



FACE Cross-Integration Successes Honeywell, RTI, and TES-SAVi 2016 FACE BITS Event

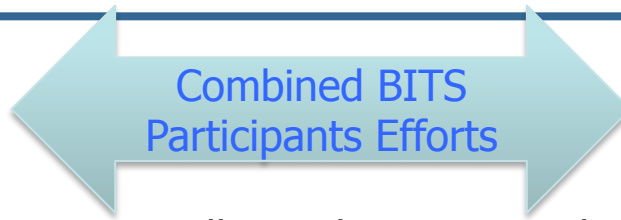
-- model-based tools for rapid FACE
development and integrations

FACE Air Force TIM/Expo
28 March 2017

A collage of four images: a technician working on a device, a hand holding a smartphone, a close-up of a device's interface, and a red car. Below the collage is the text: "EMBEDDED GLOBAL POSITIONING SYSTEM INERTIAL NAVIGATION SYSTEM (EGI) FACE PCS, PSS & IOS" and the Honeywell logo.

Matt Warpinski
12/1/16

Honeywell



Combined BITS
Participants Efforts

Honeywell, Matthew Warpinski
RTI, Mark Swick, and
TES-SAVi, TES-SAVi.com



The RTI logo with the tagline "Your systems. Working as one." is at the top. Below it is a slide titled "RTI TSS Reference Implementation presented to FACE IWS Pilot BITS Event" by Larry Kinnan, Senior Technical Marketing Engineer, dated 6 December 2016. The slide features a collage of images related to industrial systems and the Internet of Things.

Connecting the Industrial Internet of Things

RTI TSS Reference Implementation
presented to FACE IWS Pilot BITS Event

Larry Kinnan, Senior Technical Marketing Engineer
6 December 2016

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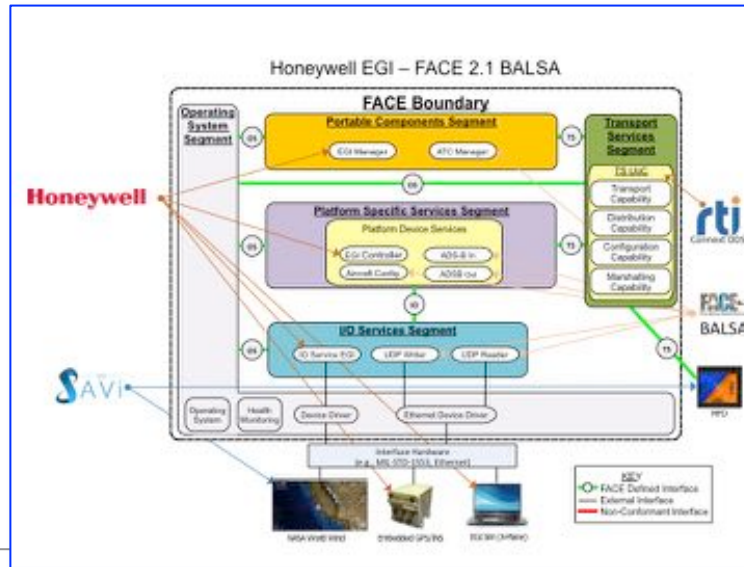
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Aligned with the FACE IWS Charter

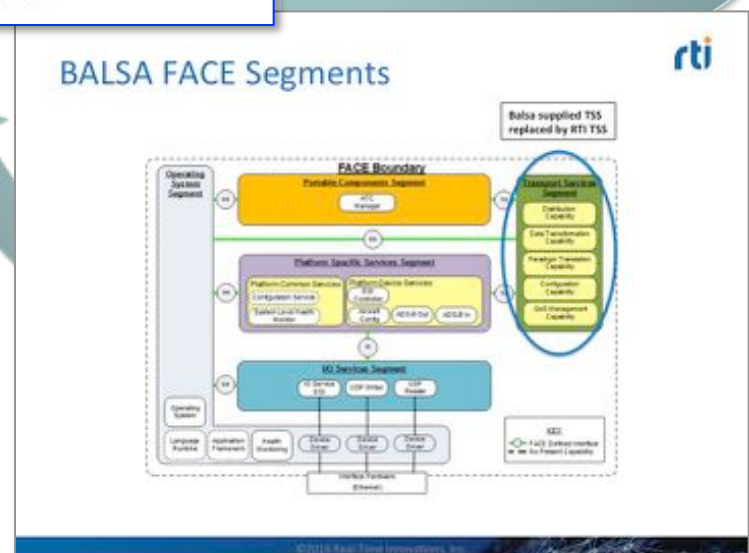
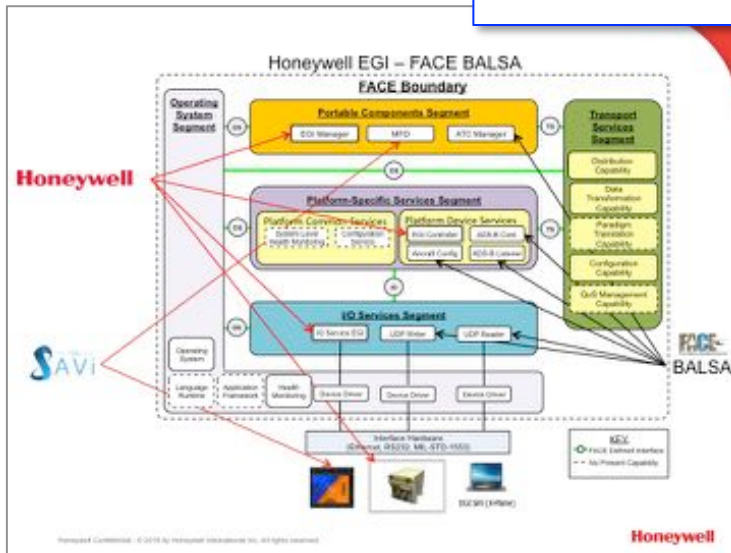


- The Charter of the Integration Workshop (IWS) is to:
 - Collaborate with the BWG/TWG to establish and enforce technical entrance criteria for public FACE Consortium sanctioned Technical Interchange Meetings (TIM) and similar events
 - Discover, evaluate, and produce FACE reference implementation examples and facilitate adoption and publication of those reference examples
- The BITS Pilot Event, December 2016 at FACE F2F at Harris
 - Participants were asked to integrate with the FACE Balsa reference architecture. 5 FACE member organizations participated
 - AMRDEC, Honeywell with TES-SAVi, Infinite Dimensions, RTI, and Textron Systems
 - After the presentations, the IWS suggested that 2 Participants investigate the cross-integrations of their individual efforts
 - Honeywell & RTI with TES-SAVi accepted the challenge, and produced a fully-functional cross-integration of the Honeywell/TES-SAVi demonstration now with the RTI DDS TSS

Scope of the Cross-Integration



Re-compiled in RTI's TSS DDS protocol



FACE Conformance Testing



- FACE 2.1.0r4 CTS test results
- Merged Honeywell EGI429 data model with the FACE BALSAs v2.1.1 GME data model, now compiled with RTI's TSS
 - Data Model – Passed. PCSS – Passed; and the PSSS – Passed.

The screenshot displays the "FACE Conformance Test Results" interface. At the top, there are two buttons: "Expand All" and "Collapse All". The main content is organized into sections, each with a plus sign icon and a title. The first section is "+ Test Configuration", which is expanded to show "—Data Model Tests—→ PASSED". This section contains three test results: "+ Test: FACE Meta Model Validation (Honeywell_BALSA_Merged_v1_0.face)→ PASSED", "+ Test: OCL Constraints Check (Honeywell_BALSA_Merged_v1_0.face)→ PASSED", and "+ Test: Shared Data Model Conformance (Honeywell_BALSA_Merged_v1_0.face)→ PASSED". The second section is "—Portable Components Segment Segment Tests—→ PASSED", which is also expanded to show three test results: "+ Test: Portable Components Segment only uses allowed FACE Segment APIs and Operating System Calls→ PASSED", "+ Test: Portable Components Segment uses restricted function calls that can only be used in TSS/IOS and within a single UoP→ No restricted calls", and "+ Test: Portable Components Segment uses fork command→ Fork Absent". The third section is "—Platform-Specific Segment Segment Tests—→ PASSED", which is expanded to show three test results: "+ Test: Platform-Specific Segment only uses allowed FACE Segment APIs and Operating System Calls→ PASSED", "+ Test: Platform-Specific Segment uses restricted function calls that can only be used in TSS/IOS and within a single UoP→ No restricted calls", and "+ Test: Platform-Specific Segment uses fork command→ Fork Absent".

Honeywell's EGI and RTI's DDS TSS integrated with FACE BALSA



- TES-SAVi merged Honeywell's data model with BALSA's data model; Integrated EGI into BALSA reference architecture resulting with Honeywell's PCS, PSS, IOS, and 3 external device components (EGI – simulated input, MFD - output, and WorldWind – output); lastly we removed the BALSA TSS and linked in RTI's TSS
- The fully-functional cross-integration was operationally demonstrated



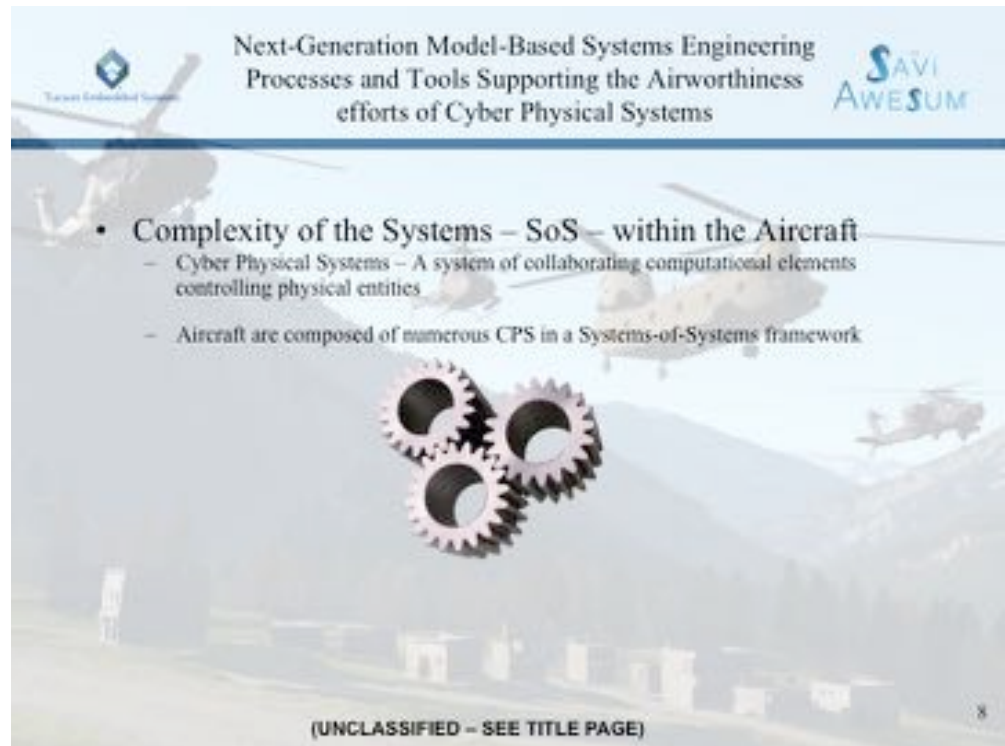
Quantifications of LOE individual and cross-integration of FACE BALSAs efforts



- Honeywell's FACE BALSAs development ~ multiple UoCs and included a data model efforts ~ 4 weeks * 2 engineers. ***Qualified:*** resources with extensive FACE experiences, including FACE data model experience and in-house MBSE development tools – *scope 8 EGI TSS interface messages*
- RTI's FACE BALSAs TSS ~ 2+ weeks. ***Qualified:*** resources with extensive TSS experience – *scope TSS limited to 3 message types*
- Post BITS Pilot Event, December 2016 at FACE F2F at Harris
 - TES-SAVi and RTI, occupied Harris' hallway space. They spent 4 hours * 2 resources, from the lunch break to COB; and they completed the cross-integration of their separately built FACE BALSAs integration efforts
 - Most of this time spent was to sync-up the dissimilar BALSAs builds, i.e., Honeywell-TES-SAVi used v.2.1.3 and RTI used v.2.1.1
 - A key enabler was TES-SAVi tools which auto-generated the IDL for BALSAs and non-BALSAs data types from the data model. This allowed quick integration of RTI TSS reference implementation
 - With RTI's tools providing visibility, some time spent to correct the use of types
 - **Overall, the cross-integration efforts went fairly smoothly, showcasing the benefits of the FACE Technical Standard**

Summary – Importance of these Cross-Integration of FACE efforts

- These cross-integration of efforts added fidelity to FACE, illustrating that systems-of-systems integration is not only possible, but is fairly simple to achieve with well-defined interface specifications
- These FACE IWS Participants showed that separate software systems provided from different developing organizations, written to the FACE Technical Standard and integrated into common reference architecture (BALSA) that share a common FACE data model, can be effectively and efficiently combined and demonstrated into an operational systems-of-systems
- *Indeed it can !!*



- slide from FACE paper published with AHS May 2016, TES-SAVI

A Peak Behind the Scene – MBSE Tooling



- In MBSE theory, *i.e.*, DO-178C's DO-331 model-based supplement
 - If a model is “sufficiently defined”, *you can generate control software, tests, and lifecycle documentation* (using MBSE processes and tools)
 - Efforts during the BITS Pilot Event, December 2016 at FACE F2F at Harris, included
 - With MBSE, we merged the 2 (8 msg) data models, then tested them for FACE conformance
 - With MBSE, we auto-generated 100% of the FACE TSS interface message code (C++), then tested the suite for FACE conformance (now, models + UoCs)
 - We auto-generated documentation – Honeywell Capability Interface Description (CID), *i.e.*, design documentation of TSS interface messages, useful for FACE VA efforts
- Does this MBSE process scale? *Answer: YES is does... 62x and growing*
 - The Army's R2C2 program has 502 TSS interface messages, whereas this EGI BALSAs demonstration effort has 8 messages, RTI 3 message types
 - R2C2 passed FACE Verification efforts, August 2015, using US Army FACE VA
 - R2C2 was integrated by GTRI, Boeing-Philly-ADD FVL efforts, and Geco-ERD
 - R2C2 supports legacy waveforms (ARC-231 and ARC-201D, 502 TSS msg). R2C2 is currently adding STT/Link-16 waveforms (adds 1,040 -> 1,542 msg, *i.e.*, 192x increase); And R2C2 is funding SANR integration (next-generation waveforms)
 - This Government Unlimited Rights Common Communications product, built using MBSE aligned to the FACE Technical Standard, is on track to support US Military needs

For additional Information



- The Honeywell EGI
 - Matt Warpinski, matt.warpinski@honeywell.com, TIM Booth #33
- The RTI TSS using DDS as a protocol
 - Mark Swick, marks@rti.com, TIM Booth #35-36
- TES-SAVi, MBSE tools and development services for FACE
 - Stephen Simi, www.TES-SAVi.com, TIM Booth #34
 - Ken Erickson (KenE@TucsonEmbedded.com), and Tom Brixey (TomB@TucsonEmbedded.com)
- FACE IWS BITS Events, FACE Getting Started Guide, and BALSAA
 - Alicia Taylor, alicia.h.taylor.ctr@mail.mil,
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Questions?

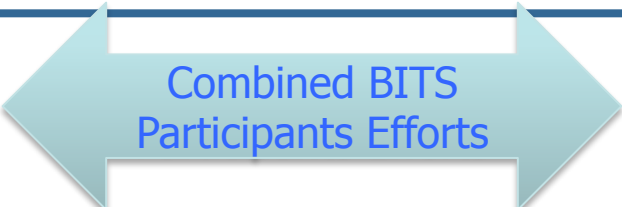
(Exhibitor booths #33, #34, #35-36, #18-19)



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