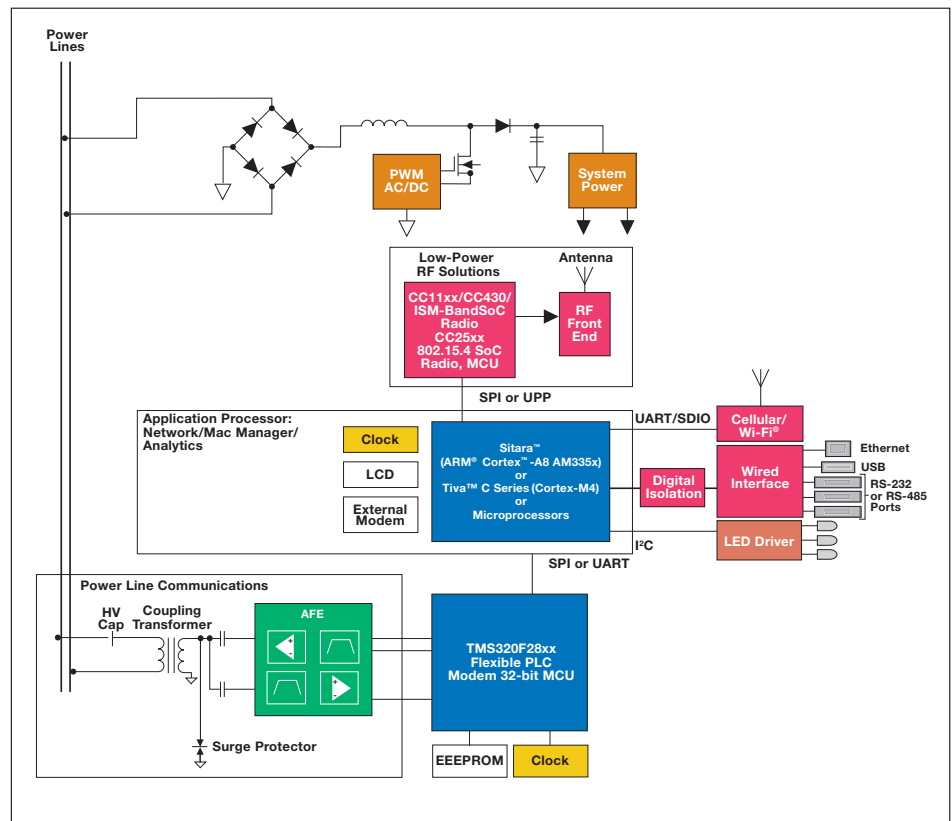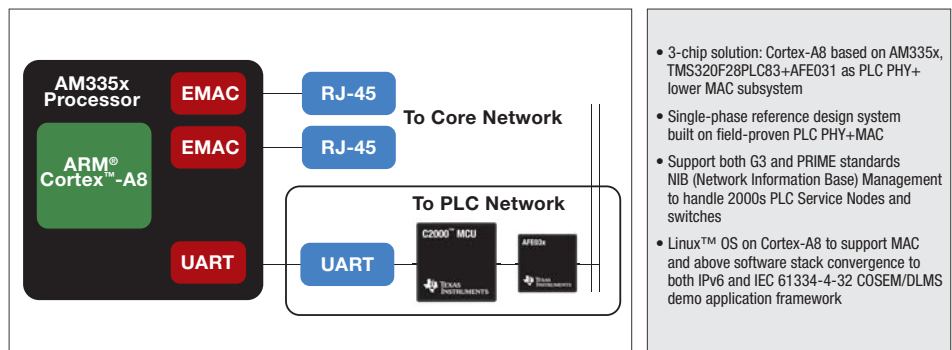# Data Concentrator System Solution

![Texas Instruments]

Automated metering infrastructure (AMI) and Automated meter reading (AMR) provide the necessary means to measure, analyze, collect energy usage and communicate that data to a central database for billing, troubleshooting, and analyzing. It would not be practical, technically as well as economically, for all meters to directly communicate with utility servers. Data concentrator applications are an important node in the AMI which is networked with several utility meters and central utility servers and enables communication of the data between the meters and the utility servers. Data concentrators at several points in the infrastructure securely aggregate data from a manageable number of meters and send to the utility servers.

The communication mode largely depends on the power infrastructure and can be either wired or wireless communication. Wired communication is comprised of Power Line Communication (PLC) and in some cases with serial or Ethernet-based communication where PLC is not suited for the infrastructure. The wireless communication comprises of mainly low-power RF (IEEE 802.15.4g protocol) communication and in some cases the existing cellular medium. The communication from the concentrator to the utility servers can be via Ethernet, GSM, GPRS, WiMAX or telecom networks.

TI Data Concentrator Solutions Block Diagram: Super Set

TI PLC Data Concentrator Platform

- 3-chip solution: Cortex-A8 based on AM335x, TMS320F28PLC83+AFE031 as PLC PHY+ lower MAC subsystem
- Single-phase reference design system built on field-proven PLC PHY+MAC
- Support both G3 and PRIME standards NIB (Network Information Base) Management to handle 2000s PLC Service Nodes and switches
- Linux™ OS on Cortex-A8 to support MAC and above software stack convergence to both IPv6 and IEC 61334-4-32 COSEM/DLMS demo application framework

Learn more at **www.ti.com/smartgrid**, **www.ti.com/dataconcentrator**, and **www.ti.com/tool/tmdsdc3359**

TMDSDC3359 – Data Concentrator Evaluation Module

Evaluate TI's solutions for data concentrator based on ARM® technology. Support up to 2000 nodes G3-PLC standard, PRIME standard, IEEE-1901.2 standard
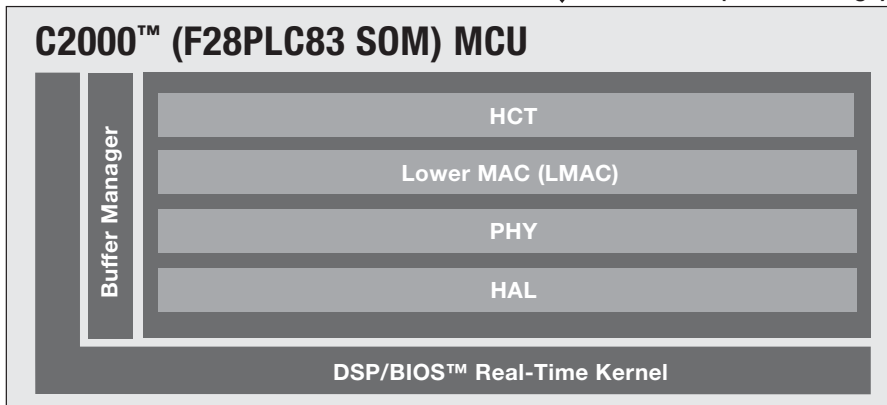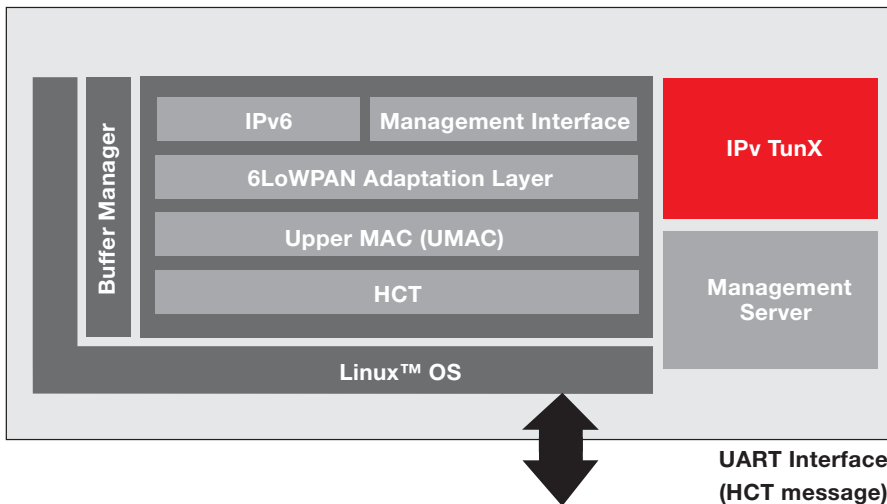
Supports control and data communications: 2× Ethernet, 3-phase PLC interface, sub-1GHz and 2.4GHz RF, 2× RS-232, 3× RS-485

Designed to best practices for high-speed systems: Good reference for design passing ESD system tests; BOM and schematics available
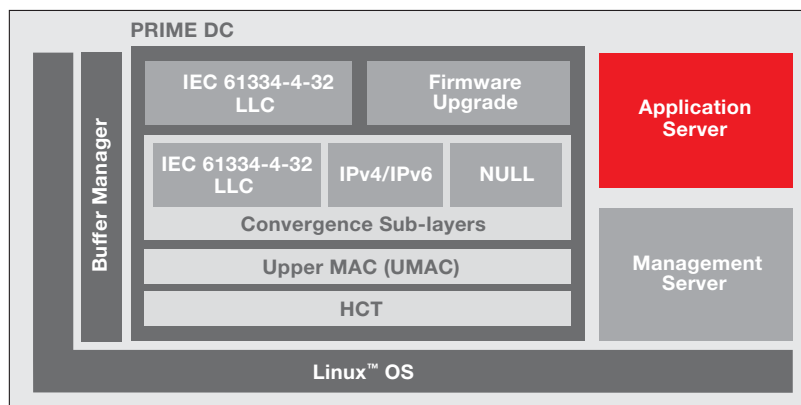
Hardware Features

Isolation to prevent damage from high-voltage currents

Three-phase power line communication module support

On-board 120-/240-V power supply

AM335x processor:
• Sitara™ ARM® Cortex™-A8 processor for upper-level data concentrator stack and communications
• Full Linux BSP supported by TI

Temperature sensor

Sub-1GHz and 2.4GHz RF

Infrared receiver and transmitter

2× USB

2× Ethernet

2× RS-232

3× RS-485

ARM9™/Cortex™-A8 Processor

Buffer Manager

IPv6 | Management Interface

6LoWPAN Adaptation Layer

Upper MAC (UMAC)

HCT

Linux™ OS

IPv TunX

Management Server

UART Interface (HCT message)

C2000™ (F28PLC83 SOM) MCU

Buffer Manager

HCT

Lower MAC (LMAC)

PHY

HAL

DSP/BIOS™ Real-Time Kernel
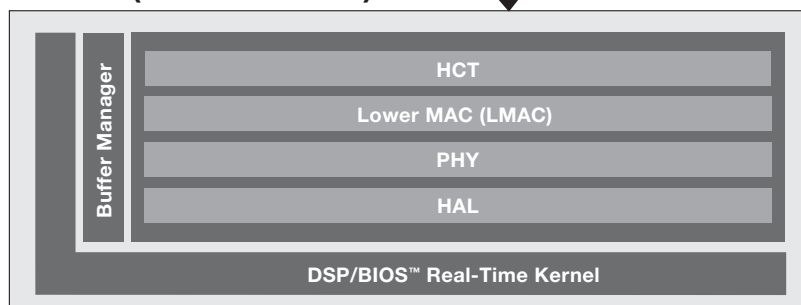
Features on ARM9/Cortex-A8 Processor and C2000™ MCU

- **G3 Stack**
  – ARM9/Cortex-A8 processor
    ○ ADP 6LoWPAN bootstrapping
    ○ Mesh routing (LOAD)
    ○ Security EAP/PSK
    ○ Upper MAC
  – C2000 MCU
    ○ Lower MAC and PRIME PHY

- **G3 DC Interfaces**
  – Management
  – DLMS/COSEM IPv6 application

- **G3 Topology**
  – Maximum 2000 nodes

- **G3 DC Resources (ARM9/Cortex-A8 processor)**
  – Program memory: 256 KB
  – Data memory: 580 KB
  – CPU consumption: < 1%
  – Note: MIPS-intensive blocks in C2000 MCUs

ARM9™/Cortex™-A8 Processor

PRIME DC

Buffer Manager	IEC 61334-4-32 LLC	Firmware Upgrade
	IEC 61334-4-32 LLC | IPv4/IPv6 | NULL	
	Convergence Sub-layers	
	Upper MAC (UMAC)	
	HCT	

Application Server

Management Server

Linux™ OS

↕ **UART Interface**

(HCT message)

C2000™ (F28PLC83 SOM) MCU

Buffer Manager	HCT
	Lower MAC (LMAC)
	PHY
	HAL

DSP/BIOS™ Real-Time Kernel

Features on PRIME Stack

- **PRIME Stack**
  - ARM9/Cortex-A8 processor
    ○ IEC 61334-4-32 LLC
    ○ IEC 61334-4-32 SSCS and NUL SSCS
    ○ Upper MAC
  - C2000 MCU
    ○ Lower MAC and PRIME PHY

- **PRIME DC Interfaces**
  - Management
  - Application

- **PRIME Topology**
  - Maximum 2000 nodes
  - 32 switches
    (to be increased for future release)
  - 3600 connections
    (Unicast and management)

- **PRIME DC Resources (ARM9/Cortex-A8 processor)**
  - Program memory: 192 kB
  - Data memory: 580 KB
  - CPU consumption: < 1%
  - Note: MIPS-intensive blocks in C2000 MCUs

Learn more at **www.ti.com/sitara, www.ti.com/tiva** and **www.ti.com/piccolo**

Embedded Processing Solutions

Description	Device	Key Benefits
Sitara™ ARM® Cortex™-A8 Microprocessors	AM335x	• Up to 1-GHz Cortex-A8 32-bit RISC microprocessor • Extensive peripheral set (2× Gbit-Ethernet, CAN, USB, 8× UARTs extended from PRU, ...) • Flexible communication protocols • Linux™ community, Android™, Windows® Embedded CE, DSP/BIOS™ Real-Time Kernel and RTOS ecosystem of development partners
Tiva™ C Series ARM Cortex-M4-Based MCUs	LM4F13x	• Up to 80-MHz core • 256KB single-cycle Flash, 32KB single-cycle SRAM • Rich interface featuring 8× UARTs, USB, CAN, up to 43 GIPO, etc. • 2× 12-bit ADC with 12 analog input channels
C2000™ 32-bit real-time MCUs	Piccolo™ floating-point series	• PLC accelerators • Integrated real-time control peripherals • Support multiple PLC modulations

Digital Isolation | www.ti.com/isolation

Description	Device	Key Benefits
Digital Isolation	ISO7131	• 3-channel small footprint digital isolators provide galvanic isolation up to 2500 V_{RMS} for 1 minute per UL and 4242 VPK
Digital Isolation	ISO7140/41	• 4-channel small footprint digital isolators provide galvanic isolation up to 2500 V_{RMS} for 1 minute per UL and 4242 VPK

RS-485 (Isolated and Non-Isolated)

Description	Device	Key Benefits
RS-485 Interface	SN65HVD3082/85/88	• 200Kbps / 1 Mbps / 20 Mbps capable half-duplex transceivers, operate with very low supply current
RS-485 Interface	SN65HVD3080/83/86	• 200Kbps to 20 Mbps capable full-duplex transceivers, operate with very low supply current
Isolated RS-485 Interface	ISO3080/82/86/88	• Isolated 5V full and half-duplex RS-485 transceivers, provide 2500 V_{RMS} of isolation for 60s

Ethernet PHY

Description	Device	Key Benefits
Interface	TLK105L	• 10/100 Ethernet PHY, error free to 150 meters, cable diagnostics, auto-MIDX, supports MII & RMII
Interface	DP83848K	• 10/100 Ethernet PHY, error free to 130 meters, auto-MIDX, supports MII & RMII
Interface	DP83640	• IEEE 1588 Precision Time Protocol transceiver for real-time industrial connectivity. Packet time stamps for clock synchronization

www.ti.com/smartgrid　　　　　　　　　　　　　　　　　　　　**www.ti.com/tool/tmdsdc3359**

ESD

Description	Device	Key Benefits
ESD Protection	TPD1E10B06/B09	• Single-channel ESD protection in small 0402 package, ±30KV IEC air-gap, over ±30KV contact, bipolar or bidirectional signal support
ESD Protection	TPD4E1U06	• Quad-channel ultra-low cap ESD device, offers ±15KV IEC air-gap and ±15KV, suitable for multiple applications like USB
ESD Protection	TPD2E007	• Two-channel ESD protection offers system-level ESD solutions for wide range of industrial applications like RS-485, RS-232

Temperature Sensors

Description	Device	Key Benefits
Temperature Sensor	TMP275	• ±0.5°C accurate from −20°C to +100°C, two-wire, serial output, two-wire and SMBus interface-compatible
Temperature Sensor	TMP108	• ±0.75°C accurate from −20°C to +85°C, ±1°C (max) from −40°C to +125°C, features SMBus and two-wire interface
Temperature Sensor	TMP75/LM75A	• ±1.5°C to ±3°C accuracy depending on temperature range, features SMBus and two-wire interface

Isolated AC/DC Power Solutions | www.ti.com/power

Description	Device	Key Benefits
AC/DC Supply	UCC28910	PWM HV switcher with 700V integrated power FET and primary-side regulation. Dedicated to flyback power supplies and provides isolated output voltage and current regulation without the use of an optical coupler.
AC/DC Supply	UCC28710/700	PWM controller with / without integrated 700V startup switch. Constant-voltage, constant-current controller with primary-side regulation, QR green mode, optocoupler less feedback, very low no-load pwr, high efficiency
AC/DC Supply	UCC28600/610	QR / DCM PWM controller, excellent efficiency at full load, industry-leading power consumption at no-load, and small footprint

DC-DC Solutions

Description	Device	Key Benefits
Step-Down Regulator	TLV62065	• 2.9V to 5.5V with 2-A output, 2×2-mm footprint, synchronous DC/DC step-down converter, up to 97% efficient
Step-Down Regulator	TLV62080	• 2.5V to 5.5V input, 1.2-A step-down converter in 2×2-mm package and high efficiency over wide output current range
Step-Down Regulator	LM3671	• 2.7V to 5.5V input, 600-mA output, 2-MHz, step-down DC-DC converter optimized for powering low-voltage circuits
Step-Down Regulator	TPS62240	• 2 V to 6 V input with 300-mA output, 2.25-MHz buck in 2×2 SON/SOT23. Offers high efficiency, power save mode at light loads
Step-Down Regulator	TPS54227/327	• 4.5V to 18V input 2-A and 3-A output respectively; DC/DC step-down converter, adaptive on-time D-CAP2™ enables high efficiency over load range, fast transient response, allows use of low ESR caps. Adjustable soft start
Buck-Boost Regulator	TPS63030/1	• DC/DC buck-boost regulators: 0.8-A, low I_Q with up to 96% efficiency
Step-Up/Boost Regulator	LM2733	• 0.6-/1.6-MHz boost converter, has 40V integrated FET switch with low RDSon. Offers cycle-by-cycle current limiting

Linear Regulators

Description	Device	Key Benefits
LDO	TLV71310/11/12/15/18	• Capacitor-free, 150-mA, LDO with 1.5% regulation over temp. This next-generation LDO was designed to be stable without an o/p cap
LDO	LP38691	• 500mA, low dropout CMOS linear regulator with tight output tolerance, and excellent AC performance with ultra-low ESR ceramic caps
LDO	TLV70710/11/12/15	• 200mA LDO with low I_Q, tight output regulation (2% typ). Offers excellent line and load transient performance

PMICs

Description	Device	Key Benefits
PMU	TPS650250	• Low-cost PMU for AM335x processor
PMU	TPS65250	• Power management IC with "last gasp" storage and release circuit

Voltage Supervisor & Reset

Description	Device	Key Benefits
Voltage Supervisor	TPS3831/9	• Ultra-low power 150nA, ultra-small voltage supervisor
Voltage Supervisor	TPS3700	• UV, OV voltage monitor; wide input voltage
Voltage Supervisor	TPS3808	• Highly accurate (0.5% typ) supervisor with low I_Q and adjustable reset delay

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