Managing the PSTN Transformation

A Blueprint for a Successful Migration to IP-Based Networks

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Contents

Preamble xi
The Authors xiii
Introduction xvii
List of Abbreviations xxvii
Project Team Members for IP Transformation xxxi

Chapter 1 Overarching Topics 1
1.1 The PSTN Migration Process and Interdependencies 1
1.2 Project Organization 4
   1.2.1 Project Structure: Roles and Responsibilities 4
   1.2.2 Escalation 6
1.3 Environmental Status Quo 6
   1.3.1 External Factors 7
   1.3.2 Internal Factors 8
1.4 Scenario Analysis 9
   1.4.1 Interim Solutions 11
   1.4.2 Full Migration 13
   1.4.3 Combined Approach (on an Area Level) 14
1.5 Standard Mandatory and Optional KPIs 15
1.6 Risk Analysis 15
   1.6.1 Project Internal Risks 16
   1.6.2 Deutsche Telekom AG/NatCo Risks (Micro Environment) 17
   1.6.3 Eco System Risks (Macro Environment) 18
1.7 End-to-End (E2E) Processes 19
   1.7.1 Adjustment in E2E Processes 19
   1.7.1.1 Processes without Major Changes 19
CONTENTS

1.7.1.2 Processes with Incremental Changes 19
1.7.1.3 New Processes 20
1.7.2 Complete E2E Process for PSTN Migration 20

Chapter 2 Migration Plan 23
2.1 Product Development Sequencing 25
  2.1.1 Sequencing Framework for Product Development 26
  2.1.2 Prioritization Criteria and Rationale for Niche Products 28
2.2 Migration Strategy (Including Phases and Types) 29
  2.2.1 Assess Migration Phases 29
  2.2.2 Migration Phases—Timing Guidelines and Key Learning 30
  2.2.3 Assess Migration Types 32
  2.2.3.1 List of Migration Types 32
  2.2.4 Define the Migration Strategy per Segment/Product and Derive the Related Costs 34
    2.2.4.1 Framework Migration Strategy for Each Segment/Product Including Unit Cost per Migration by Segment/Product 34
  2.2.5 Migration Strategy per NatCo 35
2.3 Migration Sequencing—Product Sequencing 36
  2.3.1 Prioritization Logic for Product Sequencing 38
  2.3.2 Prioritization Logic with Criteria and Rationale for Niche Products 40
2.4 Migration Sequencing—Area Sequencing 42
  2.4.1 Area Evaluation 42
  2.4.2 Area Sequencing Approach 44

Chapter 3 Product Portfolio Roadmap 51
3.1 Information Collection 51
  3.1.1 A Collection List of the Complete Current Features/Product Catalogue/Terminal Equipment 52
    3.1.1.1 IP Migration of ISDN—ISDN Features Missing in IMS 53
  3.1.2 Preparation of a Regulatory Checklist 53
    3.1.2.1 List of Regulatory-Required Features 54
    3.1.2.2 List of Further Regulatory Requirements and Their Impact 55
  3.1.3 Identification of Technically Available Features 55
  3.1.4 Matching of Current Features to Available IP Features 56
    3.1.4.1 Framework for Matching Features and Drawing Conclusions about Features 57
### Contents

3.2 Analysis and Selection of Features  
3.2.1 Identification of Feature Benefits  
3.2.1.1 Evaluation Approach for Feature Benefits  
3.2.2 Calculation of Costs/Resources for the Features in Discussion  
3.2.3 Evaluation of Features  
3.2.3.1 Evaluation Framework for the Selection of Features  
3.2.4 Retirement of Features  
3.3 Product Definition  
3.3.1 Feature Mapping to the Existing Portfolio  
3.3.2 Substitute Product Definition  
3.3.2.1 Factors Impacting Decisions on the Product Portfolio Definition  
3.3.3 Announcement to the NRA and Changing of the T&C and Submission of the RO  
3.3.3.1 Checklist for Potential Regulator Approval and Best Practices on the T&C  
3.4 Realization of the New Portfolio  
3.4.1 Prioritization of the Development and Launch Sequence  
3.4.2 Planning of the Launch and Execution  
3.5 Commercial Opportunities in B2B and B2C during and after Migration  

### Chapter 4 NT/IT Roadmap

4.1 Target Architecture and Technical Product Development  
4.1.1 Target Architecture  
4.1.1.1 The Collection and Comparison of Network Strategy Documents  
4.1.2 Technical Product Development—Information Preparation  
4.1.2.1 End-to-End Technical Solutions for Basic Voice Service  
4.1.2.2 Preparing a List of Available Technical IP-Based Features  
4.1.2.3 Identification of Differences in Service Ergonomics Due to the Introduction of IP  
4.1.3 Technical Product Development—Technical Product Design  
4.1.3.1 Assessment of the Current Status of Network/Platform Resources  
4.1.3.2 Preparation of the TCO and Technical Solution Documents
4.1.4 Technical Product Development—Product Implementation 90
  4.1.4.1 Start of Technical Product Development Implementation 90
  4.1.4.2 Integration of New Platforms or the Extension of Existing Platforms, Quality Control, and Handover 92

4.2 NT Rollout 96
  4.2.1 Network and Technical Product Readiness 96
    4.2.1.1 Definition of the Migration Enabler 96
    4.2.1.2 Major Network Deployment Plans 98
  4.2.2 Internal Resources Preparation and Planning 100

4.3 IT Roadmap 101
  4.3.1 IT Application and Product Readiness 101
    4.3.1.1 Identification of the Required Changes to IT Applications 101
    4.3.1.2 Adaptation of the Existing IT Systems/Development of New IT Systems 104
    4.3.1.3 Adaptation of Interfaces toward the Network 109
  4.3.2 Customer Migration Process within IT 112
    4.3.2.1 Development of the Migration Process 113
    4.3.2.2 Development of All Regular Processes 117
    4.3.2.3 Enable Migration Reporting 120

4.4 Interdependencies with Other General Projects 125
  4.4.1 Identification of the Interdependencies with the Current IT/NT Corporate Projects 125
    4.4.1.1 Identification of the Interdependencies with the Current IT/Corporate Projects 125

4.5 Evolution of the Network from Legacy (PSTN/ISDN) to the New IP Platform 129

Chapter 5 Business Case Framework 133
  5.1 Calculation Methods 135
    5.1.1 Calculation Rules 135
    5.1.2 Scope of Business Case Items 136
    5.1.3 Financial Impact Calculations 136
  5.2 Project Assumptions 138
    5.2.1 Scenario Definition 141
    5.2.2 Input Need from Work Streams 144
      5.2.2.1 Milestones of Business Case Calculations 144
      5.2.2.2 Input for the Migration Scenario 146
      5.2.2.3 Input for Interim Solutions 154
CONTENTS

5.3 Business Case Structure 155
  5.3.1 Revenue and Cost Base and Business Case Baseline 156

Chapter 6 Go to Market 157
6.1 Communication Plan 157
  6.1.1 Communication Strategy (Including Benefit Story) 157
  6.1.2 Communication Plan 160
    6.1.2.1 External Communication 161
    6.1.2.2 Internal Communication 167
6.2 Sales Channel Plan 168
  6.2.1 Steering and Orchestrating the Sales Channels 168
    6.2.1.1 Preferred Sales Channels as Customer Touch Points 168
    6.2.1.2 Channel Focus per Migration Phase 172
    6.2.1.3 Reporting 178
  6.2.2 Cross-Sell, Upsell, and Retention 178
    6.2.2.1 Retention 181
6.3 Training 182
  6.3.1 Sales Force Training 184
  6.3.2 Key Account Manager (KAM) Training 184
  6.3.3 General “All-Employee” Training 185
6.4 Migration Support Customer Care and Technical Service 186
  6.4.1 Involvement of Customer Care and Technical Service in the PSTN Migration Process 186
  6.4.2 Planning of Demand Volume 187

Index 191
Preamble

Claudia Nemat, Board Member, Europe and Technology, Deutsche Telekom; and Kerstin Günther, Senior Vice President, Technology Europe, Deutsche Telekom.

The IP transformation blueprint described in this book is the product of countless hours of hard work by hundreds of individuals over almost 2 years. It is not just a theoretical cookbook that tells you how this could work. This actually happened—we at Deutsche Telekom migrated the entire public switched telephone network in Macedonia to an Internet protocol-based platform. Our colleagues in Macedonia and everyone else who supported them are real pioneers, within the Deutsche Telekom Group, and within the entire industry. We are publishing our IP transformation blueprint because the lessons we learned and the experience we gained in Macedonia can easily be scaled up and applied in other markets around the world to benefit everyone.

To the untrained ear, it sounds simple: you switch the phone lines from one technology to the other. Nothing could be further from the
truth. Our experience has shown that a successful migration relies on key aspects beyond the technological side. Therefore, this work also includes a product portfolio roadmap, a commercial roadmap, an NT/IT roadmap, and several business cases. It is our firm belief that everything we learned during the network migration in Macedonia can be applied to other countries around the globe. It is simply a question of scale, of taking what we did there and scaling it up to larger network environments. In Macedonia, we encountered every type of challenge imaginable, especially in integrating complex systems such as flight control at their airports, alarms for fire and police response, large enterprise customers; the list goes on.

At its core, this is a question of cooperation and collaboration across corporate functions. Projects like this one show what we can do when our people work closely together across borders and functions. It enables us to properly apply our skill and knowledge—regardless of where they are. This close collaboration is inherent in an IP network.

An IP network is a unified, future-oriented system with an unprecedented capacity for the ever-growing demand for bandwidth. It also further strengthens our position in Europe as a technology leader. It brings us closer to our customers, who can now activate new services within hours; to our partners, who can connect their value-added services to our network within weeks; and it brings our local operations closer to each other.

Our ultimate goal is a fully integrated pan-European network where the technology speaks the same language no matter where it is. That language is IP. This network will one day integrate mobile and fixed-line technology and enable a new cloud-based production model. It will eliminate redundancies, increase efficiency, and pave the way for the value-added services and solutions of the future. This blueprint is therefore, the first vital step toward creating a truly pan-European network.

It is just a matter of time. Until then, please read on and learn all about what our IP transformation meant and means to us.

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Introduction

Next-generation networking (NGN) describes key architectural evolutions in telecommunication core and access networks that will be developed over the next years. The general idea behind NGN is one single network for all information and services (voice, data, and all types of media, such as video).

The required shift toward standards-based architectures allowing service providers to create multipurpose platforms that share a common infrastructure is called *IP transformation*. It ensures technological leadership forming a new paradigm for telecommunication businesses with higher service quality standards (see Figure I.1).

While there are several enablers supporting the IP transformation as a broadband rollout (xDSL, FTTx) and IP network optimization (e.g., BNG and TeraStream), a basic but challenging requirement is an all-IP infrastructure and thus the decommissioning of PSTN. To reach this goal, customers and products of the PSTN network need to be transferred to the IP network. This process is called *PSTN migration*.

As an enabler for IP transformation, PSTN migration is primarily focused on cost avoidance, network stability, and minimized churn during the migration process. Potential revenue increases from new IP services or value creation for customers and further efficiencies from
Process improvements are not within the scope of PSTN migration projects. They need to be addressed separately in a long-term perspective of IP transformation (see Figure I.2).

PSTN migration impacts the whole company for all business functions and with a complete fixed customer base. The largest part of this challenge is posed by the legacy TDM voice platform, the PSTN. All incumbent operators are struggling with their PSTN migration, mostly because they had initially underestimated the complexity and criticality of the issue and as a result:
1. They were not clearly focused on the core purpose of the PSTN migration—which is to avoid costs while minimizing churn—and therefore allowed themselves to be distracted by possible revenue upsides.

2. They tried to approach the problem in a “80/20” fashion, saw some initial success on simple products in simple customer segments, and finally got stuck on the more complex products.

3. They set ambitious top-down targets without prior thorough analysis of the constraints and options at hand, targets which subsequently had to be revised over and over and therefore lost credibility.

4. They framed the issue as decommissioning of a technology, to be led by the chief technology officer (CTO), rather than migration of customers, with heavy involvement and commitment of all functions, particularly the chief marketing officer/chief operating officer (CMO/COO).

During the PSTN migration project within Deutsche Telekom and seven countries, we developed a reference blueprint, summing up the state of the art knowledge on PSTN migrations and key learning.

Here, we provide an overview of this blueprint, sorted by the three key problem areas (Figure I.3):

1. How to capture the financial benefit of the PSTN migration
2. How to realize a 100% complete PSTN migration
3. How to enable and support the PSTN migration

Figure I.3 The PSTN migration challenges, grouped into three key problem areas.
How to Capture the Financial Benefit of PSTN Migration

As a key requirement for IP transformation, PSTN migration is a necessity which has to be realized in a financially optimal way considering both costs and potential revenue loss. Thus, it is not about additional revenues, it is about cost avoidance and churn minimization.

The financial benefit of PSTN migration is impacted by three dimensions—costs, churn, and time. The management of each dimension and their interaction is highly complex and provides challenges in every migration project (see Figure I.4). All three dimensions need to be reflected in the business case model.

The business case can be simply constructed by comparing migration costs to cost savings due to the shutdown of PSTN platforms. Experience shows migration from PSTN to IP technology costs around 30€ ($38) to 60€ ($75) per subscriber, distributed over 3 to 5 years, while the expected cost benefits from switching off the PSTN platform are around 10€ ($13) per subscriber per year.

However, these figures only provide a rough orientation and it has to be kept in mind that

- It is often unclear which costs are migration related and thus within scope.
• Migration costs are heavily influenced by required resources for each customer segment, especially toward the end of cleansing an area.
• Savings of PSTN migration may be underestimated, because they do not account for an avoidance in cost explosion or churn if some of the switches actually do reach the end of their useful lifetime.
• Business case results are highly sensitive to migration-related churn; already 2% of total customer base churn can alienate the financial benefit of the business case.

Hence, the business case has to be extended, taking various additional factors into account.

Additionally, for decision-relevant business cases, the question—what to compare PSTN migration with—is not an easy one. Comparing it to an imaginary “flat line” do-nothing scenario is not realistic, as do nothing yields a strong rise in costs, as well as a high risk of network failures and a total failure of the PSTN in the long run. Thus, it is not a real option and the comparison of the PSTN migration scenario should be conducted against a realistic scenario or minimal change—usually a midterm interim solution such as prolonged PSTN usage or soft switches.

Hence, the benefit of PSTN migration needs to be calculated by comparing incremental financial implications of the specific interim and full migration options of the countries with regard to revenue, operational cost development, and CAPEX (capital expenditure) investment. Having transparency in these options as well as parallel enabler projects (e.g., investments into higher broadband coverage) are key challenges and prerequisites for solid and non-overlapping business case calculations.

The financial benefit of a full migration scenario versus interim solution can be influenced by four major drivers:

• Minimize churn: A customer facing problems, while being migrated or later using IP services, will always churn with his full contract revenue from voice, broadband, TV, and other services.
• Migration costs: The level of many expenditures, such as IMS or access network investment, is determined by the technical starting point of the country; but resource needs for customer
migration and levers for optimization (e.g., remote migration) should be carefully considered.

- **Migration timeline:** Migration of the full customer base should always be accomplished in an ambitious timeframe to minimize the periods with negative cash flow.

- **Long-term savings:** The main expected benefits of switching off the PSTN platform are savings in energy costs, service level agreements, and personnel costs in planning, assembling, and maintenance.

To support each country with this challenge, we have developed a standardized business case framework. Besides overarching benefit calculations this helps to

- Provide a solid and comparable basis to orchestrate CAPEX, OPEX (operational expenditure), and revenue discussion within and across all functions (e.g., marketing, sales, customer care, NT, IT, regulatory).

- Ensure cross-functional alignment for target setting during the conception phase of the project and rollout preparation as well as final execution of the migration plan.

- Faster align the country business case results with shareholder Deutsche Telekom AG through a common understanding of the impact from PSTN migration.

**How to Realize a 100% Complete PSTN Migration?**

One key challenge of PSTN migration is that it is not about 80/20 planning, it is about migrating 100%. This holds true not only for the total project and the PSTN shutdown but also for the individual area shutdown. However, these area shutdowns are the main driver of savings. Thus, the question is not, how fast can you migrate a large number of customers, but how long does it take to migrate the last customer. It also shows the migration status in 2012, which had already migrated a large number of customers, but still has left the more complex business and wholesale customers, who might block the shutdown of the focus areas.

To mitigate the resulting risk, careful planning has to be done, which is not about setting ambitious targets; it is about hitting the targets as planned.
Consequently, migration planning needs to realistically detail how to contact and migrate customers, and also when to migrate each customer. To realize this and optimize the trade-off between costs, time, and churn, some key learning is applied in the migration planning framework presented in the blueprint:

- Migrate by area to maximize savings, migrate by product to leverage spare resources (costs and time).
- Start early with customized solutions and wholesale solutions, as they often block the clearance of areas (time).
- Maximize leverage of natural migration (NM), as it is the most optimal resource and most customer-friendly way for migration (costs).
- Manage all types of resources choosing a trade-off on churn, cost, and/or time, and check readiness to make those sacrifices (costs, time, and churn).

To ensure the implementation of learning and a smooth migration process, the framework focuses on the two major resource constraints of product development and migration resources. The resulting migration plan comprises not only the sequencing of product development but also the planning of the migration itself, defining how each customer is migrated (migration strategy), and when (migration sequence).

The planning process starts with the optimization of product development, defining not only the development start date but also the date of substitute readiness. The prioritization of products follows two imperatives:

- High-volume mass products first as their early readiness increases natural migration and resource leverage.
- Complex products first as they take a long time to develop, migrate, and form the major roadblocks.

The migration sequencing approach strives to maximize savings while managing available migration resources and reducing the delay risks of the project. As savings are mainly driven by the shutdown of an area, migration should be done in an area-by-area approach. However, to leverage spare resources before and during an area migration, a migration by product is used as well.
Identifying the product sequence within the product-by-product approach, a framework is provided by mainly applying two recommendations:

- **Complex products**: Start with multiarea products to reduce roadblocks for area cleansing, start with complex products to mitigate long migration duration.
- **Standard products**: Focus on mass products with expected limited success of natural migration.

Area sequencing forms the most complicated task, as many resource and timing constraints are implied on the area-by-area migration combined with strong interdependencies of sequencing and resource requirements. To break this circularity issue, the sequencing is done in a scenario approach taking timing constraints, savings on migration costs, and early migration savings into account. The scenarios are combined and optimized by different levers to ensure sufficient resource availability on different dimensions (CAPEX/OPEX, customer care FTEs, regional technical services FTEs).

**How to Enable and Support the PSTN Migration?**

In preparation of PSTN migration three major adjustments are required, not only in NT and IT, but also in the product portfolio and processes, which can impact various functions. Hence, PSTN migration is not a pure technical approach; it is about a cross-functional enabling of products, systems, and processes:

- The PSTN product portfolio needs to be transferred into the IP world and thus the new value-cost-optimized IP product portfolio needs to be created.
- NT/IT need to be enabled for IP and the migration demands vast adjustments in systems.
- IT processes for migration need to be defined and the majority of existing processes adapted.

The development of the new IP product portfolio is complex and crucial due to the large scale covering all PSTN product substitutes and due to the strong regulatory involvement throughout the whole
process. Both aspects impose not only high effort and huge project risks but also have a major impact on future positioning and revenues. Thus, an approach must be used ensuring a carefully cost-benefit-optimized and approved product portfolio.

As a basis for all consideration, transparency regarding the current PSTN product portfolio and its features, as well as the existing options for the new portfolio, have to be generated allowing the deduction of required actions per feature.

One of these actions is a cost-benefit analysis of the possible features to be invested in. The blueprint provides an evaluation framework assessing feature value and costs resulting in the list of features to be implemented in the IP world and identification of features to be retired.

Building on the IP feature portfolio, the new product portfolio needs to be created and optimized along with various criteria, such as financial advantages and customer experience. After defining each product, the approval by the regulator is required for resulting adjustments and documents (e.g., terms and conditions, reference offers, pricing), which for best practices and argumentation lines are provided in the blueprint.

Furthermore, the selected product portfolio needs to be technically developed and implemented as well as launched. In addition to the definition of the new product portfolio, NT and IT infrastructure needs to be adjusted to prepare for the IP world and the migration itself. This requires careful planning as large parts of the network are impacted creating high effort and high risks. Also, process adjustments are characterized by large-scale, high business risks, and a strong impact on migration success.

**Book Structure**

In general the book is divided into six chapters, including five functional work streams embedded in an overarching work stream. The main topics of these work streams, which will be presented in the following chapters, are:

1. “Overarching Topics” provide an overview of major organizational overarching topics, for example, the project structure with roles and responsibilities, the PSTN migration process,
as well as a checklist of the main questions and risks that should be considered during the project.

2. “Migration Plan” within a three-step approach including prioritization logic to ensure efficient rollout planning.

3. “Product Portfolio Roadmap” describes the necessary processes and steps for transferring the PSTN products to an IP world. This includes both the analysis of the features and the product definition.

4. “NT/IT Roadmap” consists of three substreams: network target architecture and technical product development; NT rollout—adapting the current network structure to enable PSTN migration including rollout planning and technical training; and IT roadmap—adapting current systems to enable new IP features/products.


6. “Go to Market” ensures a value-based migration of the full customer base with an efficient rollout plan as well as a detailed plan for marketing introduction, a sales channel plan, and management of the resource needs during migration.
Overarching Topics

The main topics of the overarching work stream include the following:

1. The PSTN migration process and interdependencies give an overview of IP transformation project steps, main milestones, the timeline, and show the interdependencies between all streams.
2. Project organization describes the project organization structure, roles and responsibilities of each stream during different phases of the project, key meetings, as well as escalation and decision processes.
3. Environmental status quo lists the main elements and questions which require attention from the external and internal points of view.
4. Scenario analysis assesses the different migration scenarios with a qualitative assessment of scenarios.
5. A list of standard key performance indicators (KPIs) provides mandatory and optional KPIs that should be considered during the PSTN migration process.
6. The section on risks is dedicated to project risks, their multiple dimensions, and impacts. As an output from this section, the risk list with possible measures for mitigations is developed.
7. End-to-End (E2E) process adjustments provide examples of processes that should be changed during the migration as well as new processes that could or should be introduced.

1.1 The PSTN Migration Process and Interdependencies

The overall PSTN migration process shows the major process steps and the interaction between work streams. First, it should provide a high-level view of the total process duration; and second, it should point out main interdependencies between the streams. These interdependencies can be due to input/output relations between the
streams as well as in terms of milestones to be provided to ensure the overall project success. The key milestones can be used as scheduled checkpoints for main management decisions.

The overall PSTN migration process is an overview of all major project steps describing what to do during PSTN migration (see Figure 1.1).

The PSTN migration is divided into three general steps: “conception,” “rollout preparation,” and “execution.”

Within the overall process four main project gates have to be passed:

- **Gate I:** The first board of management (BoM) decision confirms the general project start and the provision of a first budget indication.
- **Gate II:** After approximately 6 months, it provides the first insight on initial migration plan, technical target picture, and financial impact (top-down aspiration, for more details see business case work stream, in Section 5.2.1, Chapter 5). The main goal is to get the commitment of involved functions to stick with basic input and assumptions.
- **Gate III:** After the finalization of the product feature portfolio and the final migration plan, the business case will be validated based on a bottom-up calculation. These results are the base for the BoM decision of the rollout start (gate III). This gate provides transparency on the benefit of PSTN migration before major investment is done. In addition, the first drafts of functional rollout plans are ready and the main goal is to secure commitment of involved functions for rollout.
- **Gate IV:** The last gate after the rollout preparation of all work streams is the BoM decision of the migration start.

The overall timeline is shown in the PSTN migration process and the approximate duration from project start to migration start is 20 months. It is only an illustrative project process; duration differs between countries, depending, for example, on:

- Network status, broadband coverage, and penetration prior to migration start
- Size of customer base that should be migrated
- Existing product portfolio and regulatory requirements
# Overall PSTN Migration Process

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
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| 1: Overarching | - Project setup  
- Scenario analysis  
- Environmental status quo  
- E2E process adjustments |
| 2: Migration Plan | - Define initial migration plan  
- Define final migration plan |
| 3: Product Portfolio Roadmap | - Define product portfolio  
- Realize product portfolio |
| 4: NT and IT Roadmap | - Define technical architecture  
- Define technical product  
- Prepare NT rollout  
- Prepare IT rollout  
- IMS ready  
- IT systems ready  
- Migration process ready |
| 5: Business Case | - Conduct first rough estimate  
- Support rollout decision  
- Prepare monitoring/iPF review |
| 6: Go to Market | - Create communication plan  
- Prepare sales channels  
- Support migration (CC, TS) |

**Figure 1.1** Overall PSTN migration process.
• Management expectation for finalization of the project
• Handling of problems and risks during the execution
• Available resources (e.g., FTE, CAPEX)

During the execution phase, there should be a continuous monitoring of defined KPIs, updates of the business case in case of bigger changes of assumptions, and alignment.

1.2 Project Organization

PSTN migration requires an efficient project structure, involving a cross-functional and highly integrated project team. Roles and responsibilities inside the initiative are established as well as the governance structure and an escalation model. Due to its complexity, it needs absolute commitment from all areas in the company and support from top management.

1.2.1 Project Structure: Roles and Responsibilities

IP transformation is a central initiative of Deutsche Telekom (Europe). Within that initiative, a central team is formed to coordinate within the European countries all IP transformation topics referring to PSTN migration as well as BNG and TeraStream. Accordingly, the initiative organization is divided into PSTN migration with its functional and business case work streams developed in the blueprint and into two work streams for BNG and TeraStream (both BNG and TeraStream are not part of this book).

Every stream has a lead responsible for the functional topics (product portfolio roadmap, migration plan, go to market, NT/IT roadmap, business case). In addition, the two responsible for the PMO activities are required for coordination of the central team and communication toward the countries. As a common decision and steering platform an IP transformation EU core team and an overall SteerCo team are established (see Figure 1.2).

On a country level, local IP projects are set up to interact with the central team. In this book, the focus is on PSTN migration, omitting further IP transformation topics.
Figure 1.2 Initiative structure.
The experience from the countries have shown that PSTN migration is a complex project that requires aligned involvement of all functions, which has proven to be highly complex and difficult to manage. Thus, all business functions need to collaborate in an efficient way—until all customers are migrated.

Based on this discussion, the involved parties are structured into the functional topics represented by the work streams (overarching topics, product portfolio roadmap, migration plan, NT/IT roadmap, business case, go to market) leading to a cross-functional project organization. Human resources must be integrated from the beginning to support and assure a comprehensive resource planning in the migration plan. The structure is completed by the E2E responsible for the customer segment (business, residential, and wholesale customers) in order to ensure the overall customer perspective.

1.2.2 Escalation

In the first escalation instance within the local IP projects for any risk or issue is the core team. It immediately reviews and assesses the escalation. The evaluation will be recorded in the project management risk register or issue log. Mitigating actions will be taken and tracked by the project management until the issue is resolved or the risk is reduced to an acceptable level.

The next escalation step involves the local steering committee.

The ultimate point of escalation is to the IP transformation steering committee, but this must pass through the escalation channels: project/stream leader → program management → local core team. Project escalations that are not raised to the project/stream leader may not have the appropriate support to resolve them.

1.3 Environmental Status Quo

In the beginning of the preparation phase, an analysis of the environment and the situation of the company and its competitors is required. Several internal and external factors impact the IP transformation; consequently all possible elements have to be considered and defined through a checklist prior to the start of the migration. However, these factors vary by country and need to be adjusted and complemented by country specifics.
Environmental factors can be divided into external factors and internal factors. External factors are related to the market environment, customers, and regulatory conditions. Internal factors and questions are related to all areas of operation of the company: technical, marketing, sales, finance, and human resources (see Figure 1.3).

1.3.1 External Factors

The market environment should be carefully monitored because it has several consequences on the PSTN migration process. First, the telecommunication market should be considered in terms of broadband penetration and fixed/mobile penetration as well as development trends. These factors have a tremendous influence on the number of customers that should be migrated over the years, possible natural churn, and the number of broadband customers that should be forecasted. In addition, the customer structure depends on competition movement and the general microeconomic situation, which influence the purchasing power of the population. All these elements have an impact on cost and on the revenue side and should be carefully monitored.

The regulatory environment is one of the main risk drivers for PSTN migration. It can impact the timeline of the project and its financial benefits, for example, by revenue downsizing with possible changes in the interconnection fees or changes in wholesale products. The regulatory requirements can also indirectly impact PSTN migration by
affecting other enabler projects, for example, the regulation of fiber in the access could influence the estimated broadband penetration.

A special focus during the migration should be placed on wholesale customers because of the complex processes of negotiation and the complexity of the products. A delay in migration of wholesale customers forms a high risk to the project timeline and its costs.

1.3.2 Internal Factors

Internal factors that should be considered during the PSTN migration are related to technical, marketing/sales, financial topics, and HR/stakeholder analysis. More details on internal factors are listed hereafter.

From a technical point of view, the main aspects are:

- Status of the network and IT applications, considering both the availability and the readiness before the actual start of the migration
- Provisioning of HR resources for the period of migration
- Alignment of modified processes with all parties involved
- Validation of services through tests prior to the commercial launch
- Follow-up on performance, through regular reports and KPIs

From a marketing point of view, the main questions are related to:

- Alignment of the product portfolio for each customer segment and harmonization with the technical area
- Possibility to develop new products as a source of additional revenue
- Marketing communication, with a strategy and plan for both an internal and external level

Marketing and sales are strongly involved in the PSTN migration process, especially customer care and sales needed to manage the contacts with customers within different channels. This involves both a thorough planning of customer contacts and a follow-up on the performance according to the established KPIs.

The regulatory and financial environment should also be checked prior to migration. Questions for the regulatory area are mainly related to on-time communication with the regulatory agency, wholesale
matters, as well as on-time preparation of all the necessary documents, especially the terms and conditions.

Finance questions are related to:

- Input for the business case in terms of cost/savings and revenue potential
- Permanent monitoring of significant changes in estimations
- Permanent monitoring of risk
- Alignment of the PSTN migration project with financial planning cycles and with other enabler projects

Finally, the human resources environment should be checked and a stakeholder analysis should be conducted. Human resources issues can heavily influence the success of the migration. Restrictions regarding the flexibility of resource allocation can occur from several sources such as inflexible agreements with social partners or ongoing headcount reduction programs.

A thorough analysis must be carried out to identify all the relevant stakeholders who will support the migration and those who might slow it down or will try to avoid it. Through this analysis, the visible risks can be prevented and mitigated.

Some general lessons learned in the area of human resources that should be considered for migration planning are:

- PSTN migration requires additional resources (internal/external) during the migration phase and additional OPEX for training, upskilling, and reskilling
- Additional resources are not only needed in the technology area but also in the commercial/customer-related areas
- Significant savings within the HR focus (FTE, OPEX) cannot be expected before the end of the migration
- Several countries have trained their technicians as “universal technicians” (legacy and IP) to have both skill sets available
- Cross-functional project team setup is mandatory to achieve the targets

1.4 Scenario Analysis

Through a scenario analysis, it is possible to evaluate the different alternative states and interim solutions that are available to reach an
optimal solution for each country. This can differ according to several variables, including the level of the existing network, market trends, management expectations, and costs that need to be considered. By considering alternative possible outcomes and future developments, an analysis of possible future events is conducted.

PSTN/ISDN is a predominant legacy platform in which huge investments have been made in the past and which currently is still one major fixed revenue source for operators. Due to this, it is logical to focus on the evolution and further development of the voice service architecture.

The current network architecture is complex and consists of different networks and network layers. PSTN/ISDN are predominantly voice networks and are completely separate from data networks. The double operation of networks leads to higher costs in maintenance, operation, and development. Furthermore, PSTN/ISDN have reached their end of service (EoS), which leads to increasing operation costs, limited availability of spare parts, and thus an increasing risk of failure. Transforming this architecture and merging the networks to a standardized and lean IP-based architecture is a challenge. However, the simple and modern technology landscape should lead to decreased costs in maintenance, new possibilities based on convergence of voice, data, and video services, and faster time to market.

In order to identify the optimal way for how to reach the target architecture considering technical and financial impacts, the following scenarios are possible:

0. Do-nothing scenario:
   - No action and investment taken
   - Leading to network failure, resulting revenue loss, and eventually the network breaks down
   - Not considered as a realistic option

1. Interim solutions:
   - Adaptation of current architecture or replacement by substitute version, but no migration to a single network and platform (IMS)
   - Defined as a minimum requirement
   - Only delays PSTN migration
• Two possible options: Prolong PSTN usage with platform upgrades required or implementation of soft switch solution (replacing PSTN network with a separate new one, no customer contract required)

2. One platform (IMS)/full PSTN migration toward NGN IP-based architecture:
   • One joint core platform (IMS)
   • Full retirement of PSTN with only one network remaining
   • Migration of all PSTN customers
   • Two possible options for voice-only customers: Migration to MSAN POTS card (emulation of PSTN with no customer impact and contact required) or migration to broadband port (full IP solution, but customer contact and action required)

Combined approaches of interim solutions and full migration at different areas are also possible and form special cases.

A short description of each option and the combined approach is given in the following paragraphs.

1.4.1 Interim Solutions

A PSTN network is a time division multiplexing (TDM)-based hierarchical network existing on international, transit, and local exchanges where the subscribers are connected to remote subscriber units (RSUs) via TDM lines.

Interim solution options for securing the fixed voice service are the following:

1a. Prolonged usage of PSTN network.
1b. Introduction of soft switch (SSW) and media gateway (MGW) elements as a replacement for PSTN exchanges.

Option 1a: Prolonged usage of the PSTN network assumes keeping the TDM-based hierarchical network with international, transit, and local exchanges. In this network, the subscribers are connected to remote subscriber units (RSU) via TDM lines. This is a distributed service architecture, which is from today’s point of view, very complex and cost ineffective. It is characterized by a high number of nodes
both in core and access part. TDM-based switches are very old, which lead to the following challenges even if usage is prolonged:

- No further production of hardware (processors already out of stock)
- No software support by suppliers (even in the case of SLA extension)
- Source code is not accessible for other suppliers
- No guarantee for functioning exchange by suppliers

Under these circumstances, risk of failure is increased on one side and on the other side there is no possibility for the introduction of additional functionalities (for example, by the regulatory body). Therefore, in order to provide a reliable voice service, this scenario assumes that a change of existing hardware and an upgrade of the current software version of exchanges is necessary, which requires a high volume of CAPEX. The overall network OPEX cost will continue to increase year over year based on increased SLA, energy consumption, and parallel operation of old legacy and IP-based systems.

It should be emphasized that this scenario could be considered only for a limited period of time since vendors will stop development and support of old legacy PSTN equipment.

*Option 1b:* In comparison to the first scenario, the soft switch option introduces different architectures by decoupling of control (SSW) and transport layer (MGW). Thus, it enables the introduction of a cost effective IP technology in the core transport layer and SIP communication protocol in the control layer. This enables the reduction in the number of core elements where soft switches and media gateway replace several exchanges. TDM transport remains only in the aggregation and access part, so that customers do not need to be touched. However, if the digital line unit (DLU) cannot be used with the soft switches,\(^*\) full recabling in the central office to the new equipment is necessary, making it costly and time consuming.

As an interim solution, the soft switch solution replaces the old PSTN equipment thus leading to a longer lifetime due to newer soft switches. However, the lifetime of soft switches and with it the possible extension of the voice service based on PSTN (voice services only) are limited, making it only an intermediate solution toward an

\(^*\) DLU reusage is only possible with Siemens switches.
SIP-based network. Consequently, it can be used to buy some time for the time-consuming process of PSTN migration. The soft switch solution also provides the opportunity to replace RSUs with H.248 MSANs, which are capable of all-IP-based fixed voice service.

The downside of this solution is that it is not future proof, since it is only applicable to voice services and it cannot offer multimedia services.

1.4.2 Full Migration

The final IP target picture handles all types of traffic through one platform, the IMS, a basic platform for development of new multimedia customer-oriented services. Its architecture is built from end to end on IP and is characterized by independence of the service layer from the access network. This enables the reuse of common control and service layers for different types of access (copper, FTTH, 2G/3G/LTE, etc.), limiting costly adjustments of those layers. Its access independent characteristic also enables convergent services and service interaction (e.g., missed calls on IP TV screen).

Broadband customers are further serviced via broadband ports and just need to connect their telephone to a VoIP capable integrated access device (iAD), which might have to be provided. Provisioning of voice via broadband line for 2play and 3play customers presents significant savings, since one port is used for all services. However, for voice-only subscribers two options are possible, leading to two different scenarios:

2a. Migration to MSAN POTS cards (emulation of PSTN service).
2b. Migration to broadband port (same solution for all subscribers).

Option 2a assumes the provisioning of voice service for broadband customers via broadband connection (via iAD) and the usage of narrowband MSAN POTS ports for voice-only customers.

Provisioning of voice service via MSAN POTS for voice-only customers allows faster and silent migration (remote provisioning—no in-house work) and reduction of equipment provisioning cost (no iAD is necessary). However, no new services are provided to the customer since it only emulates PSTN voice service. From a strategic point of view, voice as a stand-alone service will have no future, also shown by the permanent declining number of voice-only customers. Thus,
MSAN POTS as a technology emulating voice-only services is an investment in a dying service.

Option 2b assumes full PSTN migration connecting all users via broadband ports to the IMS forming the final target picture:

As high and sufficient broadband penetration is required, PSTN migration should be planned as an integral component with the broadband access transformation. Additional costs for this option compared to MSAN POTS are invested for iAD, potential work on customer premises and if the installed broadband capacities are not sufficient, additional investment for broadband ports. Thus, these costs can be higher than the investment in a MSAN POTS card. The higher costs can be justified in the case of upselling potential during migration as well as in the years to come, as the customer is then required to move to a broadband port anyway.

Consequently, important parameters which have to be taken into account when deciding between two full migration scenarios are:

- Current country’s broadband penetration
- Marketing forecast of future broadband penetration
- Likelihood of upselling
- Characteristics of the operator’s copper access network (broadband potential depends on the quality of the physical network and the average length of the local loop)

CAPEX in both full migration scenarios is related mainly to IMS, CPE/iAD, MSAN capacities, or broadband ports. Compared with the interim solution, OPEX savings, mainly based on savings in SLA, energy, and personnel costs, are expected. In the long run, it is a future-proof solution that should enable greater efficiencies at lower costs and form a basis for value propositions centered upon applications, services, network access, and data carriage.

1.4.3 Combined Approach (on an Area Level)

The different scenarios can also be combined on an area-by-area approach defining which customers of one area will be migrated to all IP, but in other areas remain connected to old legacy platforms.
The connection of customers in nonmigrated areas can be established in three ways:

- Via old PSTN switches, which most likely need to be upgraded
- Via already introduced soft switches
- Via newly introduced soft switches

This is a highly complex solution: It is complex from an operation and maintenance point of view, since different types of equipment are implemented in the network, which also require different resources to operate with. Furthermore, customers cannot always be provided with the same services.

Costs are expected to be higher mainly due to the costs for support contracts and increased personnel cost for operation. Based on these drawbacks, the combined approach should be carefully evaluated.

1.5 Standard Mandatory and Optional KPIs

KPIs represent a useful tool to steer progress in the PSTN migration project and provide full transparency and the achieved results. Data is required from all streams to monitor the process with regard to minimal churn, time, and costs/savings. The standard KPI set focuses on the trade-off between minimal churn, time, and cost/savings.

Laying a base for project steering, the KPIs should be used for:

- Initiating corrective actions and alteration activity timing
- Setting targets, and challenging execution
- Comparing countries and standardized monitoring of the project on a group level

It should be noted that the list of KPIs is not exhaustive and can be extended further based on operator requirements.

1.6 Risk Analysis

Several external and internal risk aspects (parameters) should be considered in the overall project. Each risk has inherent multiple impact dimensions on key business case drivers and project success. Therefore,
the financial impact should be calculated when these risks can be foreseen and all risks should be reported and followed in order to mitigate them appropriately. The risk quality analysis and assessment is based on the migration plan for the remaining execution phase. Due to the long-term duration of the PSTN migration project, there could be many risk sources during the whole project duration.

During PSTN migration, risks can be inflicted by the project itself, Deutsche Telekom AG or operator level (micro environment), and eco system (macro environment). Therefore, it is important to identify and structure potential sources of risks and define the responsible person by indicating and quantifying the potential impact on churn, costs, and time (Figure 1.4).

The following paragraphs present in detail possible types of risks according to the type of source.

1.6.1 Project Internal Risks

Project internal risks are mainly related to:

- Commitment and involvement of the full organization
- Wrong assumptions of the inputs (e.g., underestimated costs or inputs readiness), wrong estimation for FTE efficiency or competency of resources in the IP world
• Forced migration (FM) process

In particular, forced migration can bear high risks—due to the product complexity (especially in the business segment) and the natural behavior of the customer; several events can occur:

• Churn above defined limits
• Specific substitution products missing (e.g., in business segment)
• Wholesale and business customer migration process is not ready within the planned timeframe

One should be aware that churn due to the PSTN migration (except in cases of poor service quality) is hard to identify. Churn can result from unexpected customer behavior (willingness for migration due to a lack of knowledge) or the need for recontracting the customer (“forcing” customers to look for other offers—especially in the business segment).

Additionally, the impact on the business case in terms of churn, costs, and time is given as an indication. The financial impact should be integrated in the business case, when these risks can be foreseen and have significant impact on the financial results.

1.6.2 Deutsche Telekom AG/NatCo Risks (Micro Environment)

Micro environmental risks could be a result of certain actions of the National Company (NatCo) itself or at the Deutsche Telekom AG group level. These risks are mainly related to:

• Changes in the CAPEX/OPEX such as possible cuts during the year or reprioritizations. These risks could have several impacts:
  • Defined migration timeframe needs to be extended, which could lead to higher OPEX costs.
  • Possible revenue loss/churn due to possible local exchange outages caused by prolonged timeframe.
  • Lower cumulated savings due to prolongation of migration time and time delay of saving achievements. Amount of savings depends on investments made until the risk took place (taking into consideration the level of each LE status).
• Headcount reduction could have an influence on costs, as external resources are needed to replace the reduced headcount. It can also have an impact on the project timeline and thus influence the expected OPEX savings.
• No fulfilled expectations for broadband penetration require a higher incremental CAPEX for PSTN migration and could also influence the timeline of the project.

1.6.3 Eco System Risks (Macro Environment)

Macro environmental risks could occur because of changes in the regulatory or overall economic situation.

Decisions of the regulatory agency have an influence on the PSTN migration process especially in the preparation phase (product development) and during the execution, for example, leading to:

• Complexity of wholesale replacement products
• Complexity of wholesale migration process
• IP products treatment (higher/lower prices, interconnection fees, etc.)
• Additional not planned regulatory requirements could happen

Even while there is a high probability that the regulatory agency will cause a significant delay in the decision-making process, the situation for each country has to be evaluated separately. All the events stated above can have an influence on:

• Prolonged migration timeframe
• Revenue loss due to different IP product treatment and interconnection fees
• Higher investment needed per closing down of each local exchange
• Possible revenue loss due to possible local exchange outages due to prolonged timeframe
• Lower cumulative savings due to prolongation of migration time and time delay of savings achievements

In addition to regulatory risks, there are other external risks as a result of the overall economic situation. For example, in price sensitive markets broadband penetration might not be reached as planned or a
change in the demands of external subcontractors impacts contractor availability and prices.

Macro-environmental risks have an impact on all three major dimensions: churn, costs, and time.

In general, the financial impact should be calculated when these risks can be foreseen and have significant impact on the business case results. All risks have to be monitored permanently, reported regularly in core team meetings, and mitigate appropriately.

1.7 End-to-End (E2E) Processes

IP transformation may require changes in the processes or introduction of new ones. The main goal of this section is to list the processes that should be carefully considered and defined prior to the start of migration.

Each company has its own specifics and processes depending on the organizational structure, the level of automation and resources, and so on.

Nevertheless, based on an analysis of the processes that are implemented in the countries, some overall conclusions can be made in terms of changes in the processes due to IP transformation.

1.7.1 Adjustment in E2E Processes

In general, the processes can be clustered into three categories depending on the need for adjustment due to PSTN migration (Figure 1.5).

1.7.1.1 Processes without Major Changes   PSTN migration does not have an incremental impact on the process structure and flow. But, PSTN migration should be included in these processes with high attention. Some examples of these processes include strategy and the business planning process, product management, billing and revenue assurance, customer relationship management, and CAPEX management.

1.7.1.2 Processes with Incremental Changes   These processes need to be adapted, as the PSTN migration has an incremental impact on the process structure and/or flow.
The following processes that need changes are identified:

- Sales and service provisioning
- Fault repair
- Wholesale provisioning

For example, the service provisioning subprocess should be adapted to PSTN migration specifics such as a check of broadband access availability or installation of an iAD. The fault repair process should be adopted in a way to use this process for the migration of customers. The process changes could influence the work orders dispatching, provisioning of network prerequisites, and installation of CPE equipment.

1.7.1.3 **New Processes** For the migration itself, new processes need to be defined. The introduction of new processes depends on the chosen PSTN migration type/scenario. External companies may be responsible for some parts of the customer migration and on-premises activities and, therefore, a new process is introduced for contacting the customers and on-site installation. Another example for new processes might involve automigration using the Web.

1.7.2 **Complete E2E Process for PSTN Migration**

In addition to considering which changes or new processes have to be adjusted for the PSTN migration, it is interesting to understand
all the necessary steps that operators have to face during the PSTN migration process.

Prior to the start of the migration, it is important to fulfill several prerequisites. Drawing on the migration plan and all the variables that form it (replacement products, resources needed, lines migrated, etc.), the selected types and modes of migration are defined first. Consequently, the operator is able to define the sales potential attached to the migration and the best channel for notifying the customer about the new services.

Once all the migration prerequisites have been defined, the IMS migration—encompassing different stages—can take place. The migration varies according to the customer (RES/BUS), the stage (active/forced), and the type of migration process (ISDN/BB). However, the migration starts when a migration ticket is open in the telco’s database and the customer data is sent to the appropriate business segment, which will prepare and send the information to the customer. This notification approach might be conducted through standard channels, such as leaflets, e-mails, Interactive Voice Response, and whitemailing (WG) in the case of residential customers or through customized solutions for business customers as large accounts.

Operators have an interest in leveraging less expensive migration strategies as natural migration (NM) and automigration in order to diminish the related costs, however when the customer, after several attempts, is not willing to migrate, alternative solutions such as forced migration and MSAN have to be taken into consideration. Therefore, the E2E process ends with a technical component in order to allow the IP services, which might be done by the customer himself or by a technician.
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