



TTE^{DE}velopment System A664 v4.1 VxWorks 653

Ready-to-Run TTEthernet Evaluation & Development System



Key Benefits

- ✓ An easy-to-use and ready-to-run solution including hardware and software as well as a Distributed IMA (DIMA) demo application
- ✓ Highly precise fault-tolerant time base for synchronization of DIMA architectures
- ✓ 3 traffic classes on one network: IEEE 802.3, rate-constrained (ARINC 664 part 7) and time-triggered (SAE AS6802)
- ✓ Full ARINC 653 compliant system solution
- ✓ System-level configuration tooling

The TTE^{DE}velopment System A664 v4.1 for VxWorks 653 is an out-of-the box starter kit for integrating TTTech's deterministic network technology with the time and space partitioned real-time operating system VxWorks 653. The entire system supports 10/100/1000 Mbit/s speeds and enables event-driven Ethernet (IEEE 802.3), rate-constrained (ARINC 664 part 7) and hard real-time (SAE AS6802) communication on the same network with the option to synchronize IMA modules using the fault-tolerant TTEthernet network time base.

Distributed Integrated Modular Avionics

Time and space partitioning is the cornerstone of Integrated Modular Avionics (IMA). It supports the integration of various functions of different criticality on one module to reduce the number of control modules and simplify certification and upgrades. Distributed IMA (DIMA) is an extended IMA architecture utilizing deterministic, high-integrity communication bandwidth partitioning as described in RTCA DO-297.

TTEthernet and DIMA

Robust partitioned communication with μ s-jitter and distributed fault-tolerant synchronization is ensured by TTEthernet. The whole networked system becomes a distributed, fault-tolerant, hard real-time platform, capable of handling multiple distributed

functions of different criticality in one network. This means that both critical and non-critical applications can safely execute on one integrated VxWorks 653 system.

Components Enabling Distributed IMA

The package includes a demo application showing deterministic communication among VxWorks 653 partitions. TTECOM A653 for VxWorks 653 enables access to a highly deterministic TTEthernet communication system through the ARINC 653 APEX interface. This allows sending and receiving messages through the API specified by ARINC 653. The TTESync for VxWorks 653 provides an optional synchronization component enabling tight synchronization of the periodic partition execution of the time-triggered communication patterns.



Application Fields

- Technology evaluation
- Product testing
- Architecture development

Synchronization	<ul style="list-style-type: none"> – TTEthernet clock synchronization precision in sub-microsecond range – Partition synchronization with approx. 1.5 μs precision (range of 10 μs)
Communication	<ul style="list-style-type: none"> – Fault-tolerance: Implicit fault-tolerance support for masking out message losses by adding an additional redundant channel without subsystem-level changes.
Embedded Software for VxWorks 653	<ul style="list-style-type: none"> – The TTEDriver for VxWorks 653 provides an interface for communicating with the TTEthernet end system hardware. It provides functions to read and write messages, to obtain status information and to perform the configuration. – TTECOM A653 for VxWorks 653 provides access to the TTEthernet communication system by means of sampled and queued ports. It implements the ARINC 653 APEX interface functions needed for communication. – TTESync for VxWorks 653 enables synchronizing of the local VxWorks 653 clock to the TTEthernet cluster cycle time. – TTESysConf653 is a configuration tool for creating the data paths in the OS module, user application and communication middleware.
Hardware Components	<ul style="list-style-type: none"> – 2 x TTESwitch A664 Lab (with each 24x ports, 6x 10/100/1000 Mbit/s and 18x 10/100 Mbit/s) – 1 x CES Commercial air cooled, rackable 3-slot VME enclosure – 2 x CES Air-cooled 6U VME single board computers (SBC) & BSP with QorIQ® P2020 @ 1.0 GHz, 512 KB L2, 1 GB DDR3, Spartan-6 LXT (VME-P0: 64-bit PCI) – 2 x TTEEnd System A664 Lab (3x 10/100/1000Mbit/s) installed on CES SBCs, inserted in CES VME enclosure – All required cabling and power supplies <div data-bbox="625 884 1396 1261"> </div> <p>Figure 1: TTEDevelopment System A664 v4.1 for VxWorks 653 – Example System Overview in Redundant Switch Configuration</p>
Software Components	<ul style="list-style-type: none"> – 2 x CES VxWorks 653 v2.4 board support package (BSP) for single board computers – 2 x TTESync for VxWorks 653 2.4 for TTEEnd System A664 – 2 x TTECOM A653 for VxWorks 653 2.4 for TTEEnd System A664 (incl. TTEDriver, TTESysConf653) – 1 x TTEDistributed IMA Demo for VxWorks 653 2.4/cesRio6Cert for TTEEnd System A664 Lab
Software Tools	<ul style="list-style-type: none"> – TTEPlan (Starter) for generation of the demo application schedules – TTEBuild Device Configuration – TTEBuild Network Configuration (Starter) to create device configurations for this lab setup – TTELoad for loading switch configurations
Required Third Party Software & license	<ul style="list-style-type: none"> – Real-time operating system software and licenses for Wind River VxWorks 653 v2.4 (for each SBC)
Order Number	<ul style="list-style-type: none"> – 12877: TTEDevelopment System A664 v4.1 for VxWorks 653
Recommended additional services	<ul style="list-style-type: none"> – 12053: 40 h support package, includes a one-day on-site installation & quick-start (8 h) as well as on-demand 32 h e-mail/telephone support



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