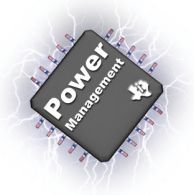
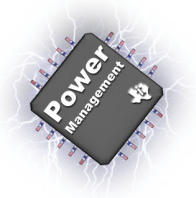


It's All in the IC: How New Applications Leverage High Performance Technology

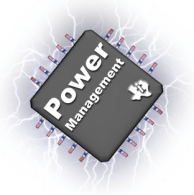
By: Dave Heacock

Business Manager for Portable Power Management Products



Addressing the Market Dynamics

- What drives semiconductor solutions?
- What enabling technologies drive applications?
- What are some of realities behind “system-on-chip” solutions?



Background Information –Market Demand

Forecasted Unit Volume – Consumer Electronics

Million Units/CY

	00CY	01CY	02CY	03CY	04CY	05CY	06CY	07CY	08CY	09CY	10CY
Notebook PC	22	24	26	28	30	33	36	39	42	43	45
Cellular	421	378	408	432	461	487	493	506	546	590	631
PDA	11	11	11	15	16	21	25	26	29	30	30
DSC	13	17	22	27	32	37	40	43	46	49	52
Camcorder	10	11	11	11	11	10	10	10	10	10	10
Power tools	26	26	27	27	27	28	28	29	29	29	30
Cordless phone	81	72	81	82	83	84	85	86	86	87	88
Portable Audio	66	67	68	69	70	70	70	70	70	70	71
Advanced Game				1	2.5	5	7	8	8	8	8
Assist Bicycle	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1	1	1	1
Electric Scooter			0.2	0.5	0.8	1.2	1.5	1.8	2.2	2.5	3.0
Bluetooth Device	0.0	0.005	0.3	1.0	1.8	3.7	5	7	10	14	17

Wireless Market Segment Dynamics

	2G	2.5G	3G
	PDAs Cell Phones		
Application Bandwidth	Voice Only 9.6 Kbps	Voice & Basic Multimedia Apps Up to 144 Kbps	Enhanced Multimedia Apps 384 Kbps and Above
Market Segmentation	PDAs & Cell Phones	Specialized Segmentation: Fashion, Teen, Professional… Smartphones & Converged Devices	Industry-Specific – Medical, Real Estate, Sales, etc. Increasing Market Segmentation…

- Data-only – difficult to expand
- Basic features – growing diversification driven by expanding segments
- Increasing market for “multimedia” – performance

Typical Power Supply Input/Output Voltages by Application

Application	Typical DC Input Voltages	Typical DC Output Voltages
Merchant Power Supplies	(Aggregate needs of applications using purchased power supplies)	
Computers & Peripherals	72V, **48V**, 45V, **28V, 24V**, 15V, **12V, 5V**	**12V, 5V, 3.3V, 2.5V, 1.8V, 1.0V (also *in 100 mV increments)***
Telecommunications	96V, 72V, 56V, **48V, 24V**, 15V, 12V	**48V, 24V**, 15V, 12V, **5V, 3.3V, 1.8V**
Datacommunications	**48V, 28V, 24V**, 15V, **12V, 5V**	**12V**, 9V, **5V, 3.3V, 2.5V, 1.8V**
Automotive	**9V to 16V and 6V to 24V Note future change to 42V**	**5V**, 3V
Instruments	**12V, 9V, 5V**	**5V**, 3V
Consumer Electronics	**24V**, 15V, **12V, 5V**	**12V, 5V, 3V**
Military/Aerospace	**28V, 24V**, 15V, **12V**, 9V, 5V	**15V, 12V**, 8V, **5V**, 3.3V
*(note: **bold values** are voltages most often indicated by OEMs)*		

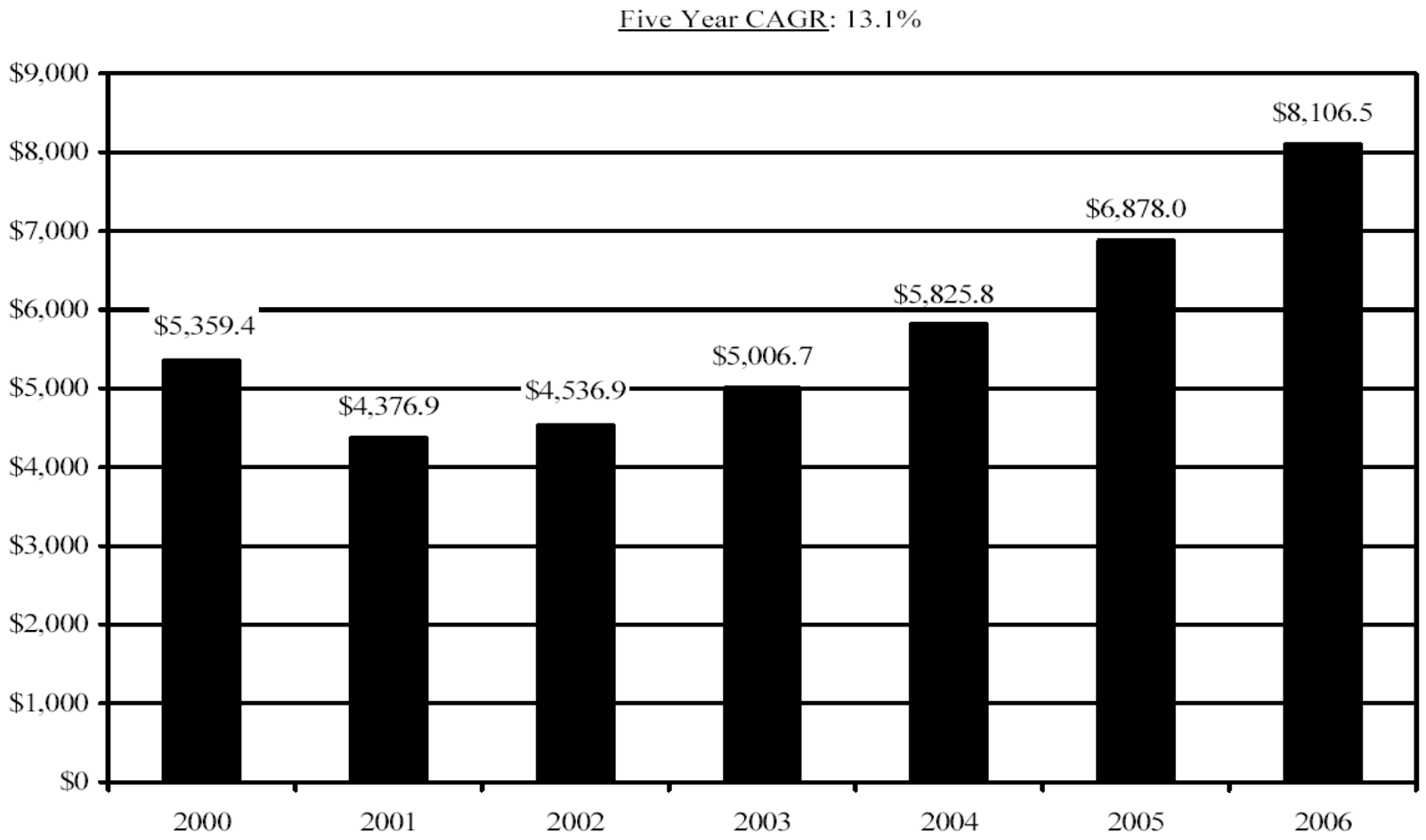
Venture Development Corporation, 2002

SIA Forecast for Future Operating Voltages

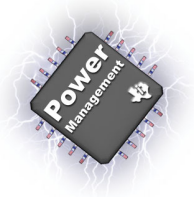
	1999	2000	2001	2002	2003	2004	2005
Technology Node (Feature Size)	180 nm		130 nm			90 nm	
Maximum Voltage for Maximum Performance	1.8V	1.8V	1.5V	1.5V	1.2V	1.2V	1.1V
Minimum Voltage for Lowest Power Dissipation	1.5V	1.5V	1.2V	1.2V	0.9V	0.9V	0.8V
High Power for Performance (Amps)	90A	108A	130A	140A	150A	160A	170A

Venture Development Corporation, 2002

WW Power Supply IC Shipments $M
(Excluding HotSwap/MOSFET Drivers)

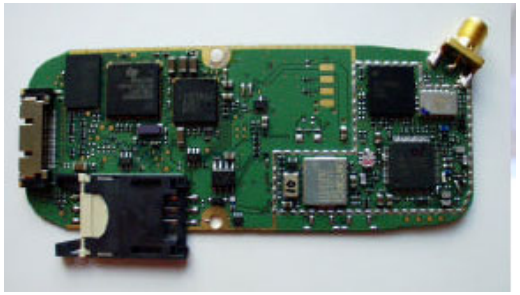


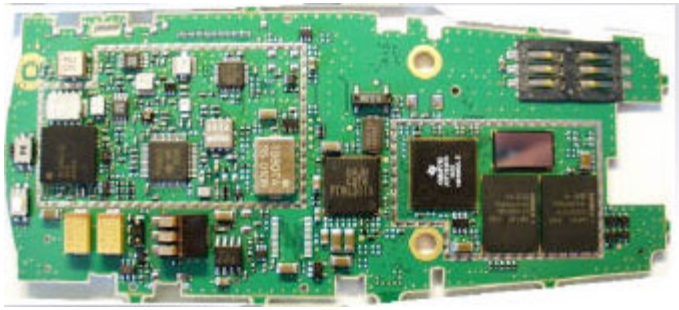
Venture Development Corporation, 2002



Technologies – How to Enable Market Growth

Example Design for Different Mobile Segments





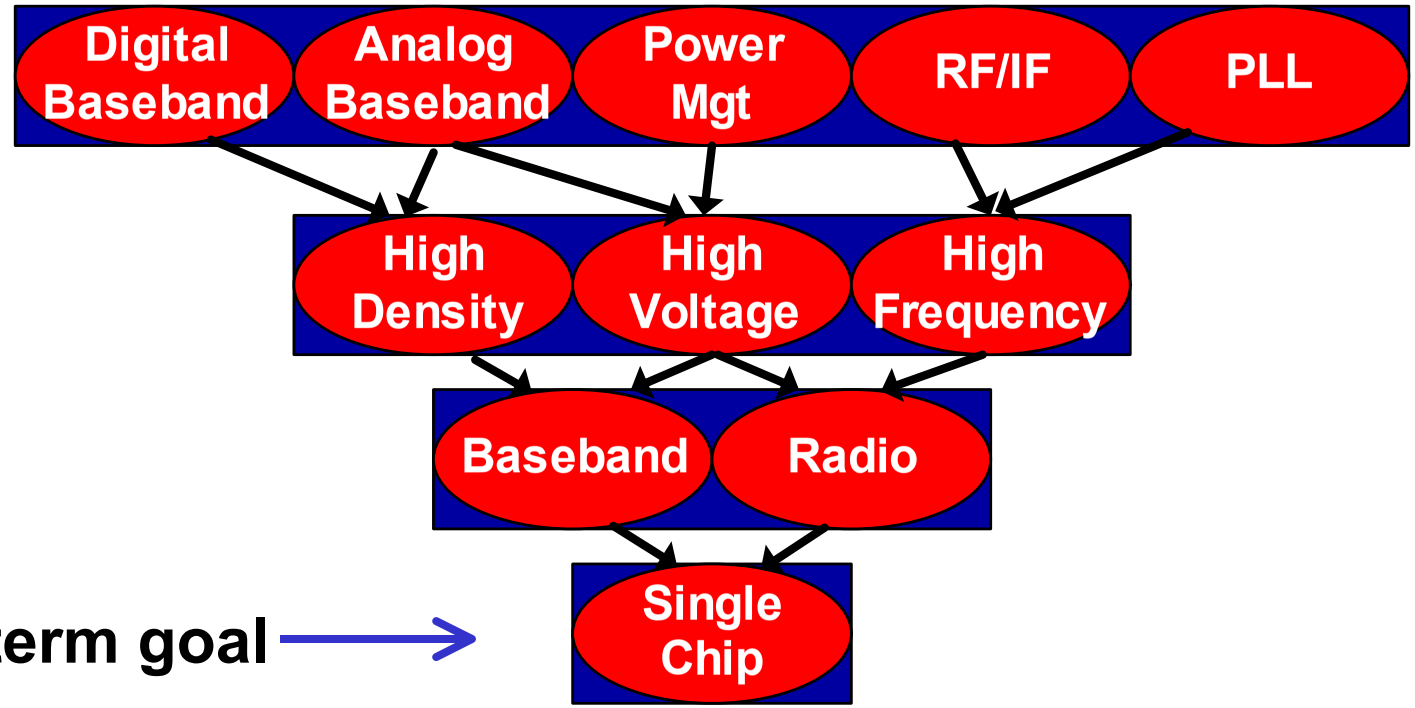
Voice only

Voice + Data

Voice + Data + Multimedia

System/Power Migration Path

- What technologies does it require?
- Can today's Semiconductor processes address this need?

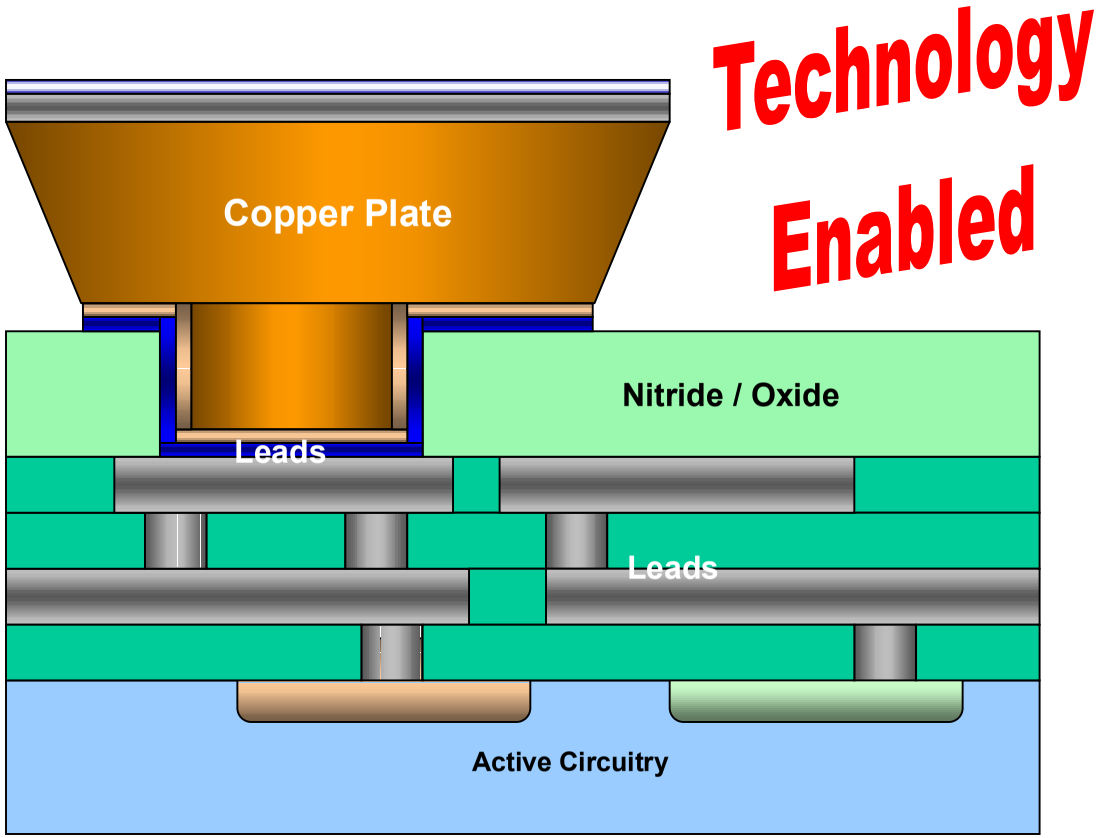


Example Semiconductor Processes addressing SOC/Power Integration

Process	LBC3s	LBC4	LBC5	LDI	LBC6	3370A07s
Voltage Usage	HV	HV	HV	HV	LV	LV
Integration	Modular	Modular	High	High	High	High
Feature	2.00	0.72	0.50	0.72	0.60	0.30
Voltage	60	60	60	100	20	20
LDMOS	Scaled	Scaled	Scaled	100V	20V	
CMOS-D/A V	5/18V	5/10V	5/10V	5/18V	5/8V	3.3/5.5/7.0V
Low VT						Yes
Depletion Device		Yes		Yes		Yes
NPN	yes	yes	yes	yes	yes	yes
PNP	yes	yes	yes	yes	yes	yes
Drain Ext-CMOS	yes	yes	yes	yes	yes	yes
Cap	yes	yes	yes	yes	yes	yes
Res	yes	yes	yes	yes	yes	yes
EPROM	yes	yes	yes	yes	yes	yes
Metal	2	2	3/CMP	2	3/CMP	3/4/CMP
Thick Cu/ BOAC	yes	yes	yes	yes	yes	yes
Primary Products	Analog Mixed Signal	Analog Mixed Signal	Analog Mixed Signal Custom Power	HV isolated and Telecom	HDD Servo	SOC Portable Power

Source: “The Earth is Mobile – Power” by Taylor Efland, TI Fellow. March 2003

Using Copper for Power IC's – the SWIFT Example



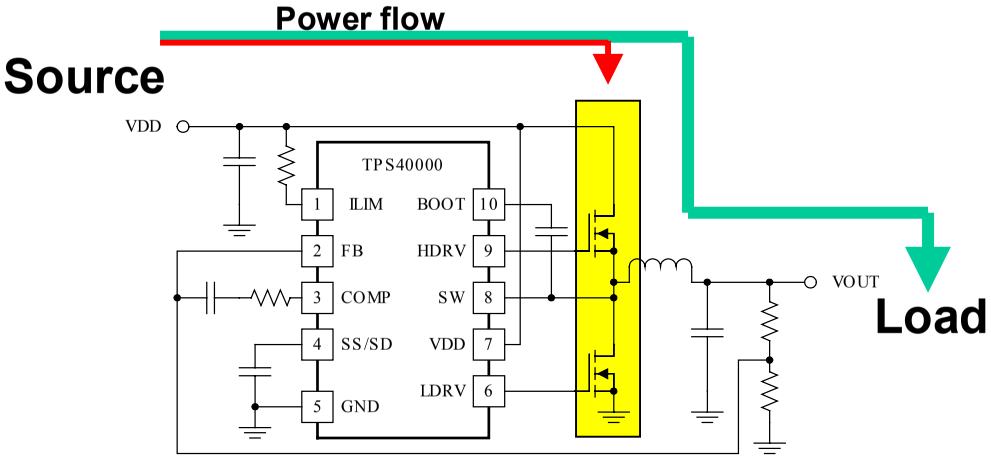
SWIFT™ – Switcher With Integrated FET Technology

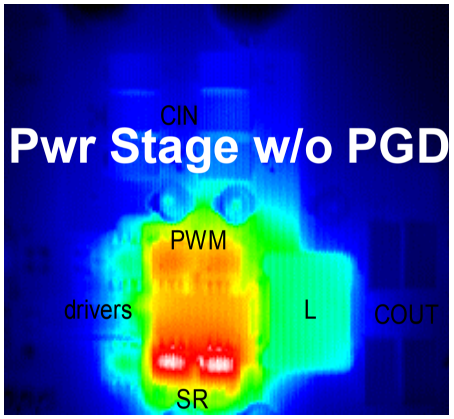
Predictive Gate Drive – how can it help?

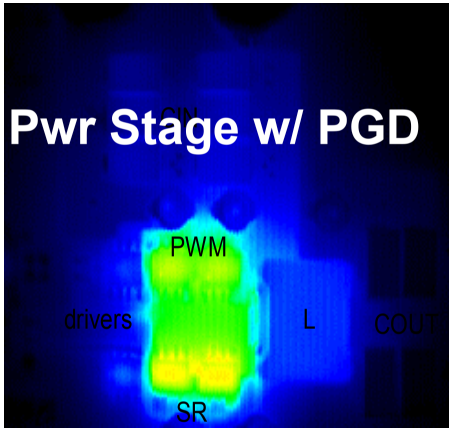
40% greater temperature rise from ambient w/o PGD

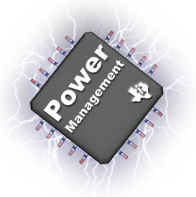
Example - TPS40001-TPS40003

- Drives external FETs
- 5A-20A Point-of-Load
- 20-40% reduction in wasted power





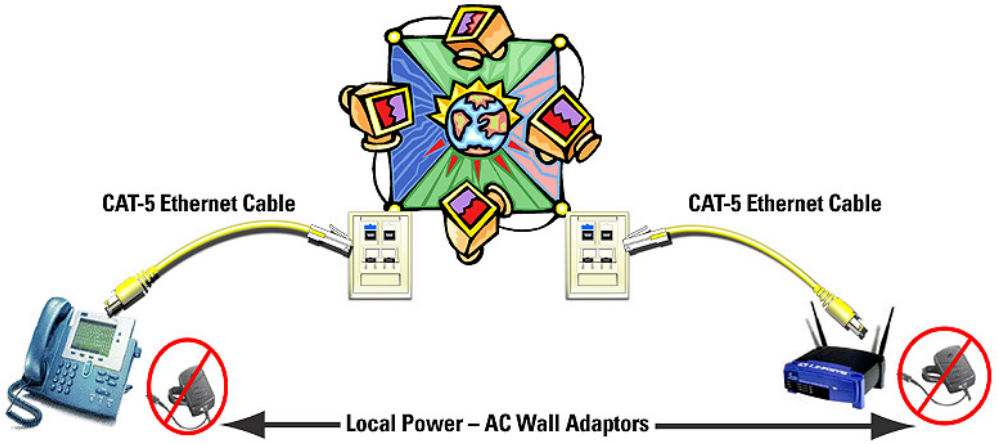


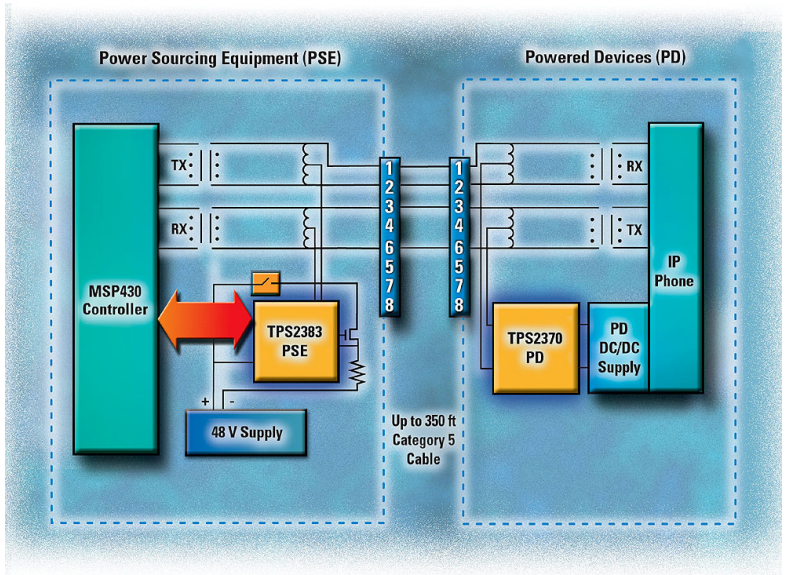


Applying the Technology – How to Expand the Application Field

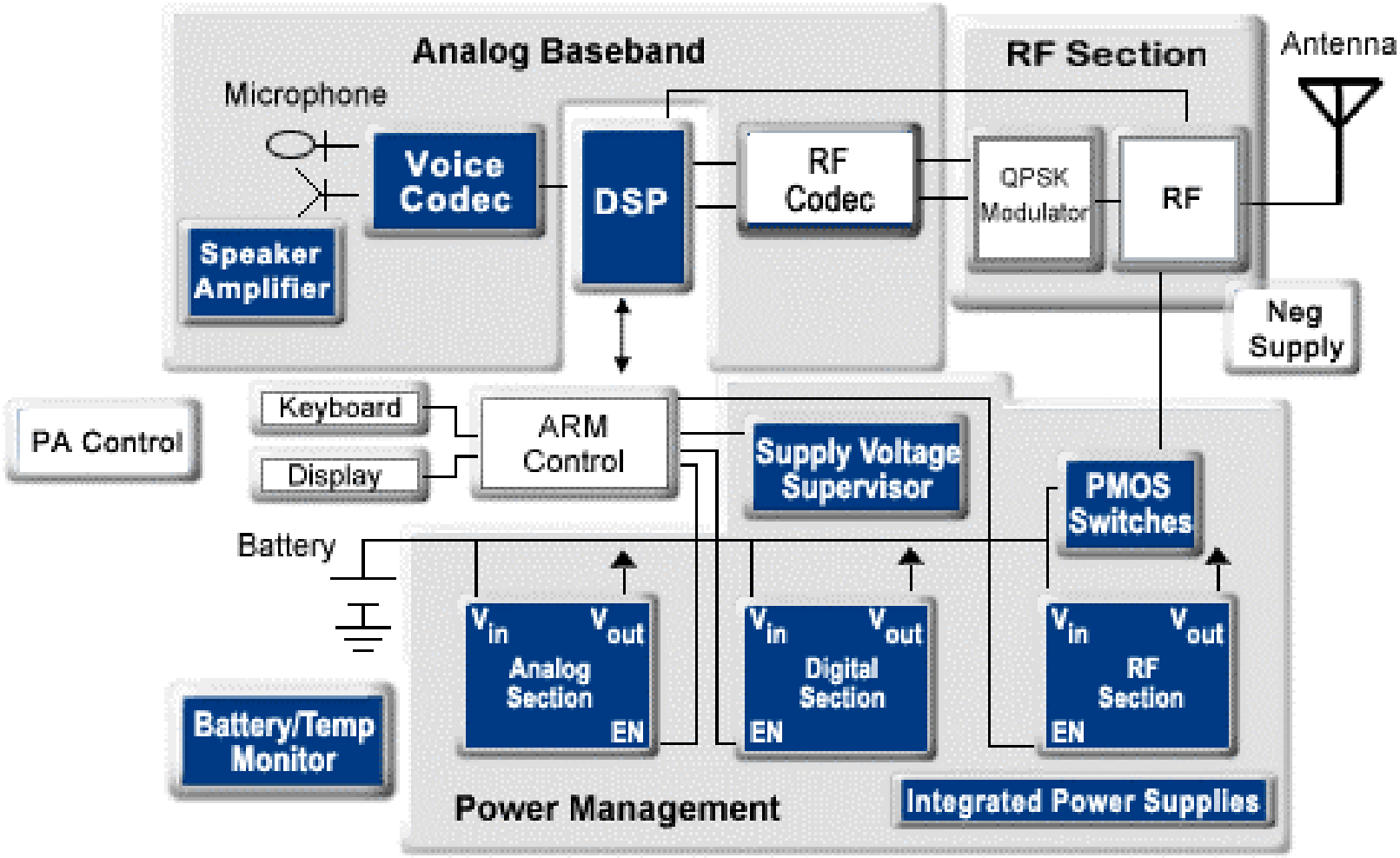
Example – Emerging Application for Power Optimized ICs

- PoE Market Drivers
  - VoIP Phones
  - WLAN Access Points
  - Bluetooth
  - Network cameras
  - Security
  - POS terminals
  - Gaming
  - Industrial automation



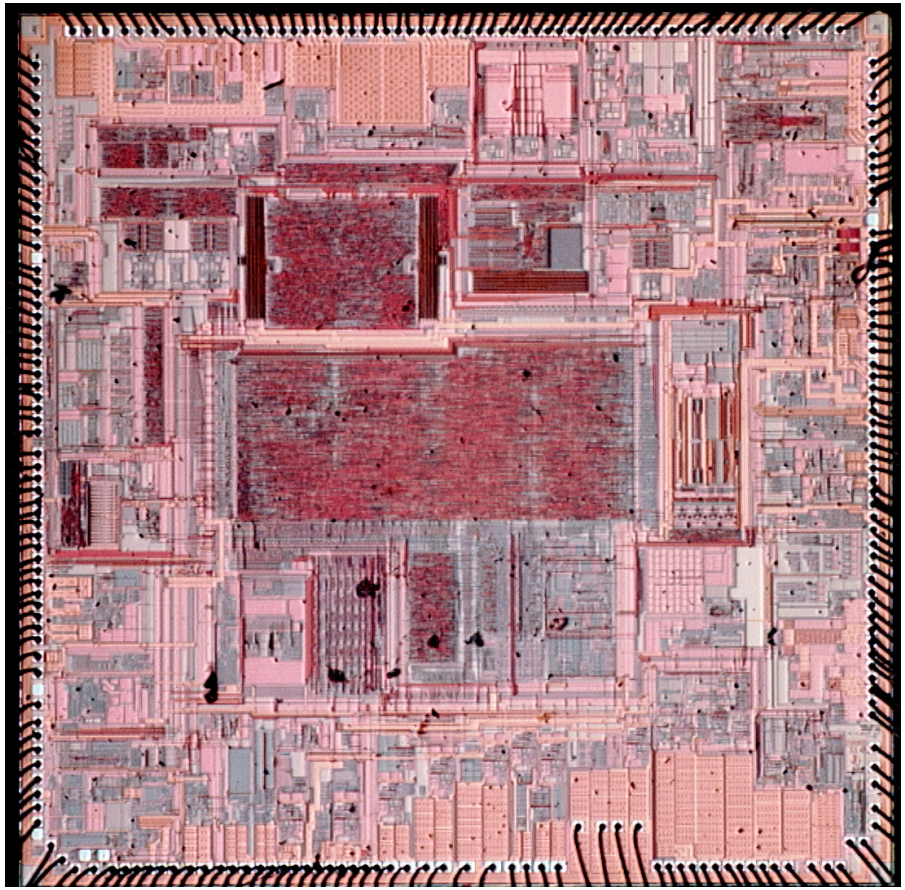


Example Block Diagram: Mobile Phone

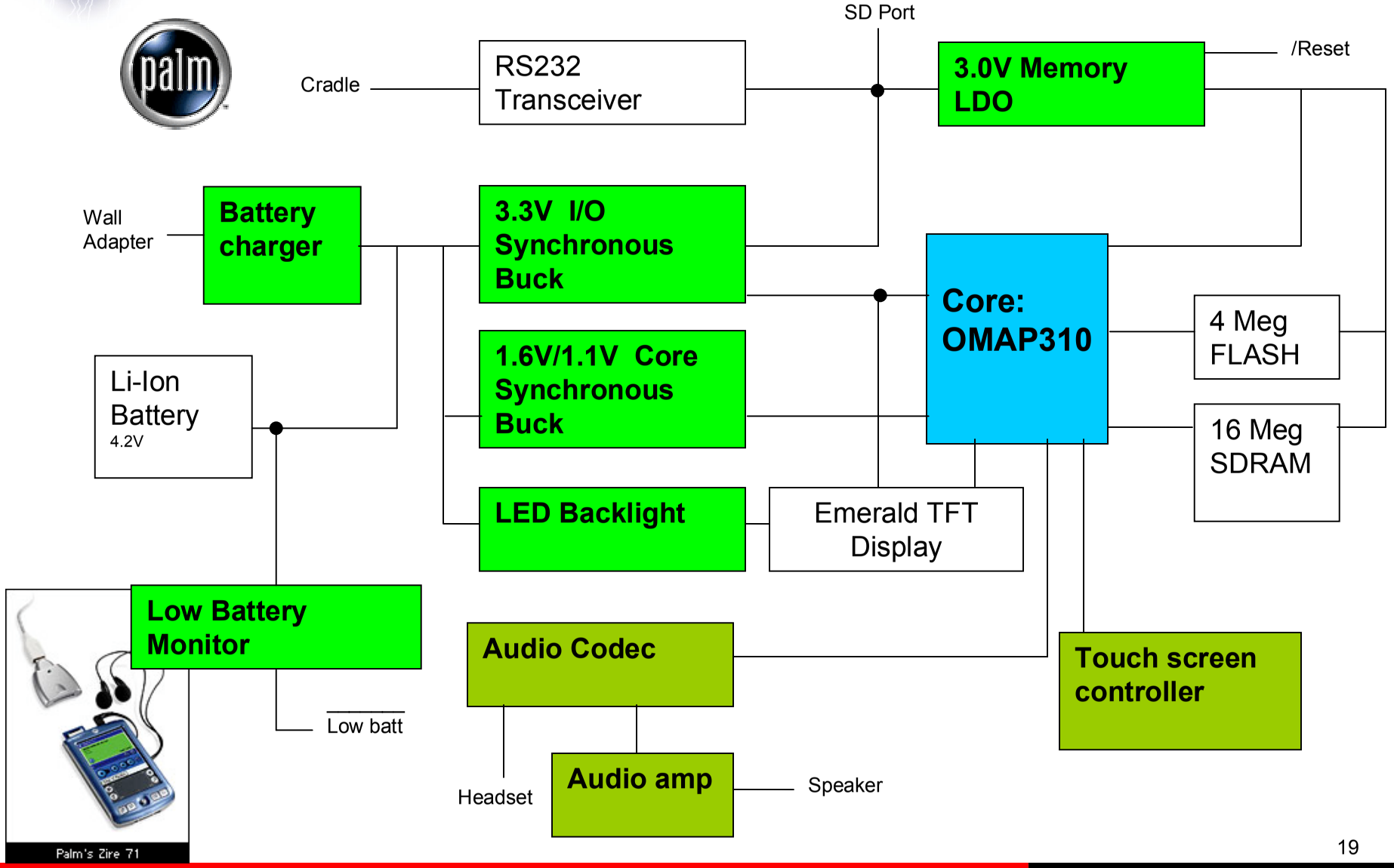


Mobile Phone Example – Integrated Power SOC

- >150k gates
- Boost and buck switching supplies from 1.8V-5V
- Battery charge and battery management
- Multiple LDO and Analog Base-Band functionality
- Multiple drivers/interface

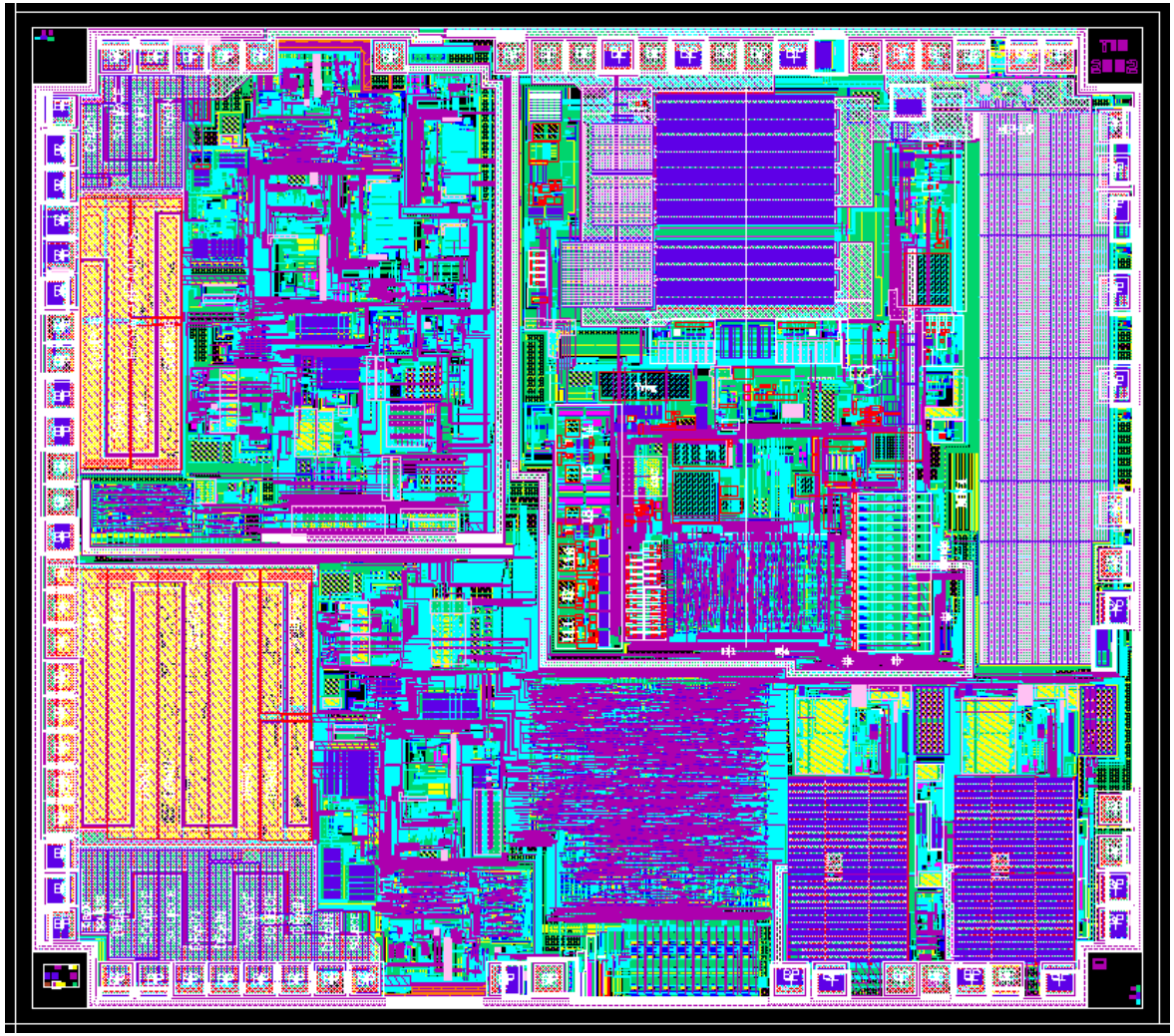


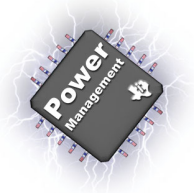
Example – PDA Block Diagram



PDA Example – Integration Power Management SOC

- Dual Buck (1A/.4A)
- Dual charger supply (wall and USB)
- Dual LDO (200mA)
- I^2C Interface for Dynamic Voltage control
- GPI/O port expander





Summary

- Advance processes/performance features drive unique application enhancements
  - Process: Embedded power FETs, thick copper interconnect, lower-voltage operation and mixed analog/dense digital capability
  - Performance: “Predictive Gate Drive”
- Universally “single-chip solutions” will be difficult to achieve
- Application base is expanding in response to IC technology