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Hardware and Software Minimum Requirements

For optimum Micromine Pitram performance, your computer system and infrastructure should meet the following recommended requirements.

Micromine Pitram - Voice System				Micromine Pitram - Automated System			
Pitram Server	Pitram Portal Server	Database Server SQL Standard	Control Room PCs	Pitram Server	Pitram Portal Server	Database Server SQL [2]**Enterprise**	Control Room PCs
Pitram and Pitram Portal can be deployed on the same server		A separate database server is required	Two Control Room PCs are recommended. One for Data Acquisition and one for Event Editor. Large (e.g. 34") screens are recommended				Two Control Room PCs are required for all automated sites. One for Data Acquisition and one for Event Editor plus Pitram 3D. Large (e.g. 34") screens are recommended
8-core CPU min 32GB RAM Allow 100GB for Pitram application storage requirements		8-core CPU min 32GB RAM Fast, min 100MB/s HD or fast RAID5 setup Allow 1TB for Pitram storage requirements	4-core CPU 16GB RAM Allow 100GB for Pitram application storage requirements	8-core CPU min 32 GB RAM Allow 100GB for Pitram application storage requirements	8-core CPU min 32GB RAM Allow 100GB for Pitram application storage requirements	8-core CPU min 64GB RAM Fast RAID5 storage (200MB/s) Allow 1TB for Pitram storage requirements	4-core CPU 16GB RAM Allow 100GB for Pitram application storage requirements
Windows Server 2016 or later, 64-bit, Standard Edition Requires SAP Crystal Reports Licence [1]		Windows Server 2016 or later, 64-bit, Standard Edition SQL Server 2016 SP2 or later, 64-bit, Standard Edition	Windows 10 Pro or newer, 64-bit	Windows Server 2016 or later, 64-bit, Standard Edition	Windows Server 2016 or later, 64-bit, Standard Edition Requires SAP Crystal Reports Licence [1]	Windows Server 2016 or later, 64-bit, Standard Edition SQL Server 2016 SP2 or later, 64-bit, Enterprise Edition [2]	Windows 10 Pro or later, 64-bit Note: Pitram 3D requires professional quality OpenGL 1.4 compliant graphics card. This includes the nVidia Geforce/ Quadro family and the ATI Radeon/ FireGL family of cards

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Minimum wireless network throughput requirements for use with Pitram Mobile

1. Minimum 20Mbps for the backbone link (i.e., the trailer/tower wireless link to Pitram servers, or in the underground mines the fibre backbone linking the wireless access points with the Pitram servers).
2. Minimum 2Mbps for the mobile equipment to the nearest wireless network access point.

Minimum hardware and OS specifications for Pitram Mobile

In cases where clients decide to supply their onboard hardware for the deployment of the Pitram Mobile software, the following provides a guideline to determine computer suitability.

The Micromine-supplied Pitram Mobile hardware is an Advantech-made computer TREK-773. The TREK-773 computer comes with 4GB of RAM and 32GB, or 128GB for Pitram Vision, CompactFlash (CF) drive. The CPU on the TREK-773 is a dual-core Intel Atom E3827 running at 1.75GHz. 64-bit Windows 10 IoT 2016 or later is required to run Pitram Mobile, the app will not run on a 32-bit Windows. The computer comes with a built-in G-sensor (accelerometer) used by Pitram Mobile to detect transitions between equipment stationary/moving states used by Micromine Pitram to automatically detect train loading cycle and idle status.

To run Pitram Vision, the computer must have an Ethernet port used for video input and a USB port for external connection to the Intel Movidius neural network processor, unless the processor is embedded in the computer. For Pitram Vision deployment, the recommended CF storage size is 128GB with a minimum 64GB requirement to help with video storage used for additional model training. Sites may also want to keep the video for a period as it can be a useful reference outside of Micromine Pitram.

The paragraphs above can be treated as a minimum specification for memory, storage, performance, and sensors should clients decide to supply their own vehicle computer. If a client decides to supply the Pitram Mobile computer, they must have the hardware specification reviewed by Micromine to prevent incompatibility surprises during project rollout.

Information on how Micromine customised the TREK-773 for Pitram Mobile deployment is also provided below.

The Micromine-supplied TREK-773 computer comes with a custom-built 64-bit version of Windows 10 IoT. The CF storage is divided into two partitions. One partition is the Windows IoT OS partition, and the other is for the Pitram Mobile application and data. The OS partition is write-protected, as recommended by Microsoft for mobile application deployment with unexpected/uncontrolled loss of power. The 64-bit Windows IoT OS is a custom-built image made in collaboration with Advantech. It's made to fit on the OS partition, contains all components to run Pitram Mobile and is write-protected.

The table below shows the full specification of the TREK-773 computer as described by Micromine's supplier, Advantech:

Core	Processor	Intel® Atom™ E3827 dual-core, 1.75 GHz
	Memory	4GB DDR3L-1333 memory (default)
	Graphics	Integrated 2D/3D graphics engine
	Operating System	Win10 IoT LTSB (64-bit) default, and Linux available upon request
Storage	CFast	1 x externally accessible CFast slot with cover and supports system boot up (32GB default for Win10 IoT LTSB)
	SD Card	1 x externally accessible push-push-type SD slot with cover for convenient expansion
Display	Type	7" automotive-grade TFT LCD
	Resolution	WVGA (800 x 480)
	Brightness (cd/m²)	1000nits (typical)
	Viewing Angle (H/V)	170°/170°
	Contrast Ratio	1000:1 (typical)
	Backlight Type	LED
	Backlight Life (Hrs)	30K
Touchscreen	Type	4-wire analog resistive touchscreen with 3H surface hardness and IK06 (510 g steel ball drop @ 300 mm) support (Optional sunlight readable touchscreen available upon request)
	Transparency	84% ±3%
Sensor	Sensor	Light sensor, G-sensor

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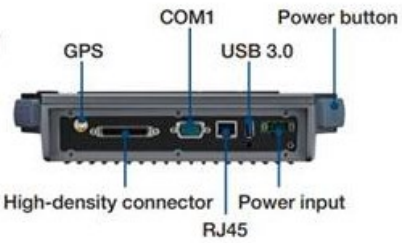
I/O	Function Keys	5 x programmable function keys with green LED indicators
	Standard I/O	1 x SIM card slot (left) 1 x High-speed full RS-232 (rear) (RS232 RI pin can be configured to 12 V_{DC} output) 1 x USB 3.0 host Type A (rear) 1 x Giga LAN with RJ45 connector (rear)
	Extended I/O[2]	1 x Mic-In/1 x Stereo Line-In/ 1 x Stereo Line-Out 1 x CVBS input, 1 x USB 2.0 host 1 x High-speed full RS-232, 1 x RS-485 with auto flow control 4 x Isolated DI (dry contact), 4 x isolated DO (open collector output, driven by replay) 1 x CAN bus (supports raw CAN, J1939, OBD-II/ISO 15765) 1 x J1708 (supports J1587) 1 x 12 V_{DC}/1.5A continuous current output (shared with standard I/0 full RS-232 DB9)
	Power Button/ LED Indicators	1 x Power button; 1 x Power LED indicator (yellow)
RF	WLAN + Bluetooth	IEEE 802.11a/b/g/n + Bluetooth (V4.0 LE, V3.0+HS, V2.1+EDR) combo module via mini PCIE slot
	WWAN	4G (LTE, HSPA+, GSM/GPRS/EDGE, EV-DO Rev a1, 1xRTT) Sierra Wireless MC73xx via full mini-PCIe (MC7354 for US/MC7304 or EU default)
	GNSS	Built-in u-blox MAX-M8Q GPS/GIONASS/BeiDou module and A-GPS support
	Antenna	1 x GPS, 2 x WWAN (LTE), 2 x WLAN/Bluetooth
	NFC	ISO/IEC 14443A, 14443B, 15693; MIFARE 1K/4K, Ultralight; NFC-IP2 protocol
Power	Input Voltage	Supports 12/24 V vehicle power, 9 – 32 V_{DC} input (ISO 7637-2 and SAE J1113 compliant) (Optional support for 18 – 58 V_{DC} input available upon request)
	Intelligent Vehicle Power Management (iVPM 2.0)	System power on/off management (e.g. programmable ignition On/Off/Delay), system monitoring and diagnostics, system power protection (vehicle battery low voltage protection), and wake-on-alarm (RTC), wake-on-call/SMS, and wake-on-G-sensor events
Mechanical	Dimensions (W x H x D)	255.7 x 161 x 56 mm (10.06 x 6.33 x 2.20 in)
	Weight	2.2 kg (4.8 lb)
Environment	IP Rating	IP54 (excluding I/O); optional IP54 protection for entire system with additional I/O cover
	Vibration/Shock	MIL-STD-810G, EN60721-3(5M3)
	EMC/Safety	CE, FCC, CCC; UL/cUL, CB
	Vehicle Regulation	E-mark (E13) for 12/24 V System, SAE J1455 class C, ISO 7637-2, SAE J1113
	Railway	EN50155
	RF Regulation	CE (R&TTE), FCC ID
	Operating Temperature	-30 – 60° C (-22 – 140 °F)
	Storage Temperature	-40 – 80° C (-40 – 176 °F)



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Pitram Vision

In addition to a third-party supplied underground positioning system interfaced to Pitram Mobile, deployment of Pitram Vision requires additional components supplied by Micromine:

- A ruggedised ethernet camera. We recommend the Orlaco EMOS Ethernet Camera 120. This version replaces the now obsolete RCT-14220 Ball Camera IP69K Heavy Duty analogue camera.
- Intel Movidius neural network processor (unless Movidius is embedded inside the computer).
- Ruggedised enclosure to house the Intel Movidius neural network processor (unless Movidius is embedded inside the computer).
- CF storage on Pitram Mobile vehicle computer must be a minimum 64GB. We recommend 128GB to store more video footage from Pitram Vision cameras.

Pitram Mobile Peer-to-Peer (P2P) data transfer functionality

To deploy the Pitram P2P data transfer feature, the network card must support at least the 802.11n standard and virtual network adapter functionality. Unfortunately, support for virtual network adapter functionality is not apparent in the hardware specification document; therefore, we recommend Micromine tests client-supplied hardware before deployment.

Pitram Connect

These specifications are intended for clients utilising the Pitram Connect app in conjunction with the Shift Planner tools. These requirements are also suitable for mobile devices utilising Pitram Connect without the Shift Planning capabilities.

- Minimum OS Version: iOS 14, Android 10 or Windows 10
- Display Size: >= 9 inch
- CPU: >= 3 cores, >= 1.5GHz
- RAM: >= 4GB

[2]SQL Server Enterprise and database re-indexing requirements

Micromine Pitram and Pitram Portal databases are high-volume transactional databases that require regular maintenance.

We recommend that indexes on the Micromine Pitram and Pitram Portal database tables are rebuilt daily. Indexes on the Micromine Pitram and Pitram Portal database are required to be rebuilt at least weekly. Fragmented database indexes cause degradation in performance of the overall solution.

Only the SQL Server Enterprise Edition allows the rebuild of the indexes to occur in online mode. Rebuild of the indexes on SQL Server Standard Edition requires that the database is taken offline during scheduled maintenance periods. Taking the database offline will cause some Micromine Pitram and Pitram Portal services to be unavailable. In addition, the SQL Server Enterprise edition allows the partitioning of large tables. This feature may be required if a large volume of data must be maintained for historical reporting.

Use of SQL Server Compact Edition, SQL Server Express or SQL Server as a client-side data management system

SQL Server Compact Edition is not supported by Micromine Pitram. While Micromine Pitram supports SQL Server Express or SQL Server as a client-side database system for Data Acquisition, Event Editor and Pitram 3D, the default and preferred database system is SQLite.

Micromine Pitram, Pitram Portal and SQL Server virtualisation recommendations

The Micromine Pitram and Pitram Portal systems have been tested and deployed in a virtualised server environment without issue.

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[1]SAP Crystal Reports licensing requirements

The Pitram Portal software application distributed by Micromine contains several SAP Crystal Reports libraries that are used to render the Micromine Pitram reports. Pitram-required Crystal Reports libraries are installed along with Micromine Pitram from a package referred to as Crystal Reports Runtime (e.g. CRRuntime_64bit_13_0_7.msi).

While libraries are installed with Micromine Pitram and the product appears to work without a SAP Crystal Reports licence, a separate stand-alone licence for SAP Crystal Reports is required for every site deployment.

Q: Do we need to purchase a SAP Crystal Reports licence if we do not install the package?	**A:** To meet the SAP Crystal Reports Runtime licensing requirements, each commercial site installation distributed by Micromine requires the purchase of a license. This gives Micromine the right to use the various Crystal libraries required by Pitram. Sites that install Micromine Pitram along with Crystal Reports Runtime libraries without a valid licence will be operating an unlicensed version.
Q: Who should purchase the SAP Crystal Reports licence for Micromine Pitram deployment?	**A:** Micromine is responsible for purchasing the license. We advise not to proceed with Micromine Pitram installation until the purchase of the SAP Crystal Reports licence has been confirmed and verified for your site.
Q: What SAP Crystal Reports product is required?	**A:** The current package name as of July 2022, is "SAP Crystal Reports". The cost of the licence is approximately AU$650. **This link (as of 1 July 2022)** provides an overview of the SAP product. Note that "SAP Crystal Server" licence is not required. Micromine Pitram does not require SAP Crystal Server to provide reporting functionality.
Q: Which version of SAP Crystal Reports is required?	**A:** We recommend SAP Crystal Reports 2016 which is the latest 32-bit version.
Q: What software key does Micromine Pitram use to activate Crystal Reports?	**A:** The SAP distributed Crystal Reports runtime does not require a software key to install and run. Anyone can download and install the runtime without a licence. This is why we rely on the above process to ensure a valid Crystal Reports licence accompanies every Micromine Pitram deployment.

Estimating the Pitram Portal client bandwidth requirements

The average Pitram page size is 100KB. The initial login and loading process will utilise the most bandwidth per user. After requesting a new page, users typically remain on that page for a period, reading the data and/or updating records.

The bandwidth can be estimated as follows:
Bandwidth = Average page size (in Kilobits) x Number of users / (Seconds between page views + Page load time)
Bandwidth is calculated in bits rather than bytes.

For example, Page Size = 800 Kilobits (100KBx8), Users = 10, Seconds between page views = 120 (2 minutes) and page load time = 2 seconds. 800 * 10 / (120 + 2) = 65.57Kbps of bandwidth. If 10 people open a new page simultaneously, the page will be slower. If only 1 person opens a new page while the other 9 do something else, it will perform faster.

The calculation above applies to refreshing the Pitram Portal pages.

Another area that may require estimation is the bandwidth required to download reports. Again, the above formula can be applied, albeit with different numbers.

For example, Report Size = 2MB = 16384Kilobits, Users = 10, Seconds between report downloads = 300 (5 minutes) and report load time = 3 seconds. 16384 * 10 / (300 + 3) = 541Kbps of bandwidth.