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Case Study Automotive Bluetooth Transmitter

Challenges

- Highest quality standards for automotive project

- Scope not completely defined in the beginning of the project

- Innovative solution with four Bluetooth modules in a single device

- Project divided into software and hardware modules developed by different companies

- Timeline and scope changes during the project

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Project Scope

- **System architecture, Bluetooth firmware design, MCU to Bluetooth module protocol design**

- **Implementation of transmitter Bluetooth module** software in line with transmitter release plan. Software update over MCU, UART protocol for MCU/DSP implementation, audio/DSP configuration, Bluetooth state machine, AVRCP support, test modes

- Deliverables: binaries, software release notes, software code, software documentation, test results, error reports

- **Transmitter MCU mock simulator** (UART communication for testing)

- Complete and **independent project management** including setting up development environment for Comarch tasks

- **Hardware review** and **HW issues resolving support**

Project Scope

- **Complete QA.** Unit testing (full coverage), sanity testing, performance and stress testing, functional testing, protocol testing, interoperability testing

- Continuous integration system and tests automation

- SonarQube for testing MISRA standard compliance

- **BT SIG certification support** (including internal PTS test).

- **Delivering documentation** for implemented SW and related processes

- **Onsite workshops,** hardware prototypes bring-ups (four HW versions)

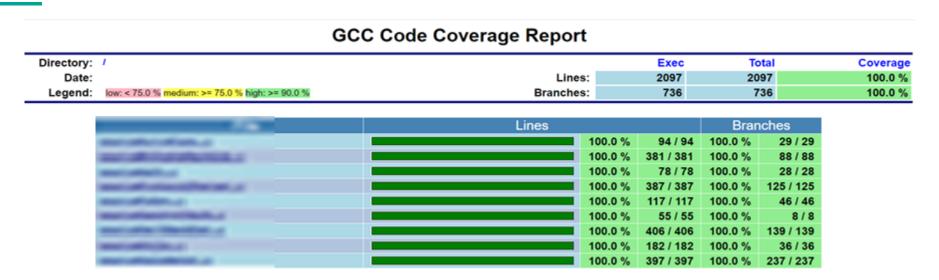- Project started with **incomplete scope,** flexible approach to delays in the project caused by HW delays

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Project Plan

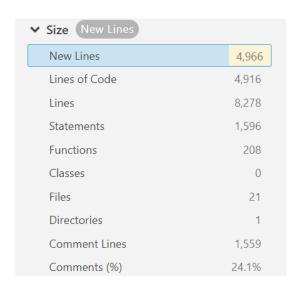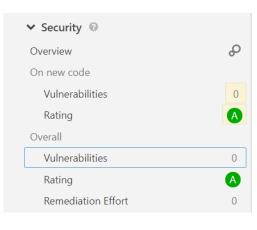| Dev	Project week:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	...
BT: base configuration (for a specific board)																																							
BT: development - base implementation (BT state machine)																																							
MCU SIMULATOR on PC: mock of Transmitter MCU UART comm																																							
BT: TEST Transmitterconfiguration																																							
BT: HW integration (HW version 1,2,3), production test tools																																							
BT: CSR dev board setup, I2S source for testing setup																																							
BT: Audio / Kalimba configuration																																							
BT: Fixing errors/improvements																																							
BT: UART protocol for MCU/DSP control - implementation																																							
BT: AVRCP commands to UART - implementation																																							
BT: software update over MCU																																							
BT: sleep mode configuration																																							
BT: Approbation, Validation and Factory tests implementation																																							
BT: finalizing production test tools and test modes																																							
BT: Coding Standard compliance/verification																																							
BT: OEM's requirements compliance/verification																																							
BT: Documentation																																							
BT: BT SIG certification support (including internal PTS test)																																							
Remote Support - 3 months, max 4 man-weeks																																							...
QA																																							
Automatic tests enviroment setup																																							
Test scenarios development																																							
Test documentation (templates)																																							
General QA (all other than IOP - test modes, MCU/DSP comm etc)																																							
IOP QA (10 HS models)																																							

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Project Metrics – Tasks in Jira

- Tasks in JIRA: **491**
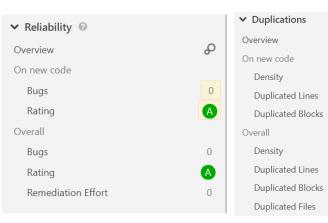 - Development tasks (sub-tasks not included)

- Tasks in JIRA for IOP testing: **689**
  - Project included: 11 test plans, 70 test case templates (about 50 as core tests).
    689 is a sum of test plans, test case templates and test case executed with devices from the market.

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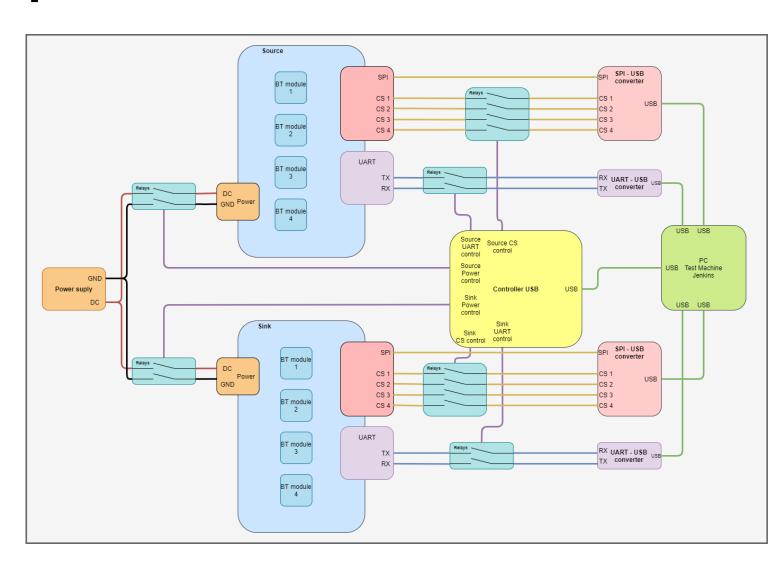# Project Metrics – Source Code Complexity, Unit Tests, Statical Analysis

GCC Code Coverage Report

Directory:	/			Exec	Total	Coverage
Date:			Lines:	2097	2097	100.0 %
Legend:	low: < 75.0 %	medium: >= 75.0 %	high: >= 90.0 %	Branches: 736	736	100.0 %

		Lines		Branches	
		100.0 %	94 / 94	100.0 %	29 / 29
		100.0 %	381 / 381	100.0 %	88 / 88
		100.0 %	78 / 78	100.0 %	28 / 28
		100.0 %	387 / 387	100.0 %	125 / 125
		100.0 %	117 / 117	100.0 %	46 / 46
		100.0 %	55 / 55	100.0 %	8 / 8
		100.0 %	406 / 406	100.0 %	139 / 139
		100.0 %	182 / 182	100.0 %	36 / 36
		100.0 %	397 / 397	100.0 %	237 / 237

Size New Lines

New Lines	4,966
Lines of Code	4,916
Lines	8,278
Statements	1,596
Functions	208
Classes	0
Files	21
Directories	1
Comment Lines	1,559
Comments (%)	24.1%

Security ⓘ

Overview	🔗
On new code	
Vulnerabilities	0
Rating	A
Overall	
Vulnerabilities	0
Rating	A
Remediation Effort	0

Reliability ⓘ

Overview	🔗
On new code	
Bugs	0
Rating	A
Overall	
Bugs	0
Rating	A
Remediation Effort	0

Duplications

Overview	🔗
On new code	
Density	0.0%
Duplicated Lines	0
Duplicated Blocks	0
Overall	
Density	0.0%
Duplicated Lines	0
Duplicated Blocks	0
Duplicated Files	0

Reliability - Issues in this domain mark code where behavior other than expected is possible.

Security - Issues in this domain mark potential weaknesses to hackers.

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Automated Test Setup

- **80 keywords** − a keyword is like a function or block and it is used to build a more complex test case.

- **98 test cases** − tests are categorized in 20 groups depending on tested functionality.

- Test run needs **1.5 hours**. Locally, it is possible to run a whole group of tests or one specific test.

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Result

- ✓ Comarch's partner accepted final delivery

- ✓ All expected and unexpected challenges that Comarch and its partner had to face have been resolved

- ✓ Comarch developed high-performance software compliant with automotive standards