

# *Wireless Intelligent Networking*

## **Table of Contents**

**Forward**

**Preface**

**Acknowledgements**

**Part 1 Introduction to Mobile Communications, Network Signaling, and Intelligent Networking**

**1. Fundamentals of Mobile Communications**

- 1.1. Personal Communications Concept
- 1.2. Origins of Radio Technology
- 1.3. Evolution of Mobile Communications
- 1.4. Fundamental Mobile Communications Concepts
  - 1.4.1. Electro magnetic waves
    - 1.4.1.1. Amplitude
    - 1.4.1.2. Frequency
    - 1.4.1.3. Wavelength
  - 1.4.2. Bandwidth
  - 1.4.3. Modulation
  - 1.4.4. Frequency reuse
  - 1.4.5. Multiplexing
  - 1.4.6. Radio technology
- 1.5. Wireless System Architecture
  - 1.5.1. Mobile Switching Center
  - 1.5.2. Mobile station
  - 1.5.3. Cell site
  - 1.5.4. Frequency reuse implementations
  - 1.5.5. Handoff
  - 1.5.6. Mobility management
- 1.6. Wireless Service Implementations
  - 1.6.1. Government frequency allocation
  - 1.6.2. Carriers and technology
  - 1.6.3. Mobile technology evolution
  - 1.6.4. Wireless intelligent networking

## 2. Mobile Communications Standards

- 2.1. Purpose of Standards
- 2.2. Standards Groups and Related Organizations
  - 2.2.1. International standardization
    - 2.2.1.1. ITU
  - 2.2.2. National and regional standardization
    - 2.2.2.1. ETSI
    - 2.2.2.2. TTC
    - 2.2.2.3. ARIB
    - 2.2.2.4. TTA
    - 2.2.2.5. ANSI
    - 2.2.2.6. ATIS
    - 2.2.2.7. T1
    - 2.2.2.8. TIA
  - 2.2.3. Trade and special interest groups
    - 2.2.3.1. UWCC
    - 2.2.3.2. CTIA
    - 2.2.3.3. PCIA
    - 2.2.3.4. CDG
  - 2.2.4. GSM Association
  - 2.2.5. GSM Alliance
  - 2.2.6. Standardization for mobile data environment
    - 2.2.6.1. UMTS Forum
    - 2.2.6.2. 3GPP
    - 2.2.6.3. 3G.IP
    - 2.2.6.4. Mobile Wireless Internet Forum
  - 2.2.7. Wireless data development groups
- 2.3. Overview of the Standards Creation Process
  - 2.3.1. Structure and organization
  - 2.3.2. TIA Committee TR45.2
  - 2.3.3. SMG
  - 2.3.4. Three stage specification process
  - 2.3.5. Standards acceptance process
- 2.4. Radio Technology Standards
  - 2.4.1. NMT
  - 2.4.2. TACS
  - 2.4.3. AMPS
  - 2.4.4. D-AMPS
  - 2.4.5. CDMA
  - 2.4.6. GSM
  - 2.4.7. PDC
  - 2.4.8. ESMR
  - 2.4.9. Satellite technologies
- 2.5. Mobile Network Standards
  - 2.5.1. ANSI-41

- 2.5.2. GSM MAP
- 2.5.3. ANSI-41 versus GSM MAP
- 2.6. Wireless Intelligent Networking Standards
  - 2.6.1. WIN
  - 2.6.2. CAMEL
- 2.7. Evolution to Third Generation Standards
  - 2.7.1. HSCSD
  - 2.7.2. GPRS
  - 2.7.3. EDGE
  - 2.7.4. W-CDMA
  - 2.7.5. Summary of Third Generation Standards

### **3. Wireless Signaling and Intelligent Networking**

- 3.1. Overview of SS7 Network Signaling
- 3.2. Physical SS7 Network
  - 3.2.1. SSP
  - 3.2.2. SCP
  - 3.2.3. STP
  - 3.2.4. Signaling Links
  - 3.2.5. SS7 Network Deployments
- 3.3. SS7 Protocols
  - 3.3.1. OSI Reference Model
  - 3.3.2. Message Transfer Part (MTP)
  - 3.3.3. Signaling Connection Control Part (SCCP)
  - 3.3.4. Upper Layers
    - 3.3.4.1. ISUP
    - 3.3.4.2. TCAP
- 3.4. Wireless Signaling
  - 3.4.1. Wireless Network Elements
  - 3.4.2. Wireless Network Reference Models
  - 3.4.3. Mobile Application Part Protocols
    - 3.4.3.1. ANSI 41
    - 3.4.3.2. GSM MAP
  - 3.4.4. Mobility Management
    - 3.4.4.1. Intersystem Handoff
    - 3.4.4.2. Automatic Roaming
    - 3.4.4.3. Roaming Message Flows
      - 3.4.4.3.1. Registration
      - 3.4.4.3.2. Call Delivery
- 3.5. Intelligent Networking Concepts
  - 3.5.1. Call Control
  - 3.5.2. Service Independent Architecture
  - 3.5.3. Service Creation
  - 3.5.4. IN Modeling

## **Part 2 Evolution of Wireless Intelligent Networking Technology**

### **4. Evolution of Wireless Intelligent Networking**

- 4.1. Origins of Intelligent Networking
  - 4.1.1. Automatic switching
  - 4.1.2. Stored program control
  - 4.1.3. Common channel signaling
  - 4.1.4. IN
  - 4.1.5. AIN
- 4.2. Wireless Intelligent Networking
  - 4.2.1. Wireless IN versus WIN
  - 4.2.2. WIN
  - 4.2.3. CAMEL
- 4.3. Relationship of Wireless Intelligent Networking Standards
- 4.4. Migration from Point Solutions to Network Based Solutions
  - 4.4.1. Impetus for migration
  - 4.4.2. Advantages of network based solutions
  - 4.4.3. Operational challenges of network based solutions

### **5. Wireless Intelligent Networking Capabilities**

- 5.1. Intelligence in Telecommunications Networks
  - 5.1.1. Fixed network intelligence
  - 5.1.2. Mobile network intelligence
  - 5.1.3. Drivers for improved network intelligence
- 5.2. Standardized Intelligence for Mobile Networks: WIN and CAMEL
  - 5.2.1. Enabling architecture and standardized capabilities
  - 5.2.2. Phased development of standards
- 5.3. Wireless Intelligent Network
  - 5.3.1. Pre-WIN
  - 5.3.2. WIN phase I
    - 5.3.2.1. WIN call model
    - 5.3.2.2. Originating BCSM detection points
    - 5.3.2.3. Terminating BCSM detection points
    - 5.3.2.4. WIN rules for the use of triggers
    - 5.3.2.5. Service drivers for WIN phase I
      - 5.3.2.5.1. Calling Name Presentation (CNAP)
      - 5.3.2.5.2. Voice Controlled Services (VCS)
      - 5.3.2.5.3. Incoming Call Screening (ICS)
    - 5.3.2.6. Service interaction manager (SIM) function
  - 5.3.3. WIN phase II
    - 5.3.3.1. Service drivers for WIN phase II
      - 5.3.3.1.1. Prepaid Charging

- 5.3.3.1.2. Preferred language support
- 5.3.3.1.3. FreePhone
- 5.3.3.1.4. Other billing service capabilities
- 5.3.3.1.5. Call management service capabilities
- 5.3.3.1.6. Location based services
- 5.3.4. WIN phase III
  - 5.3.4.1. Service drivers for WIN phase III
- 5.3.5. Service and feature support between incompatible networks
- 5.3.6. Summary of WIN
- 5.4. Customized Applications for Mobile Enhanced Logic
  - 5.4.1. CAMEL Phase I
  - 5.4.2. CAMEL Phase II
  - 5.4.3. CAMEL trigger detection points
  - 5.4.4. Service and feature support between incompatible networks
  - 5.4.5. Summary of CAMEL
- 5.5. WIN and CAMEL Implementation Issues
- 5.6. WIN and CAMEL Operational Issues

## **Part 3 Mobile Communications Business Issues**

### **6. Mobile Market Environment and Trends**

- 6.1. Competition
  - 6.1.1. More carriers = greater choice for consumers
  - 6.1.2. Downward price pressure = lower Revenue Per Unit (RPU)
  - 6.1.3. Consolidation and alliances
- 6.2. Technological Advancement
  - 6.2.1. Radio
  - 6.2.2. Switching
  - 6.2.3. Networking
  - 6.2.4. Network intelligence
- 6.3. Consumer Behavior
  - 6.3.1. Personal communications
  - 6.3.2. Greater usage and dependence
  - 6.3.3. Increased need for mobility
  - 6.3.4. Need for ready access to information
  - 6.3.5. Expectations of greater value
- 6.4. Regulation
  - 6.4.1. Regulatory bodies
  - 6.4.2. Regulatory developments
  - 6.4.3. Effect on wireless intelligent networking

### **7. Creating Market and Product/Service Value**

- 7.1. Value-added Products and Services
- 7.2. Development Issues
  - 7.2.1. Market needs and readiness

- 7.2.2. Development capability
- 7.2.3. Realization of return on investment needs
- 7.2.4. Product/service economic analysis
- 7.2.5. Product/service development gate process
- 7.3. Deployment Strategy
  - 7.3.1. Gain market share
  - 7.3.2. Promote value and loyalty
  - 7.3.3. Leverage emerging capabilities
  - 7.3.4. Market strategy
- 7.4. Technology Availability
  - 7.4.1. Standards
  - 7.4.2. Application development
  - 7.4.3. Network element readiness
  - 7.4.4. Spectrum availability
- 7.5. Pre-WIN/CAMEL Alternatives
  - 7.5.1. Proprietary based TCAP signaling
  - 7.5.2. ISUP based call control
- 7.6. In-house versus Outsource
  - 7.6.1. Vendor solutions
  - 7.6.2. Application development
  - 7.6.3. Wholesale service alternatives

## **Part 4      Leveraging Intelligence for Improved Mobile Network Capabilities and Advanced Services**

### **8. Evolution of Mobile Services: From Emulation to Differentiation**

- 8.1. Intelligent Network Solutions to Wireless Fraud
  - 8.1.1. Pre-call validation
  - 8.1.2. Cloning fraud
  - 8.1.3. Detection via ANSI-41 messaging
  - 8.1.4. Roamer Verification and Reinstatement (RVR)
  - 8.1.5. Authentication
- 8.2. The Network based HLR
  - 8.2.1. Initial rationale and benefit of deployment
  - 8.2.2. Deployment issues: feature availability
  - 8.2.3. Deployment issues: operational concerns
  - 8.2.4. Long term strategic advantages
- 8.3. Wireless Adds Wireline Services
  - 8.3.1. Emulation of Basic Wireline Services
  - 8.3.2. Emulation of Wireline IN Services
    - 8.3.2.1. Virtual Private Networks (VPN) and Extension Dialing
    - 8.3.2.2. Calling Number and Name Identification
    - 8.3.2.3. CLASS (Call Screening, Auto Callback, etc.)
    - 8.3.2.4. Prepaid wireless
      - 8.3.2.4.1. Prepaid in North America and other parts of the world

- 8.3.2.4.2. Prepaid wireless technology in North America
- 8.3.2.4.3. Prepaid wireless technology in Europe and other parts of the world
- 8.3.2.5. Wireless Number Portability (WNP)
  - 8.3.2.5.1. Number portability concepts
  - 8.3.2.5.2. LNP architecture
  - 8.3.2.5.3. WNP functional requirements
- 8.3.2.6. FreePhone
- 8.3.2.7. Calling Party Pays (CPP)
- 8.3.3. Integration of Wireline + Wireless Services (Fixed Mobile Convergence)
  - 8.3.3.1. What is convergence/integration?
    - 8.3.3.1.1. Bundling
    - 8.3.3.1.2. Fixed network mobility
    - 8.3.3.1.3. Service integration
    - 8.3.3.1.4. Network integration
    - 8.3.3.1.5. Wireless
  - 8.3.3.2. Why wireless-wireline integration?
    - 8.3.3.2.1. Customers value simplicity and service integration
    - 8.3.3.2.2. Increased wireless usage stimulates demand for service integration
    - 8.3.3.2.3. The trend to wireless replacement of wireline: High value and shrinking price
  - 8.3.3.3. Service provider benefits: Revenue and retention
    - 8.3.3.3.1. Supercarriers can offer superior service bundles
  - 8.3.3.4. Network integration = network efficiency
  - 8.3.3.5. Industry forces
  - 8.3.3.6. Sample of current approaches
    - 8.3.3.6.1. Single number service
    - 8.3.3.6.2. Single bill
    - 8.3.3.6.3. Single voice mailbox
    - 8.3.3.6.4. Extended cordless service
      - 8.3.3.6.4.1. Market split: Mobile versus cordless
    - 8.3.3.6.5. Wireless office service: Service integration
  - 8.3.3.7. Emerging needs and varied solutions
- 8.4. Wireless-Specific Services Emerge
  - 8.4.1. Messaging
    - 8.4.1.1. Message waiting indication
    - 8.4.1.2. Short messaging service (SMS)
      - 8.4.1.2.1. Difference between ANSI-41 and GSM MAP
      - 8.4.1.2.2. SMS applications
      - 8.4.1.2.3. Cell broadcast
    - 8.4.1.3. USSD
  - 8.4.2. Location technology and services
    - 8.4.2.1. Location technology

- 8.4.2.1.1. Geographic information systems
  - 8.4.2.1.1.1. Summary of GIS
- 8.4.2.1.2. Position determination
- 8.4.2.1.3. Location management
  - 8.4.2.1.3.1. Summary of location management function
- 8.4.2.2. Location services
  - 8.4.2.2.1. Emergency services and roadside assistance
  - 8.4.2.2.2. Location sensitive billing
  - 8.4.2.2.3. Location based information services
  - 8.4.2.2.4. Tracking services
  - 8.4.2.2.5. Summary of location services
- 8.5. Wireless Data
  - 8.5.1. Emergence of data prominence
  - 8.5.2. WIN must evolve to encompass Internet-based services
  - 8.5.3. A new view of network intelligence (SCPs and Web servers)
  - 8.5.4. Access to Web information = unlimited applications
  - 8.5.5. Information access (circuit and packet switched access)
  - 8.5.6. Third generation (3g) wireless technology
  - 8.5.7. Electronic commerce

## **9. Evolution of WIN Architecture: Rapidly Evolving to Include Wireless Data**

- 9.1. Trends for Next Generation Networks: Convergent IN + IP Technologies
  - 9.1.1. Industry trends
  - 9.1.2. Network requirements for a converging voice/data network
    - 9.1.2.1. Quality of service
    - 9.1.2.2. Seamless integration with existing networks
    - 9.1.2.3. Rapid service creation and development
    - 9.1.2.4. Security
    - 9.1.2.5. Scalability
- 9.2. Hybrid IN/IP Networks
  - 9.2.1. Convergence of IN and IP signaling
    - 9.2.1.1. Transport cost reduction using SS7 over IP
    - 9.2.1.2. Transport cost reduction using voice over IP (VoIP)
    - 9.2.1.3. Standards
    - 9.2.1.4. Conclusion
  - 9.2.2. PINT
  - 9.2.3. PIN
    - 9.2.3.1. PIN/IN events and procedures
    - 9.2.3.2. Similarities and differences of PIN and PINT architectures
    - 9.2.3.3. PIN architecture
  - 9.2.4. IP telephony
    - 9.2.4.1. Mechanism for accessing IN services from the IP domain
    - 9.2.4.2. IN/H.323 call model integration
      - 9.2.4.2.1. IN call model

- 9.2.4.2.2. Example H.323 Gatekeeper
- 9.2.4.2.3. Mapping the IN call model to the H.323 Gatekeeper FSM
- 9.2.4.2.4. Prototype setup
- 9.2.4.3. Operation
- 9.2.4.4. Sample call flow (IP subscriber receives IN based Calling Name)
- 9.2.4.5. Conclusions
- 9.2.5. IN access to IP service logic: WAP services as an alternative to WIN
  - 9.2.5.1. WTA bridges WIN and WAP yielding "smart phones"
  - 9.2.5.2. Additional opportunities for Internet-based services (web servers versus SCPs)
- 9.3. Open service creation
  - 9.3.1. Promise of competitive applications market
- 9.4. Conclusion

## Appendix

### Intelligent Networking Architecture and Design Concepts

- I. Intelligent Networking Conceptual Model
- II. Service Plane
  - A. Services
  - B. Service features
- III. Global Functional Plane
  - A. Service independent building blocks
  - B. Basic call process
- IV. Distributed Functional Plane
  - A. Functional entities
  - B. Intelligent network functional architecture
- V. Physical Plane
  - A. Physical nodes
- VI. INCM Plane Mapping
- VII. Intelligent Network Call Modeling Concepts
  - A. Call processing logic
  - B. Basic call state model
  - C. Points in call
  - D. Detection points
  - E. Triggers
  - F. Events
  - G. Arming of detection points
  - H. Call models
  - I. Originating BCSM
  - J. Terminating BCSM1.7.
- VIII. The Service Creation Concept
  - A. Service creation environment
  - B. Service creation through SIBs

C. Customization  
IX. Summary

Bibliography

Glossary

- Acronyms
- Industry Web Sites

Index