GSCom

Business Development for Broadband Wireless Modem

Business Background

- **Today's life style:**
  - Rich contents of life
    - Real time video, streaming music, rich multimedia applications
    - Health care, safety, & self amusement, etc
    - Home entertainment
    - Public safety, traffic and network control

- **Today's Communications:**
  - Any time and any place connection
  - Tons of information & Data
  - Personal communications
  - Public and safety communications

Business Background

- **With the advent of WiFi, WiMax, LTE in 3G/4G,**
  - Smaller coverage range,
  - More number and higher density of small cells,
  - Higher data rate & throughput
  - Higher speed with tight latency
  - Higher interference

- **Small Cell Business**
  - Explosive growth
  - Mobile users:
    - 500 M in 2011
    - 6800 M in 2013 (Wikipedia)
  - Monthly Data Usage (CTIA);
    - 122 M bytes in 2012
    - 270 M bytes in 2013

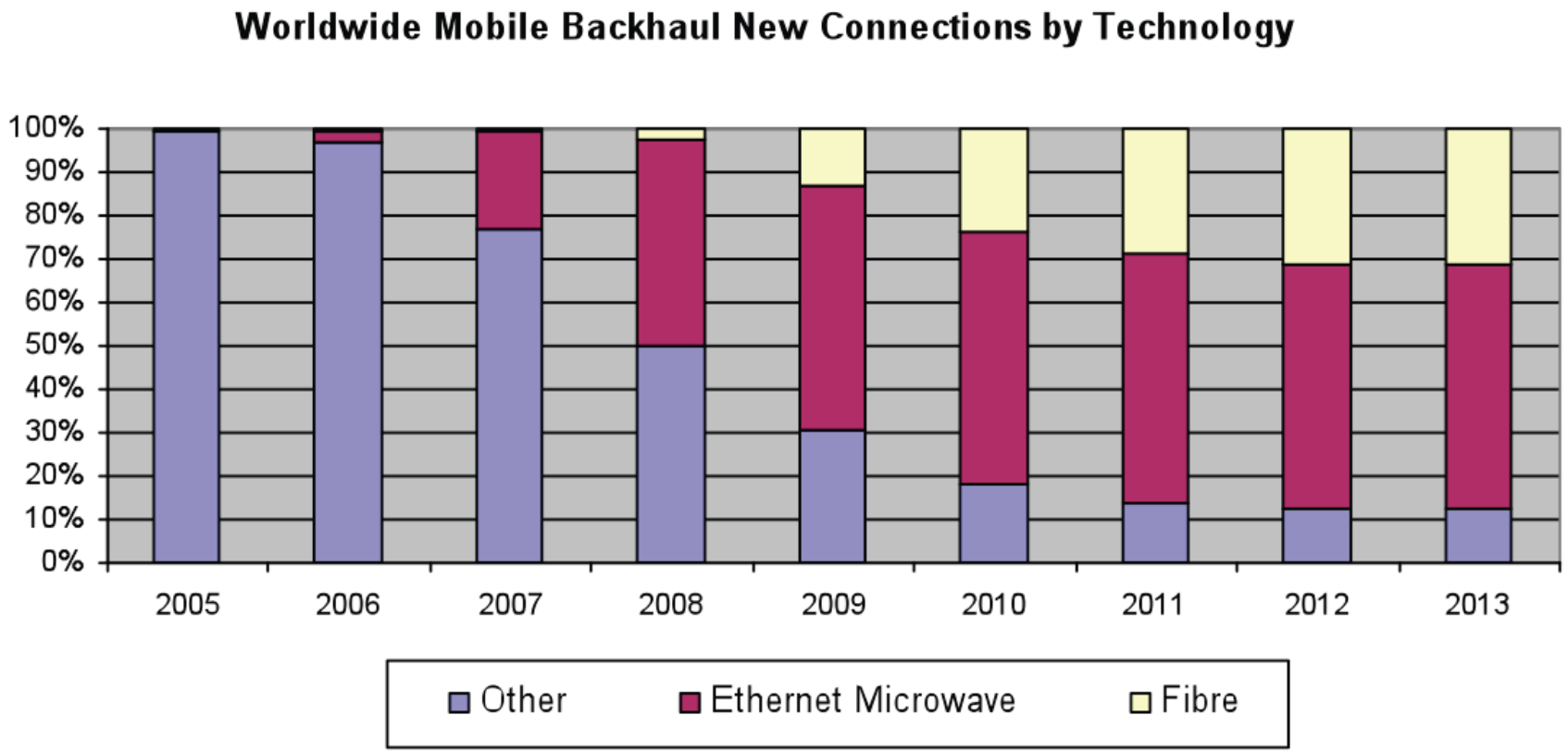
Communication System Overview

- **Wireless Communication System**
  - Mobile station (MS)
  - Access media
  - Base station (BS) (or cell)
  - Communication network (including BSC or MSC)

- **Types of Cell (depends on coverage range)**
  - Femto cell
  - Pico cell
  - Micro cell
  - Macro cell
  - **Small cell** includes Femto cell, Pico cell, and Micro cell now days.

- **Types of Communication Link**
  - **Front end Link**
    - Communication link between handset (MS) and base station (BS)
  - **Backhaul**
    - Communication link between BS, MSC, and BS

Access Media & Technologies used in Backhaul Network



Backhaul Business with Small Cell

- **Application area of Small Cell Backhaul Modem**
  - Capacity & Coverage (hotspot, airport, shopping mall, any place)
  - Explosive increase of SOHO, PAN & LAN (WiFi, AdHoc)
  - Centralized control & safety network (Point to Multi-point: PMP)
    - Traffic light tower, Security, Logistics
    - Hospital, Medical center, doctor office, remote diagnosis
    - Emergency (911), disaster report center
  - Aggregation (Point to Multi-point: PMP) network

Backhaul Business Opportunity

- **New drivers**
  - Small Cells (PAN, WLAN,)
  - LTE architectures (All IP, Point to Multipoint: PMP)
  - Network Evolution (Access & Core)
  - High-capacity & High coverage
  - Centralized control & safety network (Point to Multi-point: PMP)

- **Application Area**
  - Capacity & Coverage (hotspot, airport, shopping mall, any place)
  - Explosive increase of SOHO, PAN & LAN (WiFi, AdHoc)
  - Femto cell, Picocell, Microcell, Macrocell
  - Centralized control & safety network (Point to Multi-point: PMP)
  - Traffic, Security, Logistics
  - Hospital, Medical center, doctor office, remote diagnosis
  - Wireless access network, Emergency (911), disaster report center
  - Last mile & Aggregation network

Backhaul Business Opportunity

- **Small Cell Business**
  - Explosive growth
  - Mobile users:
    - 500 M in 2011
    - 6800 M in 2013 (wikipedia)
  - Number of small cell modem used:
    - 100 M units in 2013 (2000M/20 users/sector)
  - Monthly Data Usage (CTIA); (CTIA wireless annual report)
    - 122 M bytes in 2012
    - 270 M bytes in 2013

Small cell development overview

	Knowledge Needed	Players	Notes
Front End Modem (FEM)	Physical layer of GSM, CDMA, WCDMA, HSPA, LTE, WiFi, and WiMax Multimedia, applications Medium access control protocol & SW Radio link control protocol & SW	Qualcomm, Broadcom, Samsung, Phillips, Via telecom, Marvel, Intel, etc	Extremely difficult business to survive
Backhaul Modem (BHM)	Radio access control Mobile internet protocol SW Netwok control protocol & SW Network management protocol & SW	Broadcom, Qualcomm, Airvana, Airwalk, Mindspeed, Aircent, Intracom-telecom, picochips, Tropos Cable Modem: Moto, Cisco, RCA, Medialink, Linksys	Relatively easy for development due to; 1. Need classical communication technology 2. Simple data format and contents

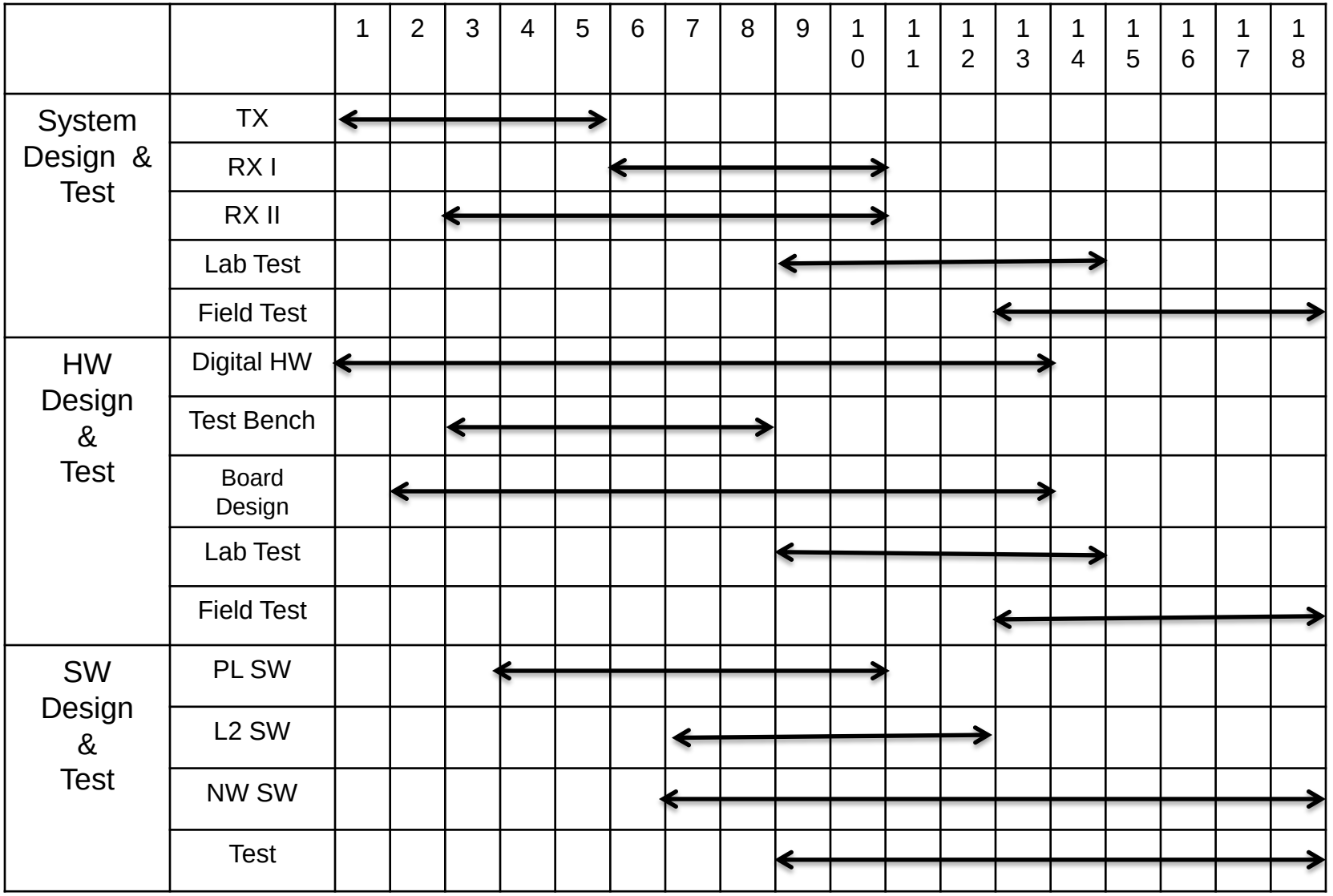
Product Development Plan

- **Project Milestone**
  - System design & Test: 14 months
  - FPGA Board design & test: 14 months
  - SW design & Test: 12 months
  - Field Test: 6 months
  - Commercial product available: 18 months

- **Project Resources Plan**
  - 2 Systems engineers
  - 2 HW engineers
  - 1 RF Analog engineer
  - 3 SW engineers

Product Development Plan

- **Project Milestone**



Project Budget

- **Employee Salary**
  - System engineer I & II (18 months & 16 months); 34 man-months
  - HW engineer I & II (18 months & 16 months); 34 man-months
  - RF Analog Engineer (17 months); 17 man-months
  - SW engineer I, II, & III (15, 12, & 12 months); 39 man-months

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  - Total no of man-months: 124 man-months
  - Sub Total; no. of man-month X 100K = **1040K USD**
  - Employee benefit (Health & 401K) = **320K USD**
- **Office rent (18 months); 180K USD**
- **Office equipment (desk, copy machine) rent: 100K USD**
- **Engineering design tool & test equipment rent: 367K USD**

- **Total: 1970K USD ≈ 2 M USD**