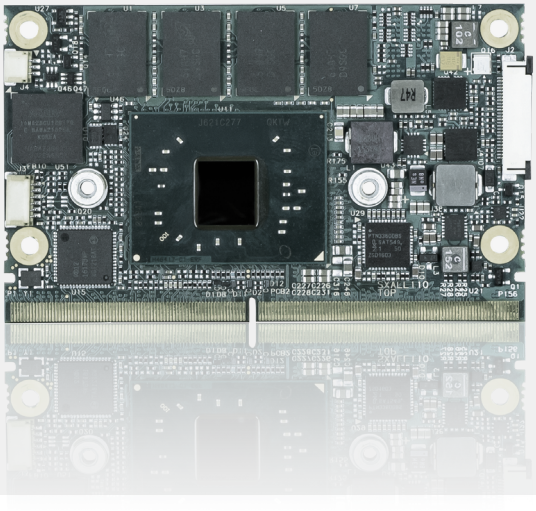
SMARC module

A SMARC APPROACH TO MEDICAL DEVICE LIFE EXTENSION

Medical manufacturer maximizes investment in essential system with retrofit Kontron Computer on Module solution upgrade

Kontron was approached by a Tier 1 medical device manufacturer for help in extending the production life of a very successful system level product used deliver controlled power to stepper motors driving peristaltic pumps, for use in certain surgical procedures.

The customer legacy product incorporated a CPU board design that made use of an older, now obsolete, NXP Arm® processor module that is very hard to source. The medical customer product includes an LCD screen with a resistive touch overlay and a pair of stepper motor controllers along with other miscellaneous I/O. The product user interface was controlled by a Windows CE 5.0 application running on the NXP Arm® application processor.



kontron

KEY OBJECTIVES

- Deliver a replacement CPU board that was to be form, fit and functionally compatible with the legacy CPU board
- Use contemporary parts that can be readily sourced in future
- Run the legacy product Windows CE 5.0 application code with little or no modification
- Ensure a cost-effective solution

Following close liaison and consultation with the customer over a period of a few weeks to clarify the technical issues and requirements, Kontron created a Requirements Document that was mutually agreed upon. However, the CPU choice and CPU board design details were left to Kontron to decide, with the stipulation that the overall end system product look and feel the same to the user as the customer's legacy product.

KEY REQUIREMENTS

- The replacement CPU board had to have identical X-Y dimensions as the legacy product, and Z (vertical) profile for meeting height restrictions
- Must run legacy Windows CE 5.0 application software with as few modifications as possible
- To drive VGA resolution LCD screen in portrait mode
- All legacy product I/O, environmental and regulatory features had to be met or exceeded - including requirements for medical device electronics in the IEC 60601-1-2 standard

Design Challenges

Based on these requirements various design challenges became evident which the Kontron solutions architects had to address.

For example, the legacy touch screen needed to work seamlessly with the new solution, with the same or better characteristics and responsiveness as previously. This was complicated by the fact that the touch screen was controlled by the obsolete NXP ARM processor.

Furthermore, maintaining compatibility with the legacy cabling and I/O connector types and positions was a prerequisite, and with the existing 48V DC power feed. Additionally, the thermal dissipation of the replacement controller had to be compatible with the customer's legacy system and enclosure.

THE SOLUTION

Hardware

Kontron's CPU hardware decisions were driven by several considerations:

- Ability to port a legacy Windows CE 5.0 customer application to the new hardware platform
- Compatibility with system thermal concerns
  - This necessitated a CPU solution with about 5 W max dissipation
- General performance and I/O considerations
  - Display
  - USB
  - Mass storage
  - Serial ports
  - GPIO
  - etc.
- Cost effectiveness

Kontron decided to implement a SMARC Carrier Board hosting a Kontron SMARC Module based on Intel Apollo Lake. The SMARC (Smart Mobility ARChitecure) small form factor open standard defined by SGET (Standards Group for Embedded Technologies) was largely pioneered by Kontron which today offers a comprehensive portfolio of SMARC products with Intel x86 and ARM processors.

For this project, the Kontron SMARC-sXAL4 Module was seen as especially well-suited by allowing a cost-effective and extremely compact fanless design, offering balanced processor and graphics performance with low power consumption to meet medical grade requirements.

This choice also made sense because the SMARC design readily supported Windows 10 IoT Core and the Win CE Container App and therefore would support the customer's legacy Win CE application software. The other system concerns, such as the general performance and I/O requirements, were also easily met by the industry standard SMARC Module selected.

Moreover, with the benefit of thermal simulations and CAD work, Kontron ensured the system thermal concerns were met with the low power 5W Apollo Lake processor and a Kontron designed passive heat sink, integrated into the customer system enclosure.

Software

Several possible software solutions to support the customer's legacy Windows CE 5.0 application were considered. The considerations are summarized in the table below.

	WINDOWS CE 5.0	WINDOWS IOT ENTERPRISE	WINDOWS IOT CORE W. UAP	WINDOWS IOT CORE W CEPAL
COMPLIANT WITH NEW HARDWARE	-	yes	yes	yes
MINIMAL CODE CHANGES	yes	-	-	yes
SUPPORTABILITY	-	yes	yes	yes
CONVERSION EFFORT	$	$ $	$ $ $	$
INTEGRATION EFFORT	$	$	$	$ $
LICENSING MODEL	$	$ $ $	$	$

Kontron decided to go forward with the Windows CE App Container two stage solution from Microsoft. The CE Platform Abstraction Layer (abbreviated as CEPAL, shown in the rightmost column in the table above) was chosen among other supported migration paths as it required minimal efforts and modifications to the legacy code to allow the existing Windows CE application to run on top of Windows 10 IoT (Internet of Things) Core.
The touch screen controller from the customer's legacy implementation was part of the EOL (End of Life) ARM device. Kontron therefore had to introduce a new I2C based resistive touch controller from Texas Instruments and develop a suitable driver and code to calibrate the screen. A GPIO driver was also created to interact with the external customer hardware and emulate specific timing sequences from the customer's legacy implementation to properly initialize the attached peripherals.

> This project underscores Kontron's high degree of competence in embedded medical systems hardware and software engineering design. We successfully achieved all the custom design and performance objectives which were made even more challenging due to the worldwide procurement issues faced during the last two years. However, thanks to close collaboration and proactive communication between Kontron and the customer and our global network of suppliers, the prototypes and final product were all delivered on time.
>
> Maria Wilde, Product Manager Medical at Kontron

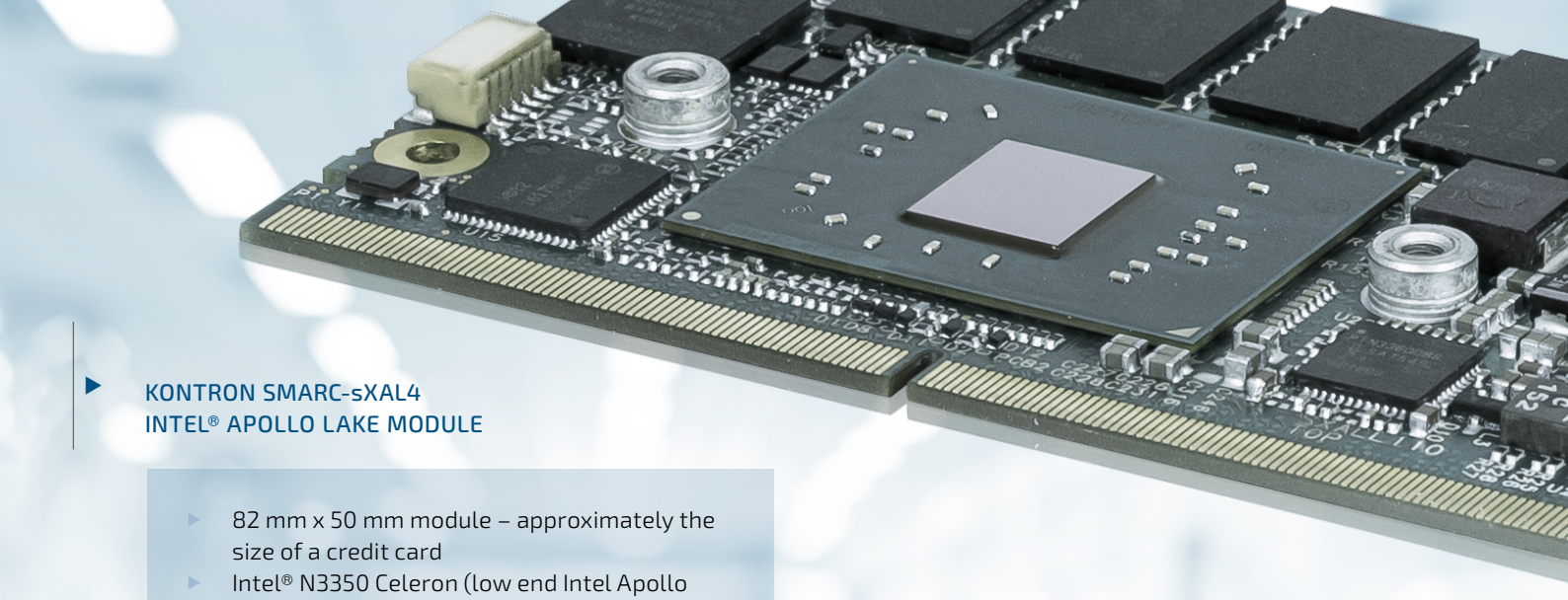
RESULTS

- Customer legacy code was preserved, in original source code form:
  - Logic and data layers
  - User interfaces and interface responsiveness
  - Proprietary serial communication protocol
- Touch controller hardware and software driver was implemented to replace unavailable legacy hardware, to seamlessly interface to customer's legacy software
- Hardware mechanical form factor requirements
- Electrical I/O requirements
- Thermal objectives. The case ventilation was limited but the product passed the thermal chamber tests
- Regulatory requirements

BENEFITS

Utilizing the versatility and speed to market offered by the open standard SMARC Module, Kontron has successfully completed a retrofit design for an obsolete ARM CPU board in an efficient and timely manner. Compatibility with both the customer's hardware and software ecosystem has been successfully maintained despite the limited amount of information available. Furthermore, the module can be upgraded without changing the carrier board, ensuring a future proof solution offering a longer life cycle.

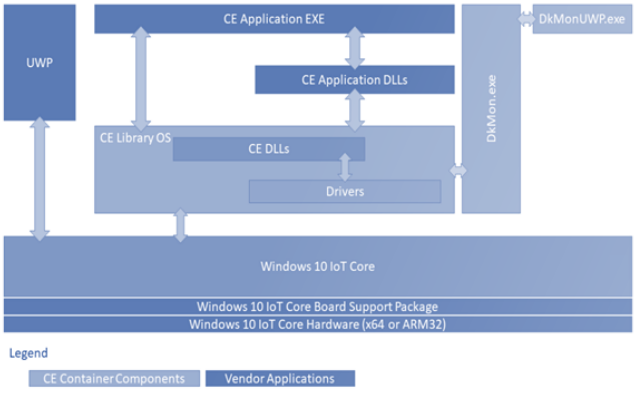
- Meets all customer hardware and software requirements
- Maintains same look and feel for users, no need to re-train
- Easy to source low power x86 CPU board and Kontron software
- Enables production of successful legacy medical device to continue
- Faster development and time to market
- Lower cost



KONTRON SMARC-sXAL4
INTEL® APOLLO LAKE MODULE

- 82 mm x 50 mm module – approximately the size of a credit card
- Intel® N3350 Celeron (low end Intel Apollo Lake, from Intel® Atom® line)
- 2 GByte LPDDR4 DRAM, on the module
- 4 GByte eMMC for OS (Operating Systems) and application program storage on the module
- 2x USB 3.0 used for debug and software updates
- Single or dual channel LVDS flat panel display output
- HDMI (available for debug use in this case)
- 2x Gigabit Ethernet (one available for debug in this case, other not used)
- Other SMARC I/O (PCIe, SATA, I2C, GPIO, serial ports etc., some used)
- Kontron orderable part number 51012-0204-11-2

SOFTWARE ARCHITECTURE MAP



The Figure above is courtesy of Microsoft and diagrams their Windows CE App Container product and concept, to be used with Windows 10 IoT Core.

In this Figure:

- The hardware and BSP layers are shown at the bottom of the Figure, in brick red
  - The hardware can be a 64-bit x86 or Arm® CPU
  - Windows 10 IoT core support is not available for 32-bit CPUs
  - Windows 10 IoT core support is routine from Intel on many x86 products
  - Windows 10 IoT core support is harder to come by on Arm® products, and is not often supported "out of the box"
- The CE Library OS, CE DLLs and Drivers are the software interface between the Windows 10 IoT Core and the legacy CE application, shown in orange / brown above
- The legacy CE application code runs on top of this, shown in purple above

About Kontron

Kontron is a global leader in IoT/Embedded Computing Technology (ECT) and offers individual solutions in the areas of Internet of Things (IoT) and Industry 4.0 through a combined portfolio of hardware, software and services. With its standard and customized products based on highly reliable state-of-the-art technologies, Kontron provides secure and innovative applications for a wide variety of industries. As a result, customers benefit from accelerated time-to-market, lower total cost of ownership, extended product lifecycles and the best fully integrated applications.

For more information, please visit: **www.kontron.com**

About the Intel® Partner Alliance

From modular components to market-ready systems, Intel and the over 1,000 global member companies of the Intel® Partner Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest IoT technologies, helping developers deliver first-in-market solutions.

GLOBAL HEADQUARTERS

Kontron Europe GmbH

Gutenbergstraße 2
85737 Ismaning, Germany
Tel.: +49 821 4086-0
Fax: +49 821 4086-111
info@kontron.com

www.kontron.com