16:9 or 4:3 aspect ratio. *Dedicated stream for Video Analytics with* WDR *cameras* and sufficient IR for the analytics purpose. Our algorithms can be adapted to any other requirement. *Database & Management servers could be installed On-premises or in Cloud and can be same server with. two functions.***

imotion Supported Integrations and Partners

Hardware Provider	> Any compatible hardware from the NVIDIA Certified Systems list
VMS Provider	> Milestone XProtect, Genetec, Hikcentral
Camera Provider	> Any ONVIF compatible camera, including but not limited to those from: Avigilon, Axis, Bosh, Dahua, and Hikvision
Data Visualization & Analytics	> Hydra, Argos

While every effort has been made to validate the above architecture, NVIDIA cannot guarantee this will be suitable for your project. Please contact your solution aggregator for a bill of materials and specification.

Modifications and Changes

Design requirements must be reviewed with your solution aggregator prior to design. This should include:

1) A list of the cameras on your site including camera model and streamed resolution, framerate, and codec.

2) A summary of which cameras will need video analytics and what specific functionality is needed.

3) Any other required systems, such as video wall equipment, additional operator licenses, or disaster recovery.

4) A list of minimum performance criteria/test cases which you will use to validate the system before sign-off.

5) Any site restrictions that could impact deployment, such as cyber security restrictions, data center space available or environmental conditions, or clearance for site access.

Please contact your solution aggregator for any changes to this system architecture including hardware models/provider, video management software (including integration with PSIM/CSIM platforms), video analytics solutions, or video/data retention policies.

Notes for Selling/Purchasing: Cameras and Sensors

- Much of the existing camera infrastructure can likely be reused for video analytics. Review the existing systems' coverage and video quality before deciding on replacements.
- Don't just look at resolution when deciding on cameras. Support for H.264/H.265 encoding, low light/WDR performance, and the ability to stream 2+ full resolution streams is more important.
- Ensure key areas have fixed camera coverage, even when PTZ cameras are not in their home position.
- Select cameras with at least 720p resolution and 10 frames per second.
- For object recognition applications, you should have at least 125 pixels per meter at the maximum camera range. You will need substantially more pixels on target for identification.
- Review the camera bandwidth requirements to avoid overloading the network. This will also have an impact on VMS storage requirements.

Assumptions

- This architecture, solution stack, and bill of materials has been prepared based on a proven reference deployment for RENFE.
- Physical Security Information Management (PSIM) systems are often required for large Railways. Where PSIM platforms are used, both video analytics and VMS are integrated with and send alarms and video directly to the PSIM. PSIM platforms are highly customized and are outside the scope of this document. Please contact your solution aggregator for more information including supported PSIM integrations.
- We have assumed that all cameras will be connected to the VMS. We have assumed that 50% of the cameras on site will require video analytics.
- Please contact your solution aggregator for the latest recommended imotion Analytics® specifications and availability.
- Video Analytics Redundancy/Disaster Recovery options available on request.

Project Timeline

Specification	**10 Days** Decide on key objectives and deliverables. Engage your preferred system integrators and aggregators. Review your existing systems. Decide what will be retained, what will be removed, and what will be improved. Confirm key business functions and measures. Investigate which software, hardware, and other partners are right for your site through your tender/review process. Confirm and engage stakeholders. Award the project to your preferred integrator/aggregator.
Design	**10 Days** Award project to your preferred system integrator (SI). SI works with your solution aggregator to finalize the design and implementation plan, including any site preparation needed. All parties engaged.
Preparation	**10-60 Days** Your system integrator conducts a site survey to create an accurate deployment plan. Your integrator and aggregator engage partners. Lead times, project milestones, and timeline agreed with all parties. Order for hardware, software, and any other components is placed. Any legal requirements identified and prepared.
Delivery	**5 Days** Hardware is installed in the datacenter. Video management system installed and connected to cameras on network. Video analytics software installed; camera views calibrated and linked to VMS; rules configured. On-site walk testing/monitoring. Your integrator will monitor performance while operators continue using the old system.
Validation	**5 Days** Soft launch of the system to pilot users. Old system will remain live in background. Feedback is collected from pilot users to improve system performance/usability. End user training sessions.
Handover	**1 Day** Final walk testing to validate correct detections and performance. All critical issues addressed and fixed. The system should now be operational and ready for permanent use. Highlight any remaining, non-critical issues and set timelines set for their resolution. Sign off on the system. All users change to the new system.
Maintenance	**Ongoing** Any remaining issues resolved by your system integrator. Maintain the legacy system for 2+ weeks in case of disaster before deactivation/removal. Your system integrator, aggregator, and technology partners provide ongoing support and maintenance for any issues that arise. Prepare for periodic performance reviews/upgrades to the system.

Additional Resources

Partner Website http://www.imotionanalytics.com

Ready to Take the Next Step?

Contact your solution aggregator or learn more at
nvidia.com/en-gb/industries/smart-cities

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Notices and Disclaimers

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