

# Architectural Overview & Requirements Brainstorm

## Phoenix Ambulatory Blood Pressure Monitor

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# Table of Contents

- 5 minutes of requirements (skip)
- 30 seconds of constraints (skip)
- Major subsystem interfaces
- Diary subsystem (skip)
- Analysis software subsystem (skip)
- Device subsystem (requirements only — skip architecture)

# Requirements

- Collects a week of blood pressure measurements
- Inexpensive
- Unobtrusive
- Easy to use

# Requirement

## Week of Measurements

- Records measurements at least every half hour for at least 7 days
- Measures systolic and diastolic blood pressure
- Measures heart rate
- Measures physical activity
- Measures blood flow

# Requirement Inexpensive

- Price is not a barrier to using the monitor
- Less expensive than:
  - Blood pressure cuff
  - Wrist watch (<\$50)
  - “Two bushels of yams” (<\$10)
    - 3<sup>rd</sup>-world friendly

# Requirement Unobtrusive

- When in place
  - Patient can forget about it — not be aware of it
  - No more encumbering than
    - wrist watch
    - band-aid
    - piece of jewelry
- Usable wherever the patient is, such as at home or at work when allowed
  - Not just for hospital, clinic or doctor's office

# Requirement Easy to Use

- Better than devices with blood pressure cuffs:
  - Easier to use
  - Equally accurate
- Patient:
  - Should be able to ignore it, but
  - Can determine whether functioning normally
  - Can observe a blood pressure and heart rate measurement
- Automatic — measurements taken regardless of patient behavior
- Allows manually initiated measurements

# Constraints

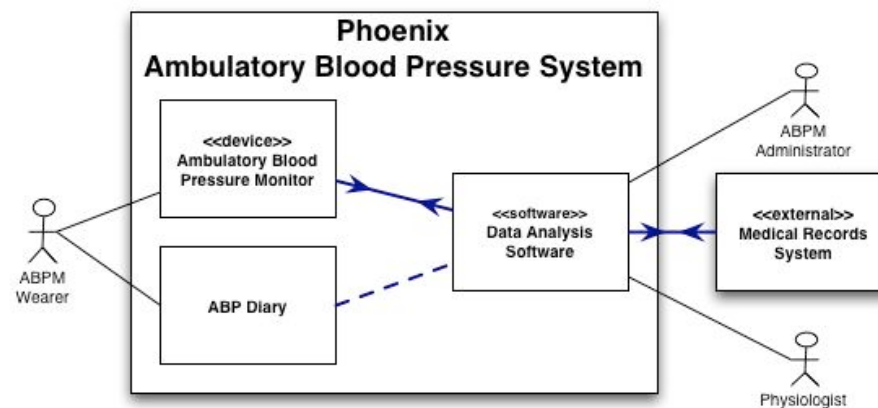
- Open-source
  - Major impact on design
    - Must be buildable by fluid, virtual organization
    - Developers have major say in content
    - 3<sup>rd</sup>-party components must pass licensing constraints



# Recap

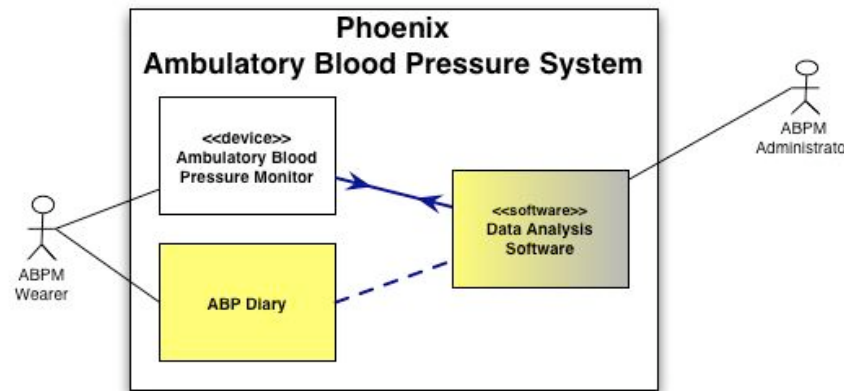
- 5 minutes of requirements
- 30 seconds of constraints
- Major subsystem interfaces ⇐
- Diary subsystem
- Analysis software subsystem
- Device subsystem

# Major Subsystems & Interfaces



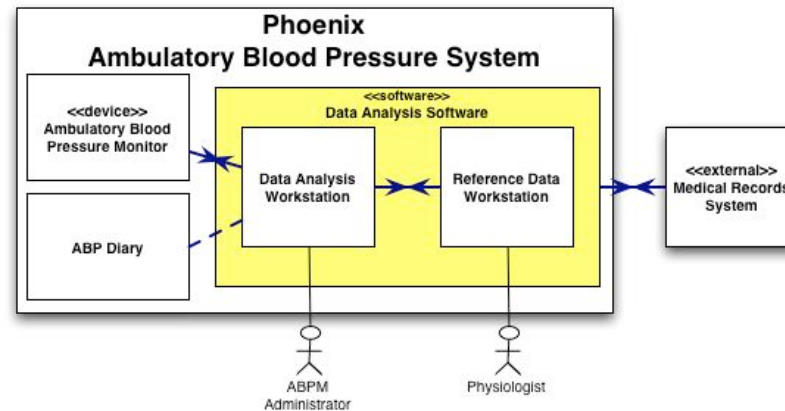
- Monitor measures the Wearer
- Wearer records observations in the Diary
- Administrator & Physiologist use Data Analysis Software to assess the data collected by the Device
- Diary influences the interpretation of the data
- Clinical settings: data stored in Medical Record Systems

# Diary Subsystem



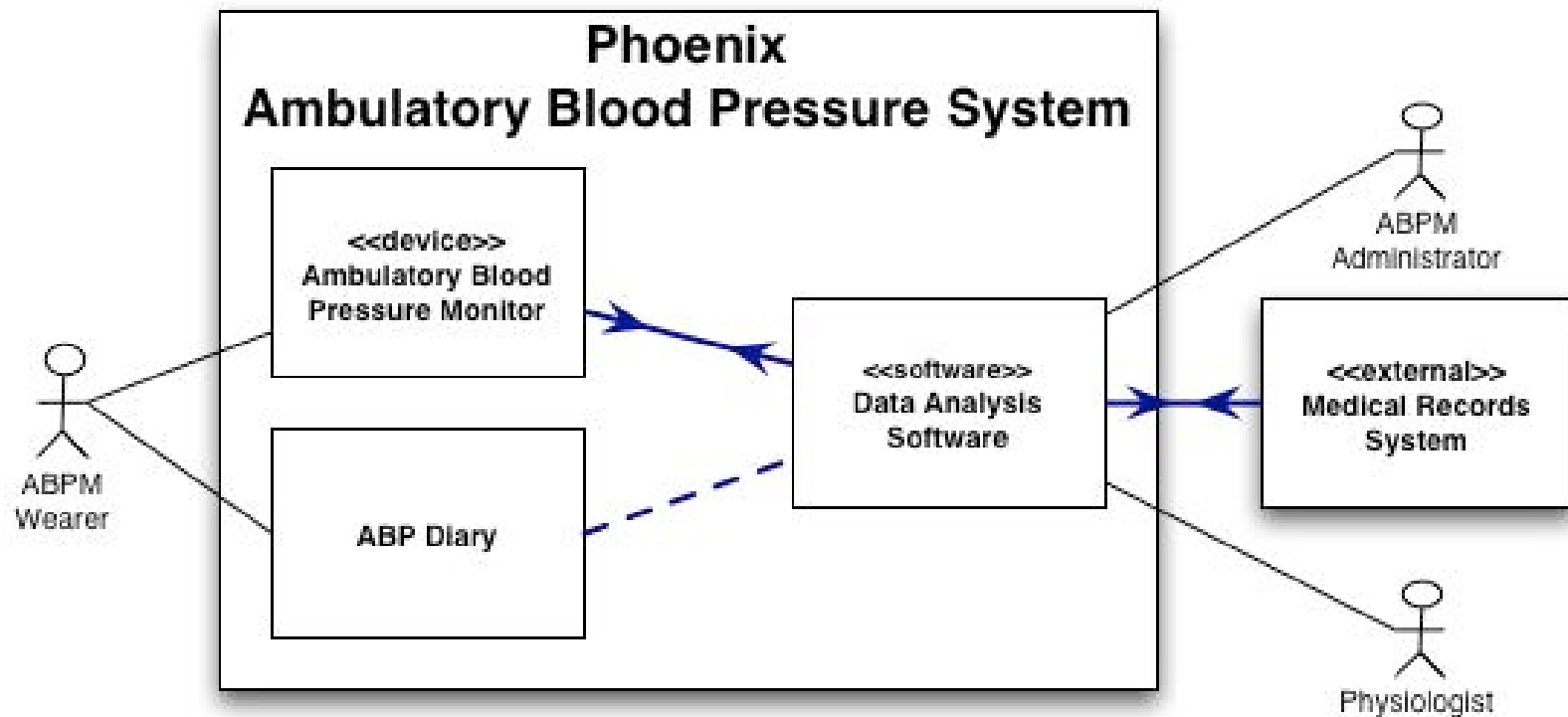
- Observations influencing diagnosis
- Defined content
  - Patient identity (*new subsystem?*)
  - Background, demographics
  - Daily entries
    - Exceptions to background
- Multiple formats
  - Paper      PDA
  - ...
- Integrated device feature
- **Could be an electronic device**  
**➔ Phoenix  $\approx$  2+ devices**

# Analysis Software Subsystem

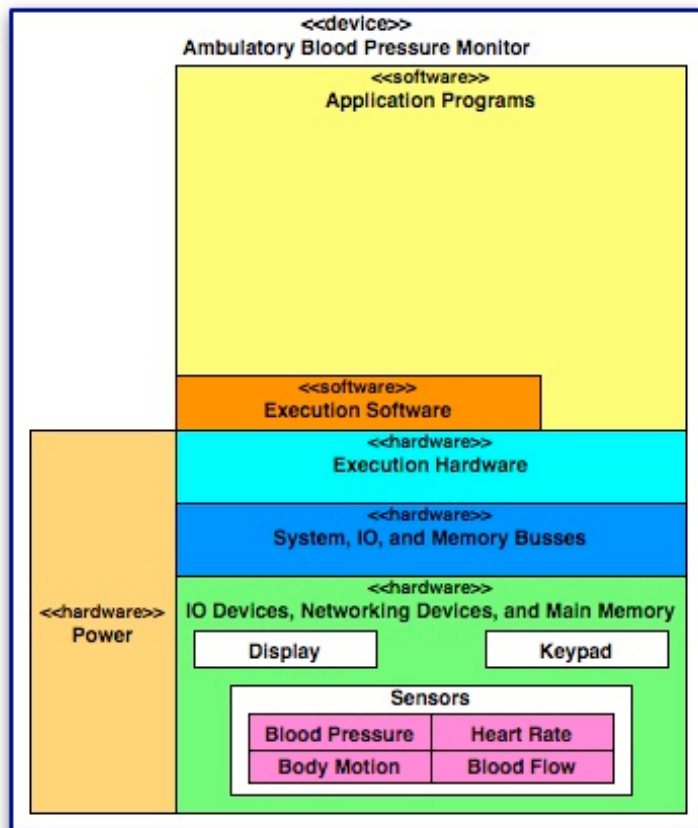


- Analysis Workstation
  - Handles data for a single **wearer**
  - **Nominally** a desktop application
  - **Multiple implementations** ←
    - Clinical Care Support System
    - Personal care support tool
- Reference Data Workstation used by Chronobiology Center
  - Handles data for whole populations
  - Could be a distributed or internet application
- Analysis Workstation relies on model parameters from Reference Data Workstation

# Recap

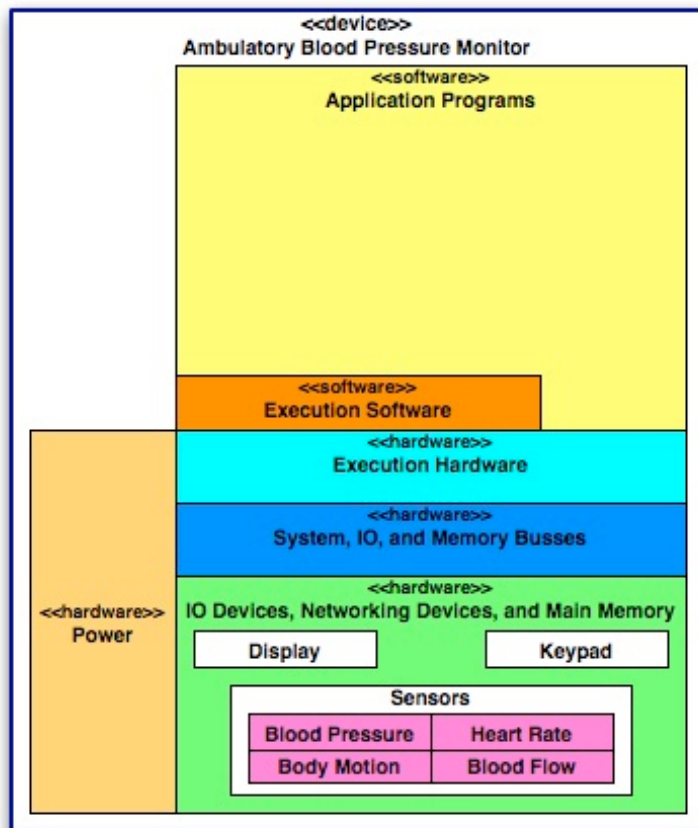


# Device Subsystem



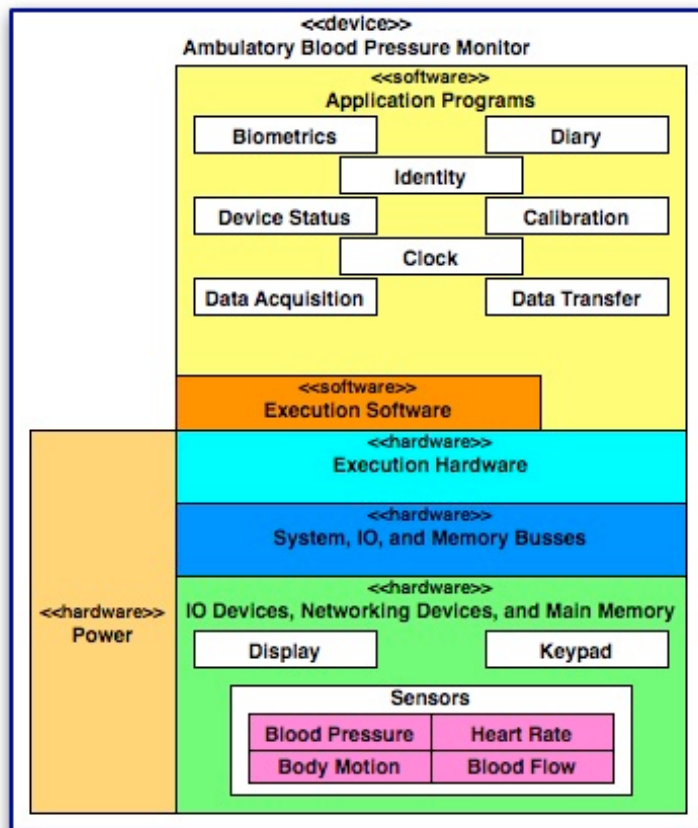
- Small, wearable computer
- Related subprojects:
  - Low Power Microprocessor
  - Power
    - Subsystem must be modular for easy substitution
    - thin-film battery would be cool
- Real-time embedded software ⇐
- Execution software =?
  - RTOS? OS? No OS?
- Functionality may be allocated to multiple, linked devices

# Device Subsystem



- Display
- Keypad
- Sensors
  - Blood pressure
  - Heart rate
  - Body motion
  - Blood flow
- Issues
  - Sensor proximity & bundling
  - Number of devices

# Device Subsystem



1. Clock
2. Identity
3. Diary
4. Calibration
5. Device status
6. Biometrics
7. Data transfer
8. Data acquisition



# Requirements Clock

- Timestamp every sample
  - Include date
  - Record in UCT
- Display time-of-day for diary recording
  - Display precision = 1 minute
  - Do not display date
  - Display in local time → need timezone
- Precision
  - Current devices require about 1 minute to take a single measurement
  - Sampling Beat-to-beat →  $300 \text{ beats per min} \times 25 \text{ samples per cycle} = 125$   
samples per sec = 8 msec per sample → precision = 1 msec
- Set time, date, and timezone at “initialization”

# Requirements

## Identity (Onboard/Offboard)

# Requirements Diary (Onboard)

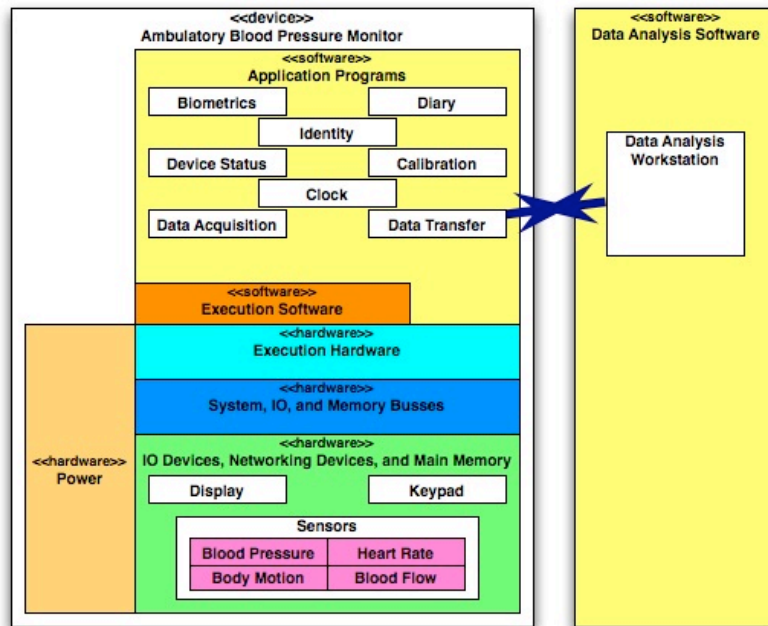
# Requirements Device Status

# Requirements Calibration

# Requirements Biometrics (Onboard)

# Requirements

## Data Transfer—Standards



- HL7
- IEEE 1073, “Standard for Medical Device Communications”
  - Defines “Medical Information Bus”
  - May be superseded
- ISO/IEEE 11073, “Standards for Point-of-Care Medical Device Communication”

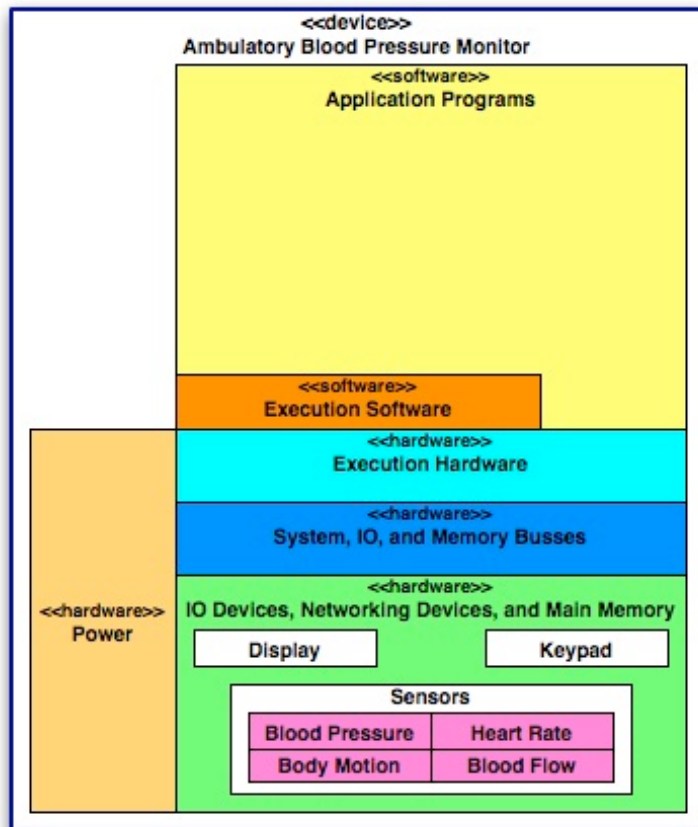
# Requirements

## Data Transfer—Content



# Requirements Data Acquisition

# UI Requirements



- Display
- Keypad