Vodafone Test & Innovation Center service portfolio—M2M and ICT testing and know how for your business

Date: February 2011
Subjects to change or factual errors excepted.
Our Know How for your business

<table>
<thead>
<tr>
<th>M2M services</th>
<th>ICT services</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Global Vodafone Approval process</strong> for basic Machine-2-Machine products (Modules, M2M Terminals)</td>
<td>• Worldwide one of the first <strong>IPv6 Test-Networks</strong></td>
</tr>
<tr>
<td>• <strong>Test sessions, Drive tests and Certifications</strong> of M2M Devices / Solutions and Communication products</td>
<td>• <strong>LTE Test Network</strong> incl. analysis and support by our experts</td>
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<tr>
<td>• Interactive <strong>Workshops</strong> to M2M</td>
<td>• Interactive <strong>Workshops</strong> regarding to</td>
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<td></td>
<td>– Mobil Communication Technology</td>
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<td></td>
<td>– Fixed network technology</td>
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<td>– Your way to IPv6</td>
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<td></td>
<td>– Other issues for the future</td>
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</tbody>
</table>

**Your benefit**

- We are testing **End-to-End** under realistic and controlled conditions
- **Security and trust** for your solutions for mobile networks, national and international
- We share our **long-time experience** of more than 150 experts

> „With the Vodafone Test & Innovation Center, you achieve time to market advantages for your products and avoid unpleasant surprises with subsequent costs!“ — Jill Doppelfeld-Watson, Director Test & Innovation Center

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LTE (Long Term Evolution) Product Overview

Targeting at: LTE module/device manufactures and LTE solution developer

LTE Infrastructure
- Reference LTE environment with eNode B (800 MHz and 2.6 Ghz) and Core Elements (EPC)
- LTE devices: 4g LTE Sticks
- Tracing of relevant interfaces

LTE Products
- LTE development in our Test facilities and support by vodafone experts
- LTE Test network at customers location
- Support of LTE field tests
- LTE HF Lab measurements
- Technical LTE support/overview
- Future: Certification of LTE-Modules/solutions

Your benefit
- Early development in a real LTE Test environment
- Know how exchange with LTE vendors and Vodafone expert in a early phase of a project
- Development close to the technical Vodafone LTE Roadmap

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Targeting at:
    Developer of IPv6-devices, applications, services, platforms or IT-Systems

IPv6 Infrastructure
    • Worldwide one of the first IPv6 Test-Networks
    • Test-SIM-Cards for connection to the IPv6 Test network
    • Tests over the live network are possible (Germany)

IPv6 Products
    • IPv6 Workshops
    • IPv6 Test-SIM Cards for customized test over the live network

02/11 Subjects to change or factual errors excepted.
1. Consulting:
   M2M solution in interaction with the Vodafone Mobile network

2. Vodafone Global approval services:
   2.1 For M2M Modules & Terminals
   2.2 For M2M Devices / Solutions

   Applicable only for those products, which meet the set of entry criteria's

   Deliverable: VF test certificate, valid for all Vodafone Operators and Vodafone Partner Networks

3. Vodafone M2M test session:
   For M2M devices & solutions

   Test cases to be defined with the customer. No formal entry criteria's, Deliverable: Detailed Test Report

   For more details, see next slides.
Vodafone Test & Innovation Center differs between M2M modules, M2M terminals and M2M devices / solutions.

**M2M module:**
Communication unit as distributed by manufacturers like Telit, Cinterion, etc. The module is the smallest unit covering the communication part of the M2M device. It contains RF part, antenna and the chipset containing the logic to setup, maintain and tear down a mobile connection, usually using AT commands that are input from the machine application.

**M2M terminal:**
M2M Terminals are similar to modules, but “wrapped” modules. Terminals are designed to be used in conjunction with other hardware. We mean hardware, where an underlying module is included in a hardware part with different input and output gates. An M2M terminal does not include any further intelligence or functionality.

**M2M device / solution:**
M2M devices are part of the complete M2M solution (solution includes server, application and devices for communication). They contain hardware, software and module. The difference between a terminal and a device is that the device has a SW which controls the module and the remaining hardware to deliver the device functionality to the final user, whilst the terminal require some other piece of hardware and software to deliver its functionality to the user. The hardware can take many forms but in general has a microprocessor, memory, optional storage and input devices (buttons, keyboard, GPS receiver or sensors).

We offer general consulting, testing & approval services for each category to fulfill your needs.
1. „Machine-2-Machine Solution“ Customer Workshop

M2M solution in interaction with the Vodafone Mobile network

Targeting at:
Developers, user and interested people in M2M communication; Application developers.

Content of Workshop:

Theory:
- GSM / GPRS / EDGE / UMTS Basics; Basic knowledge of antenna design; Application/Module communication; specific AT commands of a module; SIM/Module communication.

Practice:
- Verification of the interface between Application and Module via AT commands (Check and Analysis of mobile network- and module availability; Evaluation and optimisation of AT commando sequences; Activation and preparation of data transmission via SMS, GPRS, EDGE, UMTS or CSD; Optimisation of the power consumption; Roaming Features)
- Solution possibilities of the Application/Module Communication
- Examples

Duration: 1 day minimum

Your benefit

- Customer obtains an all-embracing overview to the technical requirements of the M2M data transmission. Based on customers product and specifications, possible solutions will be discussed.
- Optimisation proposal for customers M2M solution from mobile network perspective
- Better knowledge of the AT command sequences for the application

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2.1 Approval of M2M base products (modules & terminals)

Global Vodafone-Approval for all VF operators and partner networks

Targeting at:
Manufacturers of modules and terminals for the M2M business

Test cases and scenarios (Duration: 10-15 working days for test execution + 2 weeks for test evaluation & submission of certificate)
- Attach procedures, PDP context activation, handover, emergency calls, e.g., "PDP Context deactivation via MMI"; "PS Mobility - different RA, same SGSN, DUT in STANDBY state"
- Data traffic depending on the capabilities of the module/terminal (e.g., 2G/3G)
  e.g., "max IP Download performance in Rel.99 Cell"; "HSPA HS-DSCH physical Layer Category"
- Steering of roaming
- One delta test inclusive

Infrastructures: Against Vodafone infrastructure

Formal Entry criterias: Health & safety, GCF certification (for details, see table of requirements)

Note: for those M2M hardware not meeting entry criterias, customized testing services are available (without marketing package)

Your benefit

• Recommendation of readiness to use in all Vodafone OpCos and partner networks
• Marketing-package:
  – Right to use the VF logo and speech mark
  – Recommendation of the certified products to application developers and business customers
  – Products listed under: [www.vodafone.de/testing/wireless-module-terminal-testing.html](http://www.vodafone.de/testing/wireless-module-terminal-testing.html)
• Assurance to use in M2M-solutions in different national/international mobile networks
• Vodafone Global Test certificate and detailed test report for the customer

02/11 Subjects to change or factual errors excepted.
2.2 VF Global Approval of M2M devices and solutions

Global Vodafone-Approval for all VF operators and partner networks

Targeting at:
System house, solution provider, major and medium-sized customers which develop M2M solutions for their potential clients

Test cases and scenarios (Duration: 15 - 18 working days for test execution + 2 weeks for test evaluation & submission of certificate)
– module-/terminal-tests against global test criteria (if not VF approved)
– Robustness + negative tests for M2M devices/solutions: typical mobile network scenarios (with network components like BTS, BSC, SGSN, internet...); network-upgrades; changing of SIM cards; mobility (handover, interferences)
– Test of solution specific use cases
– One delta test inclusive

Infrastructures: Against Vodafone infrastructure
Formal entry criterias: Health & safety, SAR, GCF certification (at least for module inside),
(for details, see table of formal entry requirements)
Note: for those M2M hardware not meeting entry criterias, customized testing services are available (without marketing package)

Your benefit

• Solution provider and end customers benefits from the experiences and internal knowlegde of an mobile network operator to meet a challenge
• Detection of potential of optimizations. Linking to the module manufacture, if necessary, to improve the product quality
• Test certificate and detailed test report for the customer

02/11 Subjects to change or factual errors excepted.
3. Test session for M2M devices and solutions

Customized test session for M2M solutions

Targeting at:
System house, solution provider, wholesale and medium-sized customers which develops M2M solutions for one or a hand full of customers

Test cases and scenarios (Duration: 0.5 days test scope definition, 2 days testing + 1 week for preparation of test report):
- Modul/Terminal Test with focus of the relevant use cases; Robustness + negative tests for M2M devices/solutions: typical mobile network scenarios (with network components like BTS, BSC, SGSN, internet...); changing of SIM cards; mobility (handover, interferences); Test of solutions specific use cases.
- Test of specific use cases will be discussed with the customer in advance

Infrastructures: Against Vodafone infrastructure
No entry criterias; M2M product is tested "as it is".

Your benefit

- Solution providers and end customers benefit from the experiences and internal knowledge of an mobile network operator to meet a challenge
- Having no cost increase while avoiding the risk of an outage of the solution
- Detection of potential of optimizations. Linking to the module manufacture, if necessary, to improve the product quality
- Test report of all conducted test cases for the customer

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<table>
<thead>
<tr>
<th>Criteria</th>
<th>Module</th>
<th>Terminal</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCF Certified Declaration &amp; GCF FT / IOP Test Results</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;TTE Certificate (must cover safety: EN 60950, EMC: EN 301*)</td>
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<td></td>
<td></td>
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<tr>
<td>FCC ID at the device</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evidence of FCC approval (conducted mode only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CE mark at the device and CE-identifier of auditing body</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SAR Report for position at the head and body (as applicable) for all supported frequencies (for terminals test have to be conducted with a recommended antenna even if that is not sold with the terminal)</td>
<td></td>
<td>(antenna)</td>
<td></td>
</tr>
<tr>
<td>SAR tests have been conducted by a VF approved SAR laboratory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A declaration must be made of the maximum SAR for ME and that the SAR value will stay inside the defined limits during the lifecycle of the product</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery safety report according to UL 1642 standard and to the IEEE1725 standard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROHS Certification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ElectroG Environmental Legislation marking at the device &amp; electrical accessories[1] (only valid for commercial Terminals)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sollten die Kriterien nicht in Gänze erfüllt sein, bieten wir individuelle Testdienstleistungen an.

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## Technical Requirements for Approval Service:

<table>
<thead>
<tr>
<th>Technical Requirements</th>
<th>Module</th>
<th>Terminal</th>
<th>Device</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Module EVB (Evaluation Board or DSB) with all necessary connectors</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td># of Module Silver (Production) Samples</td>
<td>3*</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td># of Terminal/Device</td>
<td>-</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td># of All Modem Drivers</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td># of Mobile Software Application, Connectivity Suite</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Technical Specification. These must include:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Short manual</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>- Information on the baseband chipset and the baseband s/w version.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SW Release note of the embedded cellular module, including the known issue list.</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>SW Extraction Code</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>HW Release Note of the embedded cellular module</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>AT commands list</td>
<td>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td># of Accessories for the hardware</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Feature comparison for the DUT with family devices as appropriate</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td># of RF Lead</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td># of Data Lead</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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Interest?

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Vodafone und Partners worldwide

Map showing countries with own and partner networks and roaming agreements.
Example: Approval of a Machine-to-Machine Application

Linde AG pressure- und fill level meter with Telit data module

- Service
  - Test of Smart Metering Application
  - Test of integrated mobile module against global test criteria

- Customer benefit
  - Verification of End-to-End process chain in core business
  - Quality assurance for innovative solution
  - Defect and error analysis

- Why choose Vodafone Test & Innovation Center?
  - Real End-to-End Testing within a controlled mobile network / Environment
  - Experience with Modules & Applications
  - Project management
  - Approval including Test Report