Challenges and Solutions for Multi-Master / Multi-Slave PMBus Systems

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What is a Multi-Master PMBus System?

• In SMBus a “Master” is any device that initiates a digital transmission
  – Drives the CLK through entire transmission
  – Drives DATA during Address and Command, may drive/read DATA during the data phase of a transmission
• Only 1 “Master” at a given time
  – A System “Host” for Telemetry
  – A Powered Device for AVS, Configuration
  – A System Host for Fault Management
Why do Multi-Master systems exist?

• System Host plus one or more powered devices using PMBus to actively control or monitor their power supply
  – Adaptive Voltage Scaling (AVS) through PMBUS (not AVSBus)
  – Adaptive Power
    • Scaling Operating Modes based on temperature, power, etc

• Multiple System Hosts
  – Separate Telemetry, Configuration and/or Fault Handling
  – External Interface with Internal Bus
Challenges of Multi-Master Systems – Slave Side

• Host Notify Protocol
  – Slave becomes a Master in response to a Fault

• Paged Devices
  – How does the Master know the “active” page?
    • Especially problematic when “Masters” may alternate
Challenges of Multi-Master Systems – Master Side

- **Master Side Challenges**
  - Transmission Collisions
    - SMBUS Bit-Arbitration
  - Coordinating Bus Traffic
    - Time Division Multiplexing, Defined Idle Delay, Shared Interrupt
  - Legacy Devices
    - May not support Multi-Master solutions
    - May not fully support bit arbitration
Challenges of Multi-Master Systems – System Side

• System Side Challenges
  – Bus Congestion
  – Repeated Collisions
Solutions to Multi-Master Systems – Slaves

• Paged Devices
  – Use `PAGE_PLUS_READ / PAGE_PLUS_WRITE`
    • Changes current page, so must be used on every command
  – Use devices that allow pages to be assigned unique Slave Addresses
    • Avoids using pages and the problems with pages

• Host Notify Protocol
  – Forces Multi-Master System
  – Slave device becomes Master during fault
Solutions to Multi-Master Systems – Masters

• Use 1 System Host as a Bridge
  – Avoid the Multi-Master system altogether
    • Host needs multiple communications ports
    • Adds delay to Communication Responses

• Determine who gets to talk next
  – Shared Interrupt uses 1 I/O from each powered device
    • Some powered devices may not support I/O control
  – Time Division Multiplexing – Everyone gets a turn
  – Programmable Idle Delay
    • Staggers start devices in start time
    • Idle delay sets bus priority
    • Matched Delays will default to Slave Address Arbitration
Resolving Conflicts

• Collision Resolution
  – I2C / SMBus Bit Arbitration
  – Bit Arbitration Loss
    • Reduced Idle time to grant Priority for next transmission
    • Random Idle time to prevent repeated collisions

• Interrupting In-Process Command
  – SMBus Time-Out = 25ms!
Thank you!
Questions?