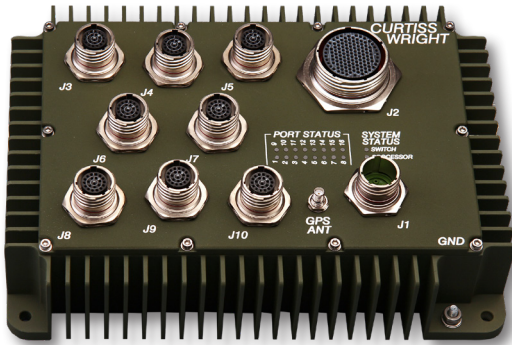


Digital Beachhead™

DBH-670 Ethernet Switch and Vehicle Management Computer

**CURTISS-
WRIGHT**

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Key Features

- SWaP-C optimized network switch and vehicle management computer:
 - + Size: 10.5 x 7.5 x 3.0” (266 x 190 x 76mm)
 - + Weight: 6.5 lb (3.0 kg)
 - + Power: 28W max
- 16-port Gigabit Ethernet switch
- Vehicle management computer with flexible vetronics interfaces
- VICTORY architecture
- Designed for rugged applications and environments

Applications

- Intra-vehicle networks
- Vehicle modernization
- VICTORY architecture compliance
- Vetronics
- Vehicle usage and HUMS
- Network interconnects and expansion
- Shared processing and peripheral communications

Overview

Curtiss-Wright Defense Solutions' [Digital Beachhead](#) is a size, weight, power, and cost (SWaP-C) optimized solution designed to provide the essential foundations for modern vehicle digital architectures including:

- Vehicle Gigabit Ethernet switching
- Vehicle management framework for vetronics interface and logistics
- [VICTORY](#) Data Bus management and shared services

The Digital Beachhead combines a powerful Gigabit Ethernet switch with a power-efficient Arm® based vetronics computer. With a powerful set of pre-integrated software applications and interfaces, the Digital Beachhead provides the foundation services to implement a network-enabled vehicle architecture with a level of integration never before attained.

Designed specifically for ground vehicles in industrial, transportation, and defense markets, the Digital Beachhead prepares all levels of vehicles for network-enabled operations and is easily usable in any rugged application. This cost effective approach provides platforms with an affordable entrance into digital architectures.

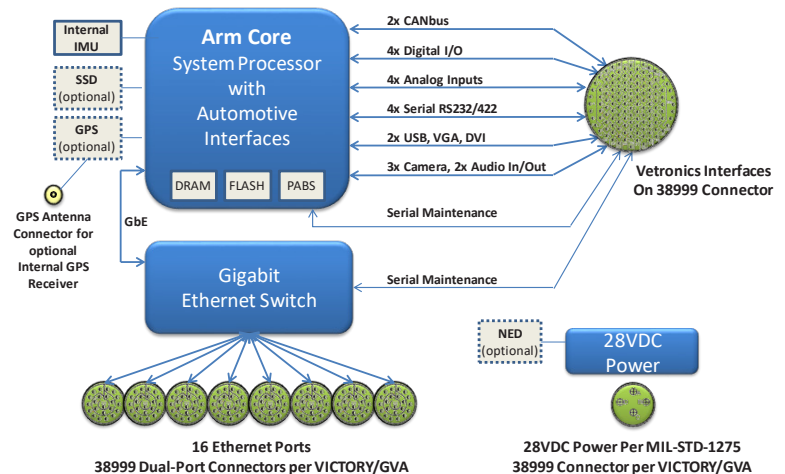


Figure 1: DBH-670 Digital Beachhead hardware block diagram

Features

SWaP-C optimized Network Switch and Vehicle Management Computer

- Extremely small footprint
 - + Size: 10.5 x 7.5 x 3.0" (266 x 190 x 76mm)
 - + Weight: 6.5 lb (3.0 kg)
- 20 watts typical power

16-port Gigabit Ethernet Switch

- Non-blocking architecture supports tri-speed operation (10/100/1000 Mbps) with auto-negotiation and auto-MDIX
- Energy Efficient Ethernet (EEE) with built-in status LEDs and cable diagnostics
- Feature-rich networking support includes IPv4/v6 switching, VLANs, IGMP multicast, QoS, MSTP/RSTP, link aggregation, port mirroring, and jumbo frames
- Powerful in-band (HTTP/Telnet/SNMP) and out-of-band (RS-232) switch configuration and management
- Hardware support for IEEE-1588v2 Precision Time Protocol with nanoseconds timing synchronization

Vehicle Management Computer with flexible Vetronics interfaces

- Vehicle Management Framework (VMF) provides a software interface for vehicle management and control, with interfaces to VICTORY Services
- Vehicle interfaces include multiple CANbus ports, serial ports, audio and video (camera) interfaces, as well as analog and digital I/O interfaces
- Local display (VGA/DVI) and remote monitoring via web/HTTP services

VICTORY architecture features

- Support for VICTORY Data Bus and Platform Services, including centralized distribution of time, position, speed, heading, and orientation
- External GPS (DAGR compatible) and Inertial Navigation interfaces
- Optional internal GPS receiver (Polaris Link or GB-GRAM/MPE-S) saves valuable vehicle space
- Can chain one GPS to multiple DBH units for multi-enclave architectures
- GPS interfaces support 1 PPS input for PTP time accuracy
- VICTORY and GVA compliant MIL-STD-38999 pinouts

Designed for rugged applications and environments

- -40 to +71°C natural convection design also supports cold-plate to +80°C
- 28 VDC power compliant to MIL-STD-1275D and compatible with MIL-STD-704A
- Optional Nuclear Event Detector (NED)
- Designed to meet IP67, MIL-STD-810 and MIL-STD-461

Network Switch

The Digital Beachhead includes a 16-port Gigabit Ethernet switch. Built around a non-blocking core fabric, the switch supports a wide range of network features, including:

- Full support for IPv4 and IPv6 networks
- Tri-speed operation (10Base-T, 100Base-TX, and 1000Base-T) with auto-negotiation and auto-MDIX for trouble-free interconnects
- Diagnostic/status LEDs to display link status
- EEE per 802.3az
- Port, MAC, and protocol-based VLANs per 802.1Q with MVRP
- Spanning Tree support (STP, RSTP, MSTP)
- Multicast support, including IGMP and MLD snooping
- Multiple traffic classes via QoS with flexible scheduling algorithms and traffic shaping
- Support for jumbo frames up to 9,600 bytes
- Link aggregation, Port mirroring
- Static routing is also supported for IP routing to attached WAN/radio ports

The network switch also includes full support for hardware-based Precision Time Protocol (IEEE-1588v2), enabling network nodes to synchronize time with nanoseconds accuracy. Time synchronization to internal or external GPS receiver is supported for Master Clock applications.

The Digital Beachhead network switch is compliant with the US Army's VICTORY Architecture as a Infrastructure Switch and Network Time Source. Network ports are provided on MIL-STD-38999 connectors compliant to both VICTORY and GVA (UK Def-Stan 23-09) pinouts for dual Ethernet.

Vetronics Computer

The Digital Beachhead includes a powerful multi-core Arm processor connected to a wide variety of standard vetronics interfaces. Combined with an easy-to-use web enabled configuration interface and our flexible Vehicle Management Framework (VMF) software, the Digital Beachhead provides the vehicle integrator with a powerful set of vehicle management services focused on monitoring and managing the overall health of the platform.

Powerful processing engine

The Digital Beachhead is equipped with an energy efficient multi-core Arm processor designed for the vetronics industry. Powered by the NXP (formerly Freescale) i.MX6 processor, the processing engine features:

- Dual-core Arm Cortex-A9 processor at 800 MHz with 1 GB DDR3 system memory and 16 GB Flash
 - + A quad-core processor with 2 GB DDR3 system memory is an available option for more demanding applications
- Multi-standard hardware video codec, capable of real-time MPEG and H.264 encoding and decoding up to 1080p resolution
- Dual independent image processing units for video resizing, rotation, inversion, blending, de-interlacing and image enhancement
- 2D, 3D, and vector graphics accelerators supporting OpenGL ES and OpenVG to displays up to HD1080 resolution
- Cryptographic accelerator and assurance module
- Gigabit Ethernet controller, connected internally to the Ethernet switch (does not use any of the external 16 Ethernet ports)

Internal data storage

The Digital Beachhead has 16 GB of on-board Flash storage, used for storing the operating system, user applications and data. Run-time data such as health logging or mission recording data can also be stored on this Flash memory.

For expanded storage needs, the on-board Flash can be increased in size to 32 GB. An additional 2.5" SATA-II SSD can also be added inside the DBH chassis. Standard SSD storage capacities include 128 GB and 256 GB, and an encrypted SSD is also available for enhanced security.

Vetronics interfaces

The Digital Beachhead processor has a wide range of hardware interfaces, providing flexibility when fitting the DBH to a particular platform. Standard interfaces include:

- 2 x independent CANbus interfaces
- Serial RS-232 and RS-422 ports
- 3 x camera inputs supporting RS-170 video, typically used for backup camera or other utility video functions
- 2 x analog audio inputs and 2 x analog audio outputs
- 4 x configurable analog inputs capable of differential, 2-wire, 3-wire and 4-wire sensing operation up to 10V
- 4 x configurable digital inputs/outputs capable of operation up to 28V

Audio interfaces

The Digital Beachhead includes two analog audio inputs and two analog audio outputs. Audio interfaces are typically used to realize audio bridging functionality, integrating analog intercom systems into the vehicle's digital architecture. Audio outputs can also be used to provide alert tones or playback pre-recorded audio messages in response to vehicle conditions, sensor inputs, or network events.

User interfaces

Although capable of headless operation, user interfaces to the Digital Beachhead are available through networked web services or locally attached display. Both VGA and DVI display ports are provided, along with multiple USB ports for keyboard/mouse or touch-screen devices. These interfaces are typically used to feed driver displays with vehicle health and operational data. They can also be used to drive a complete digital dashboard, having access to all vehicle data via the vetronics interfaces, along with other data available across the network.

3-Axis Inertial Measurement Unit (IMU)

The Digital Beachhead includes a 3-axis IMU capable of sensing orientation and movement. Used as a vehicle position sensor, or used along with a GPS receiver as a backup positional sensor, the IMU provides 10-bit resolution and is capable of motion sensing of up to 8g full-scale measurement.

GPS support

The Digital Beachhead supports direct connection to an external GPS receiver (NMEA, DAGR or equivalent) to provide real-time GPS position and time data. An optional internal GPS (GB-GRAM/MPE-S or Polaris Link) can also be added, further reducing overall system SWaP. An external powered antenna connection is provided on the DBH chassis.

Both internal and external GPS configurations support a 1PPS reference input from the GPS receiver, which is used by the Ethernet switch to provide a master clock reference for the IEEE-1588v2 / Precision Time Protocol time server.

Operating System

Fully featured Linux® operating system

The Digital Beachhead comes configured with an Arm-optimized UBUNTU® Linux operating system. Several desktop options are provided, including the Unity Window Manager and Matchbox desktops.

Kernel drivers are included for all hardware interfaces of the DBH such as GPS, IMU, digital and analog I/O, etc. The Root File System also includes a wide range of other utilities and applications typically expected in a Linux system, including:

- Firefox®, wcbrowser
- Debian® based software package management, APT
- Editors, debuggers
- Networking tools
- System and user management tools
- Disk utilities
- Terminal and network shells (bash, SSH)

For target applications development, the DBH includes a full compiler tool chain (GNU GCC/G++, Python, Java), permitting applications to be compiled locally on the DBH for “on-target” development. Alternatively, application code can be developed and built on an external computer hosting

the tools required to build applications for an Arm processor. This type of build environment requires cross-compilation capabilities on the host development machine.

As an open Linux system, a wide range of 3rd party tools and utilities can be used on the DBH.

VMF Software

Vehicle Management Framework (VMF)

The Digital Beachhead is supplied with Curtiss-Wright’s VMF software. This middleware provides high-level multi-threaded application access to all DBH interface data, greatly simplifying and speeding up the development of target applications. Based on the D-Bus message passing system, the VMF permits efficient sharing of data between drivers and processes/services that need the driver data.

D-Bus interfaces are provided for the following DBH services:

- CANbus data, including J1939 decoded and filtered messages
- GPIO interfaces
- Analog inputs (A/D converter data)
- GPS/Accelerometer/IMU interfaces

Sample source code is also provided to aid in applications development.

Web enabled DBH configuration

The Digital Beachhead includes a web-enabled configuration utility which is used to configure all system interfaces for a particular installation. Providing a logical and graphical interface, the configuration utility also supports status monitoring of hardware interfaces, which can be used during development and for in-field diagnostics.

Configuration data is stored as an XML file, which can also be directly edited if desired.

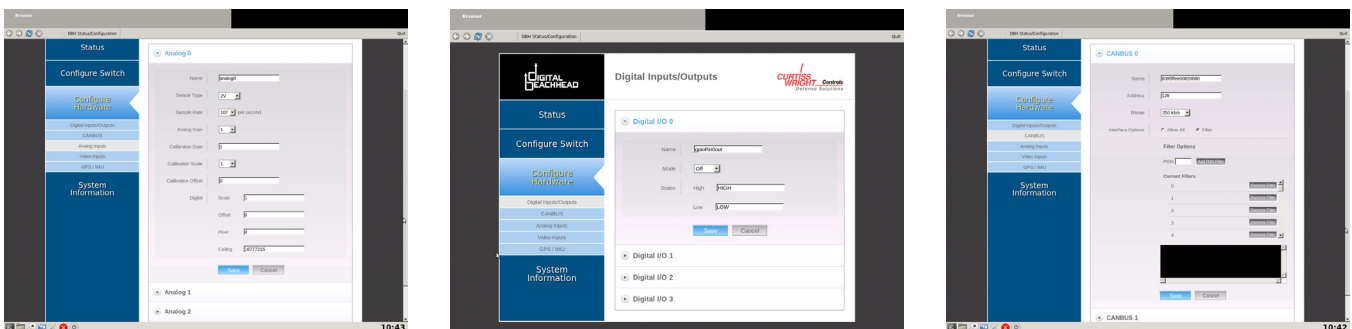


Figure 2: Examples of web enabled DBH configuration utility

VICTORY Services

The Digital Beachhead provides essential VICTORY Services to a vehicle or platform. Compliant to US VICTORY specifications, the Digital Beachhead provides centralized network services to realize a truly network-centric architecture whereby common network services are available to all connected and authorized equipment.



VICTORY is the result of many years of network-centric design concepts applied to a deployable platform, and provides an architecture that supports integration of network enabled services such as:

- command and control
- situational awareness
- electronic warfare
- audio and data communications
- video and image acquisition and distribution
- sensors and data acquisition
- threat detection and reporting
- mission recording
- power distribution
- automotive systems and logistics
- crew protection

GPS and Inertial Navigation services

The Digital Beachhead supports direct connection to an external GPS receiver to provide real-time GPS data. An optional internal GPS (GB-GRAM/MPE-S or Polaris Link) is also supported. An internal 3-axis IMU is included as standard, along with support for an external IMU.

Using VICTORY Services, these devices provide centralized time, position, speed, heading and orientation data that can be distributed to network devices, eliminating equipment duplication and lowering overall platform costs and complexity.

Additional Health Usage and Monitoring Systems (HUMS) and CBM+ capabilities

The Digital Beachhead is an ideal platform to support off-platform HUMS for fleet logistics.

By integrating 3rd party HUMS software, the DBH can interface to vehicle systems for management, gathering and logging critical vehicle data. No additional hardware is needed.

Interoperability with the US Army's CLOE for CBM+ applications can also be supported with 3rd party software.

VICTORY compliant Ethernet Switch

The Digital Beachhead's Ethernet network switch is also VICTORY compliant as an Infrastructure Switch and Network Time Source via PTP (IEEE-1588v2).

Additional VICTORY Capabilities

The Digital Beachhead can extend support for new services with software updates insuring compliance to the latest VICTORY specifications. Examples of future VICTORY capabilities include:

- Shared Processing Unit (SPU)
- Mission Recorder
- Condition-Based Maintenance (CBM+)
- Network Attached Storage (NAS)

MIL SPEC Compliance

The Digital Beachhead easily meets the needs of the defense industry. Power is compliant to 28 VDC under MIL-STD-1275D, and supports normal, generator, and cranking modes, including spike and transient conditions. The Digital Beachhead is also compatible with MIL-STD-704A power requirements.

All connections are via MIL-STD-38999 rugged connectors. Ethernet connections are compliant with VICTORY and GVA specifications for dual-Ethernet ports. Power connector is also compliant to VICTORY and GVA specifications. Extended temperature operation is supported, with no pre-warming or startup requirements over the entire working -40 to +71°C operational range. Natural convection design ensures reliable operation without forced air or fans. In cold-plate mounting conditions, the Digital Beachhead operates with cold-plate temperatures up to 80°C.

The Digital Beachhead chassis is designed to meet the most rugged conditions, including IP67 and MIL-STD-810F for environmental and MIL-STD-461E for EMI/EMC compliance.

Low Power Operation

The Digital Beachhead is designed for low power operation. Ethernet ports are power optimized per IEEE, and unused ports are automatically powered down. The system processor is a power-efficient Arm processor, which has been configured to reduce power for unused system processing blocks.

Specifications

Physical

- Power
 - + +28 VDC nominal, per MIL-STD-1275D under normal, generator-only, and cranking conditions, including spike and transients
 - + Max: 28 watts
 - + Typical: 20 to 23 watts (exclusive of optional internal GPS or SSD)
- Size: 10.5 x 7.5 x 3.0" (266 x 190 x 76mm)
- Weight: 6.5 lb (3.0 kg)

Environmental

- Thermal (see note)
 - + Operational
 - › Natural convection: -40 to +71°C
 - › Cold plate mounted: -40 to +80°C
 - + Non-operational: -55 to +125°C
- Shock (see note): 40g peak per MIL-STD-810F method 516.5
- Vibration (see note): 10g peak sinusoidal, 0.1g²/Hz random, over 15 Hz to 2 KHz per MIL-STD-810F method 514.5
- Additional qualifications: Designed to meet IP67 and MIL-STD-810F environmental and MIL-STD-461 EMI/EMC specifications. Please contact factory for details.

Note: DBH models with internal GPS receivers have reduced temperature range, shock and vibration specifications, while still meeting the requirements of MIL-STD-810 for ground vehicles. Contact the factory for details.

Ethernet Software

Ethernet performance

- Fully non-blocking wire-speed performance with all ports and all frame sizes
 - + 4 Mb integrated shared packet memory
- EEE with ActiPHY

Layer-2 switch

- Support for IPv4 and IPv6 switching
- Automatic switch learning and aging with up to 8,192 MAC addresses
- Support for jumbo frames up to 9,600 bytes
- QoS support with eight traffic classes

- VLANs
 - + 4,096 VLANs per 802.1Q
 - + VLAN broadcast, 802.1Q VLAN tagging and double-tagging
- Multicast
 - + 8K L2 multicast groups, 8K IPv4/v6 multicast groups
 - + IGMPv2/v3, MLDv1/v2 snooping for forwarding of multicast traffic
 - + GMRP for multicast registration propagation
- Link Aggregation (802.3ad) for increased bandwidth and load sharing
- Port Mirroring

Hardware

Ethernet Switching Fabric: Carrier Grade L2 Gigabit Ethernet Switch

- Fully non-blocking wire-speed performance with all ports and all frame sizes
- 4 Mb integrated shared packet memory

Ethernet management and control processor: Embedded MIPS processor

- 128 MB DDR2 DRAM
- 16 MB Flash

External Ethernet ports

- 16 ports tri-speed 1000Base-T supporting 10Base-T, 100Base-TX, and 1000Base-T copper interfaces

Ethernet port specifications

- 10Base-T interfaces per IEEE 802.3
- 100Base-TX interfaces per IEEE 802.3u
- 1000Base-T interfaces per IEEE 802.3ab
- Auto-MDI/MDIX crossover
- Max 100m segment length
- EEE per IEEE-802.3az

Ethernet maintenance port

- RS-232 serial port

System processor: dual-core Arm Cortex-A9 processor

- 800 MHz core speed
- 1 GB DDR3 DRAM
- 16 GB Flash memory

Vetronics interfaces

- 2 x CANbus interfaces, per ISO-11898
 - + Up to 1 Mbps interface speeds
- 4 x Analog interfaces supporting differential, 2-wire, 3-wire, and 4-wire configurations
- 4 x Digital I/O interfaces
- 1 x RS-422 interface for external GPS, including 1PPS input and output for downstream GPS
- 1 x RS-422 interface for external IMU
- 1 x RS-232 auxiliary interface

Internal sensors:

- Internal 3-axis accelerometer/IMU

Optional internal expansion

- System processor
 - + Quad-core Arm processor
 - + DRAM expansion to 2 GB
 - + Flash expansion to 32 GB
- Internal GPS receiver: Rockwell Polaris Link or GB-GRAM/MPE-S
- Internal SSD: 2.5" SATA-II @ 3.0 Gbps

Indicators:

- LEDs for:
 - + Switch status
 - + Processor status
 - + Each Ethernet port has a link status LED
- LEDs are normally powered OFF, and can be turned on for status and diagnostics via hardware discrete I/O pin

Security features

- Arm High Assurance Boot (HAB) capable
- Optional internal encrypted SSD
- Rapid and Multiple Spanning Tree protocol (802.1w, 802.1s)
- IEEE 802.3x flow control and back-pressure support

Layer-3 routing

- IPv4 Unicast static routing

Other

- IEEE-1588v2 Precision Time Protocol (PTP) with support for 1-step and 2-step clock sync
- DHCP client

Management

- Port based security per 802.1X
- RADIUS accounting, TACACS+ authentication
- Web access security via HTTPS and SSHv2
- Web and CLI user login security
- SNMP v1/v2/v3, Syslog, RMON

Ordering Information

The Digital Beachhead is available in a variety of different configurations. Consult the factory for additional options or models not listed.

Switch-Only or Processor-Only models

These models support either the Ethernet switch functionality, or the Arm vetronics processor functionality, but not both. Processor-Only models do not include VICTORY Services software.

TABLE 1 Switch-Only or Processor-Only Models Ordering Information

PRODUCT NUMBER	FUNCTIONALITY	16-PORT ETHERNET SWITCH	VEHICLE MANAGEMENT COMPUTER WITH VMF SOFTWARE			INTERNAL GPS
			ARM PROCESSOR	DRAM	FLASH	
DBH-670-112000	Switch only	Yes	-			None
DBH-670-110024	Processor only	-	4-core	2 GB	32 GB	

Models with Ethernet Switch and Vehicle Management Computer

These models are ideal to build a network backbone and provide vehicle management functionality. Although the Ethernet switch is VICTORY compliant, these models do not include VICTORY Services software.

TABLE 2 Ethernet Switch & Vehicle Management Computer Ordering Information

PRODUCT NUMBER	FUNCTIONALITY	16-PORT ETHERNET SWITCH	VEHICLE MANAGEMENT COMPUTER WITH VMF SOFTWARE			INTERNAL GPS
			ARM PROCESSOR	DRAM	FLASH	
DBH-670-112214	Switch and quad-core processor	Yes	4-core	2 GB	16 GB	None
DBH-670-112216	Switch and quad-core processor. Includes GPS receiver installation kit.	Yes	4-core	2 GB	16 GB	None

Models with Ethernet Switch, Vehicle Management Computer, and VICTORY services software

These models are used to provide both a VICTORY compliant Ethernet switch, and also provide VICTORY backbone services running on the internal Arm processor (these models are ITAR controlled).

TABLE 3 Models with VICTORY Services Ordering Information

PRODUCT NUMBER	FUNCTIONALITY	16-PORT ETHERNET SWITCH	VEHICLE MANAGEMENT COMPUTER WITH VMF SOFTWARE			INTERNAL GPS
			ARM PROCESSOR	DRAM	FLASH	
DBH-670-112110	US Army Ground Vehicles with VICTORY services	Yes	2-core	1 GB	16 GB	None
DBH-670-112111						GB-GRAM/MPE-S
DBH-670-112112						Polaris Link
DBH-670-112114	As above, with higher performance processing	Yes	4-core	2 GB	16 GB	None

Accessories

To simplify lab development, the following accessories are available.

- CBL-DBH-SET1
 - + 38999 breakout cable set for DBH-670 Digital Beachhead includes:
 - › J1 power cable breakout to spade lugs
 - › J2 utility breakout to industry standard connectors
 - › J3-J10 Ethernet breakouts to RJ45 male ends
 - + 2 meter length, lab use only