

3G Evolution

HSPA and LTE for Mobile Broadband

Second edition

- Includes details of the standards and technologies with 160 new pages: LTE radio interface architecture, LTE physical layer and LTE access procedures
- Contains three brand new chapters on LTE: Transmission Procedures, Flexible Bandwidth and LTE Evolution, plus expanded details on the physical layer (total LTE content is 270 pages)
- Examines the latest developments in the evolution of LTE into IMT-Advanced, the next stage of 3G Evolution
- Gives clear explanations of the role of OFDM and MIMO technologies in HSPA and LTE
- Outlines the System Architecture Evolution (SAE) supporting LTE and HSPA evolution

Reflecting the recent completion of LTE's specification, the new edition of this bestseller has been updated to provide a complete picture of the LTE system. The latest LTE standards are included on the interface architecture, the physical layer, access procedures, MBMS, together with three brand new chapters on LTE Transmission Procedures, Flexible Bandwidth in LTE and LTE evolution into IMT-Advanced.

Key technologies presented include multi-carrier transmission, advanced single-carrier transmission, ac receivers, OFDM, MIMO and adaptive antenna solutions, advanced radio resource management and power and different radio network architectures. Their role and use in the context of mobile broadband general is explained. Both a high-level overview and more detailed step-by-step explanations of HSPA and LTE implementation are given. An overview of other related systems such as TD-SCDMA, CDMA2000 and WIMAX is also provided.

This book is a 'must-have' resource for engineers and other professionals in the telecommunications working with cellular or wireless broadband technologies, giving an understanding of how to use the technology in order to stay ahead of the competition.

The authors of the book all work at Ericsson Research and are deeply involved in 3G standardisation since the early days of 3G research. They are leading experts in the field and are actively contributing to the standardisation of both HSPA and LTE within 3GPP.



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Erik Dahlman
Stefan Parkvall
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Per Bemning

SDPHYS02



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Erik Dahlman, Stefan Parkvall, Johan Sköld and Per Beming



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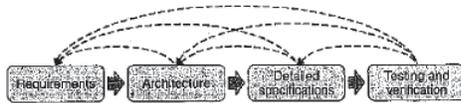


Figure 1.1 The standardization phases and iterative process.

3. *Detailed specifications*, where every interface is specified in detail.
4. *Testing and verification*, where the interface specifications are proven to work with real-life equipment.

These phases are overlapping and iterative. As an example, requirements can be added, changed, or dropped during the later phases if the technical solutions call for it. Likewise, the technical solution in the detailed specifications can change due to problems found in the testing and verification phase.

Standardization starts with the *requirements* phase, where the standards body decides what should be achieved with the standard. This phase is usually relatively short.

In the *architecture* phase, the standards body decides about the architecture, i.e. the principles of how to meet the requirements. The architecture phase includes decisions about reference points and interfaces to be standardized. This phase is usually quite long and may change the requirements.

After the architecture phase, the *detailed specification* phase starts. It is in this phase the details for each of the identified interfaces are specified. During the detailed specification of the interfaces, the standards body may find that it has to change decisions done either in the architecture or even in the requirements phases.

Finally, the *testing and verification* phase starts. It is usually not a part of the actual standardization in the standards bodies, but takes place in parallel through testing by vendors and interoperability testing between vendors. This phase is the final proof of the standard. During the testing and verification phase, errors in the standard may still be found and those errors may change decisions in the detailed standard. Albeit not common, changes may need to be done also to the architecture or the requirements. To verify the standard, products are needed. Hence, the implementation of the products starts after (or during) the detailed specification phase. The testing and verification phase ends when there are

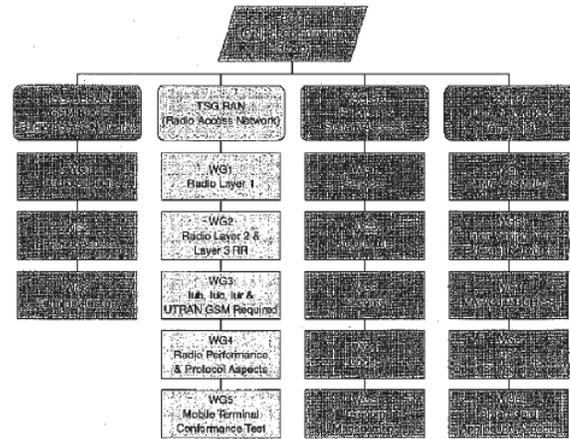


Figure 1.2 3GPP organization.

stable test specifications that can be used to verify that the equipment is fulfilling the standard.

Normally, it takes one to two years from the time when the standard is completed until commercial products are out on the market. However, if the standard is built from scratch, it may take longer time since there are no stable components to build from.

1.2.2 3GPP

The *Third-Generation Partnership Project* (3GPP) is the standards-developing body that specifies the 3G UTRA and GSM systems. 3GPP is a partnership project formed by the standards bodies ETSI, ARIB, TTC, TTA, CCSA and ATIS. 3GPP consists of several Technical Specifications Groups (TSGs), (see Figure 1.2).

A parallel partnership project called 3GPP2 was formed in 1999. It also develops 3G specifications, but for cdma2000, which is the 3G technology developed

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