



# Smart Battery System Overview

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# Agenda

- SBS History and Design Goals
- SBS Architectural Overview
- Importance of Compliance



# Smart Batteries

- Driven by:
  - End Users
  - Power Management Technology



# The Elements of End-User Dissatisfaction

**They want to use notebook without thinking about battery:**  
*Use System on Battery > 8 Hours & Recharge Over Night*

- Consistent user experience:
  - *Battery Life < PC Magazine Benchmark < OEM Specs*
- Don't know the capacity left on backup batteries
  - Self discharge (NiMH - 30%, Li-Ion 3% per month)
  - Irreversible capacity loss over life of battery; fn(temp & discharge rate)
- Don't know the true "run time" left on their inserted battery
  - Actual capacity of inserted battery
  - Actual power used by system



# The Evolution of NB Power Management

Timeframe	'89-'91	'91-'97	>'97
Technology Developer	Intel	Intel-Microsoft	Intel-Microsoft Toshiba
Technology	SMM	APM 1.0, 1.1, 1.2	ACPI
OS participation	OS transparent	OS assisted	OS directed
Breakthrough	- New interrupt - OS independence	CPU idle notification	Applications involvement



**Algorithms**

**Timeout Based**

**Demand Based**

**OS interface**

**None**

**BIOS**

**Hardware/  
Software**

# Requirement for Uniform Battery Data

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Requirement for uniform battery data	None (OS does not see battery)	Minimal (OS does not use battery data)	High (or OS cannot trust battery data)
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# Benefits of Uniform Battery Interfaces

- **Software Benefits**
  - Reliable and consistent battery data, enables development of better power management algorithms
  - No need to support custom drivers
- **OEM Benefits**
  - Lower development costs
  - Multiple sources of smart battery components
- **Battery Vendor Benefits**
  - Can focus on core business (battery cells)
  - Faster time to market for new chemistries
- **End-User Benefits**
  - Accurate, reliable battery data, consistent across systems
    - Custom battery interfaces are not visible to end users, they provide no OEM differentiation



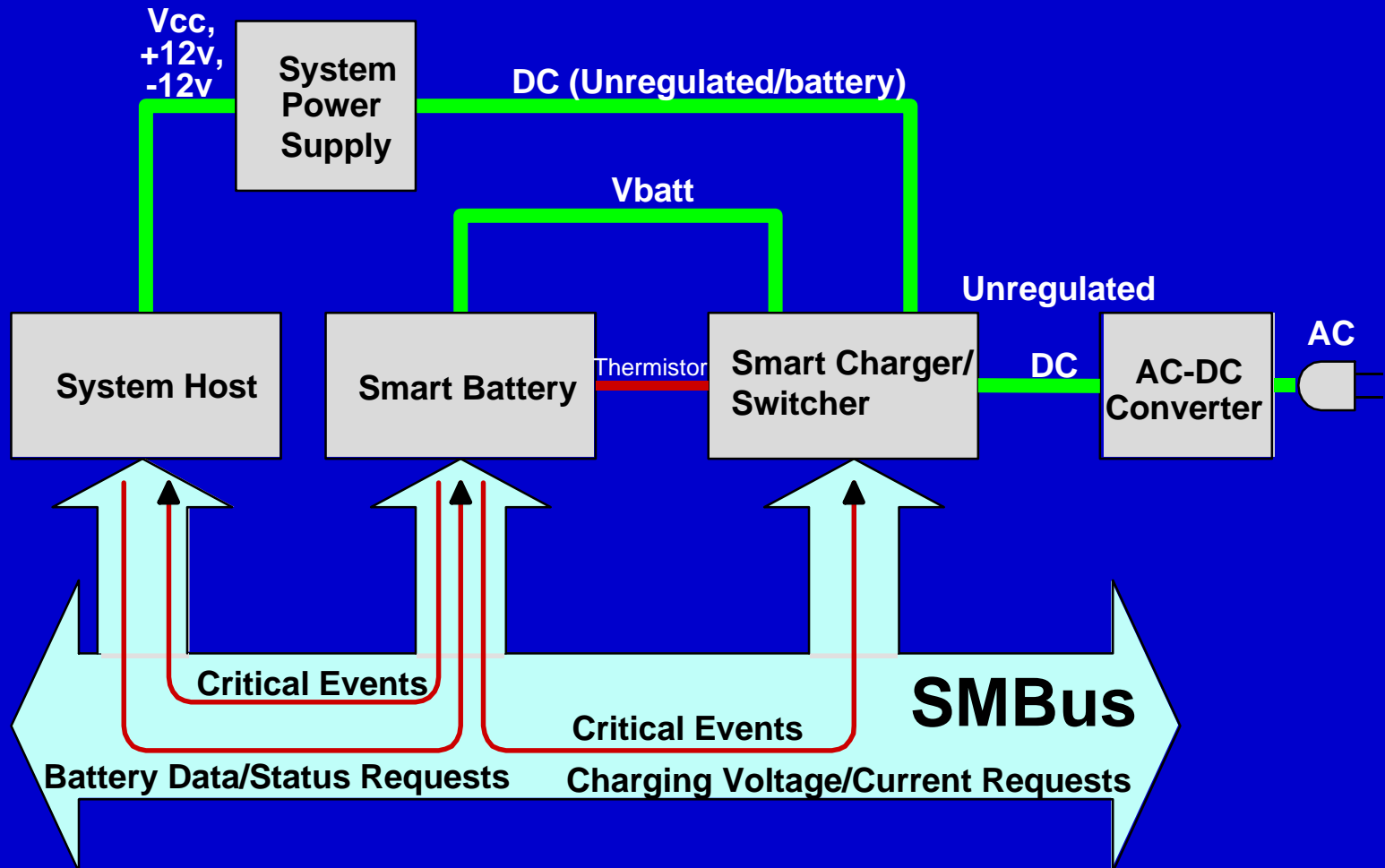
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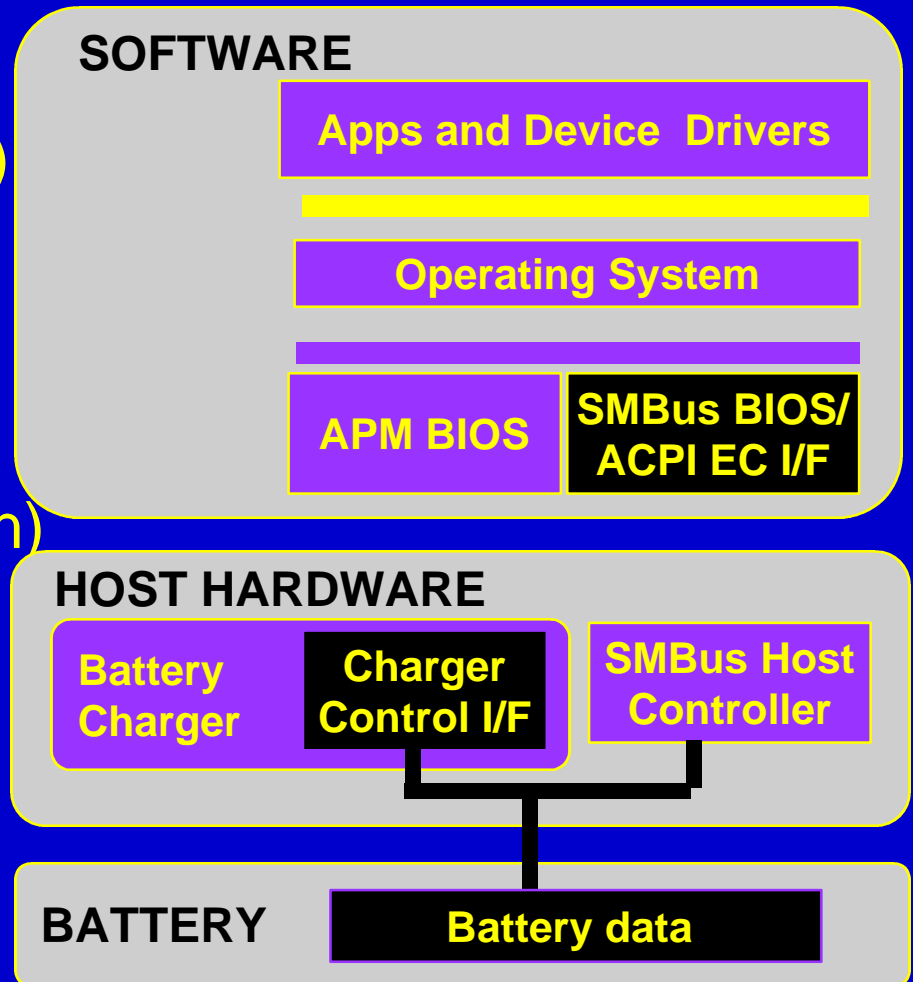
# Typical Smart Battery System



# SBS Architecture and Specifications

- **Five Interfaces defined**
  - Electrical protocol (SMBus)
  - Battery data set (SBD)
  - Charger data set (SBC)
  - BIOS I/F (SMBus BIOS)
  - Battery Selector (not shown)

A System-level Solution



# SBS Beyond Batteries

## SOFTWARE

Apps and Device Drivers

Operating System

APM BIOS

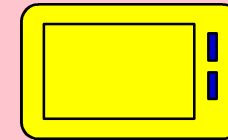
SMBus BIOS or  
ACPI EC I/F

## HOST HARDWARE

Battery  
Charger

Charger  
Control I/F

SMBus Host  
Controller



1000 1000...100011 SMBus

## BATTERY

Battery data

Audio  
Volume  
Control

Backlight/Panel  
Control

Voltage  
Control

**Battery is integrated in device control architecture**



# Summary:

## Fundamental SBS Concepts

- Battery participates in system power management
  - Accurate fuel gauging is required
- Battery controls its own charge
  - Charging algorithms are contained in the battery not in the charger
  - Enables chemistry independence
- All notebook batteries speak the same language
  - Regardless of size, brand or chemistry
  - Enables software innovations



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# Common issues about the SBS specs

- Number of functions (data specification)
  - Safety
  - Selector scheme
  - Precision of data
  - Power consumption
  - Standard packs
- } Implementation issues

We will cover all these in detail  
at the conference



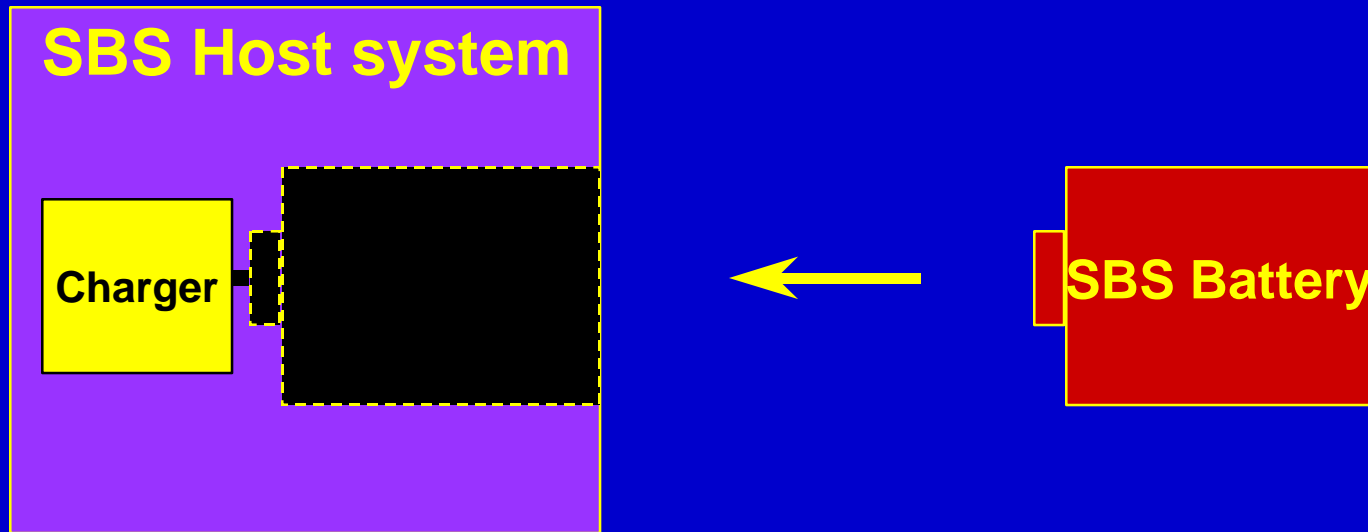
# Data Specification Summary

- **Measured values**
  - Battery Current
  - Cell Temperature
  - Battery Voltage
- **Discharge Calculated Values**
  - Battery state of charge
  - Uncertainty Factor
  - Remaining capacity
  - Time remaining at present rate
  - Predicted time remaining at host specified rate
  - Battery can supply Host desired rate
- **Charging Calculated Values**
  - Recommended charge current
  - Recommended charge voltage
  - Time remaining to full charge
  - Predicted charging time remaining at host specified rate
  - Capacity available at full charge
- **Life Data Calculated Values**
  - Cycle count
  - Last Full Charge Capacity
- **Battery Modes**
  - Capacity mode/charger mode
- **Battery Status**
  - Charging or Discharging
  - Fully Charged
  - Fully Discharged
  - Initialized
- **Alarms**
  - Terminate charge
  - Overcharged
  - Terminate discharge
  - Over Temperature
  - Below User Set Cap. Remaining
  - Below User Set Time Remaining
- **Manufacturing data**
  - Design capacity
  - Design voltage
  - Specification information
  - Serial number
  - Manufacturing date
  - Device Name
  - Manufacturer Name
  - Device Chemistry

The smart battery offers complete and accurate battery system reporting - battery, charger and selector.



# Safety

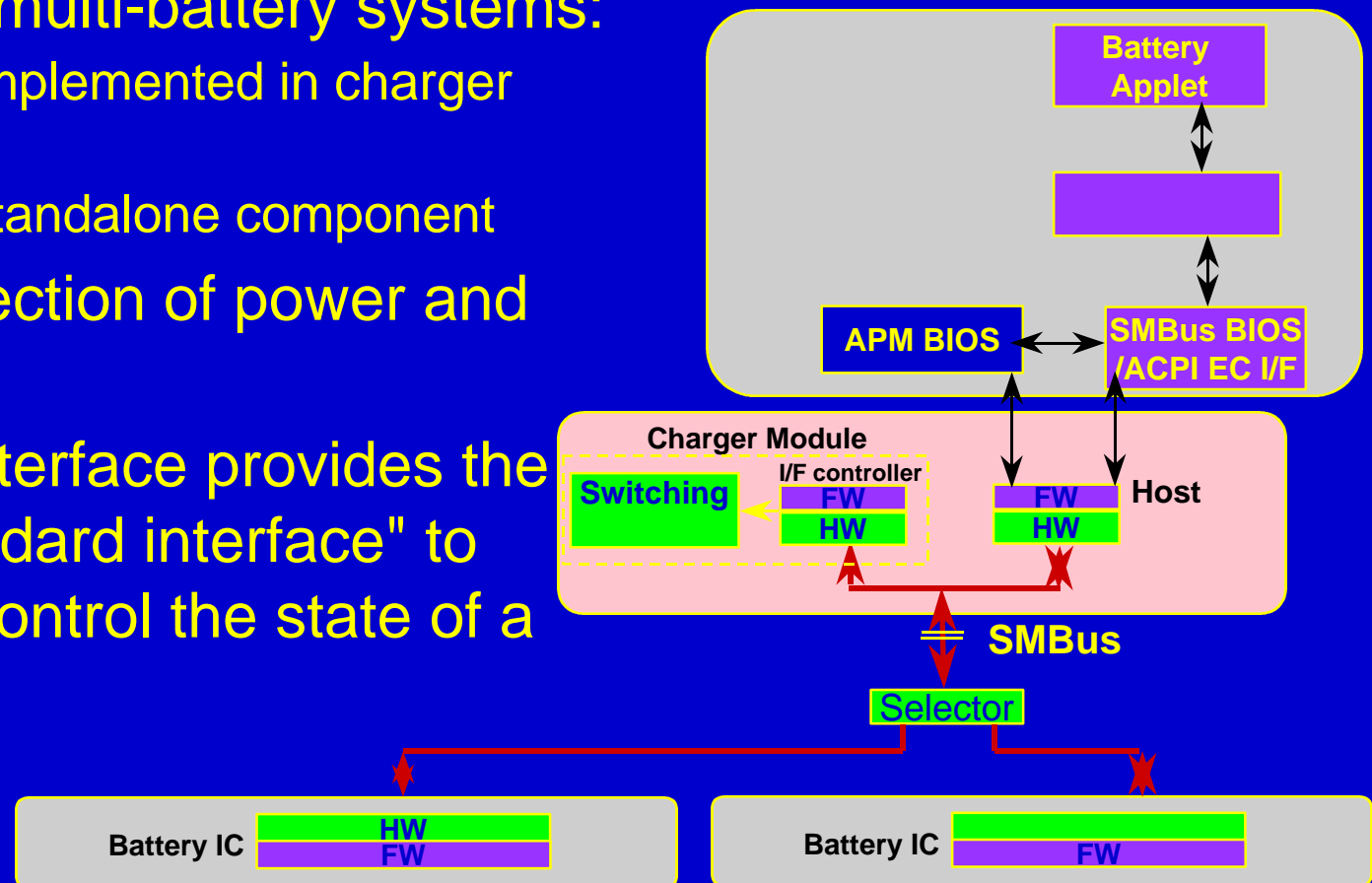


- The SBS specifications define a protocol to deal
  - Malfunction of charger or battery
  - Compliant battery dealing with non compliant charger





- SBS "Selector" function is needed in multi-battery systems:
  - Can be implemented in charger module
  - Can be standalone component
- Allows selection of power and data paths
- Selector interface provides the OS a "standard interface" to read and control the state of a



# Compliance is Important Because:

- Without data compliance the OS cannot rely on battery information
- Without SMBus compliance devices from multiple vendors cannot be interconnected
- Without charger and safety protocol compliance, chemistry independence cannot be achieved.



**That's what PlugFests are for !**