Xilinx Spartan-II FPGAs in HomeRF Products

XILINX®

Chaos in the HN Marketplace

- Multiple broadband & multiple Home LAN technologies
- Too Many Standards & Too Many Specs

	RF - Wireless	Phoneline	Powerline
Pros	Mobility - UNTETHERED Broad geography support at specific frequencies Can compliment a wired network with bridging	Low cost and fast (10Mbps+) Strong Industry Alliance (HPNA) Dedicated home bandwidth Voice and data share existing lines	Electrical outlets in every room easy connection for non-PC appliances Low cost - will drop with silicon integration High performance (up to 10Mbps)
Cons	Relatively expensive - getting cheaper Distance limits & wall attenuation (150 ft/10 barriers) Security must be addressed Prone to narrowband interference	Phone jacks not near every PC in home Different phone lines (numbers) isolated International deployment issues	Must be robust in hostile environment (noise, stubs, vnet) International deployment issues (Regulatory issues) Security must be addressed Standards need to be addressed
Snapshot Take Away	International Solution, Mobile in North America	Low-cost desktop solution for North America	Ideal for non-PC devices

Chaos in the HN Marketplace

- Three Major Wireless Consumer Home Networking Campaigns are Racing in Separate Directions
  - Wireless LAN/Ethernet, HomeRF & Bluetooth technologies vary in data rate, range, frequency & marketplace aimed for

Technology		Data Rate (Mbits/sec)	Range (meters)	Frequency (GHz)	Technology Aimed For
Wireless LAN/ Wireless Ethernet	802.11	2	100	2.4	Office Enviornments
	802.11b	11	100	2.4	
	802.11a	~40	TBD	5	
Bluetooth	802.15 (Bluetooth)	<1	10	2.4	Consumer, short-range, wireless personal-area technology
	802.15 (high-rate)	20+	TBD	2.4/5	
Home RF	HomeRF	1.6	50	2.4	Home Space
	HomeRF (next gen)	10	50	2.4	

Home Networking Today

- Growing chaos in this emerging technology
  - Solutions are just coming to market
  - Leading players are showing indecisiveness towards different varying technologies
    - Building independent solutions
    - Participation in multiple consortiums
    - Different wireless standards for same frequency band
- Interoperability is a key factor to market success
- Future revisions already in the works
  - HomePNA is already out with v2.0

Implications of this Chaos...

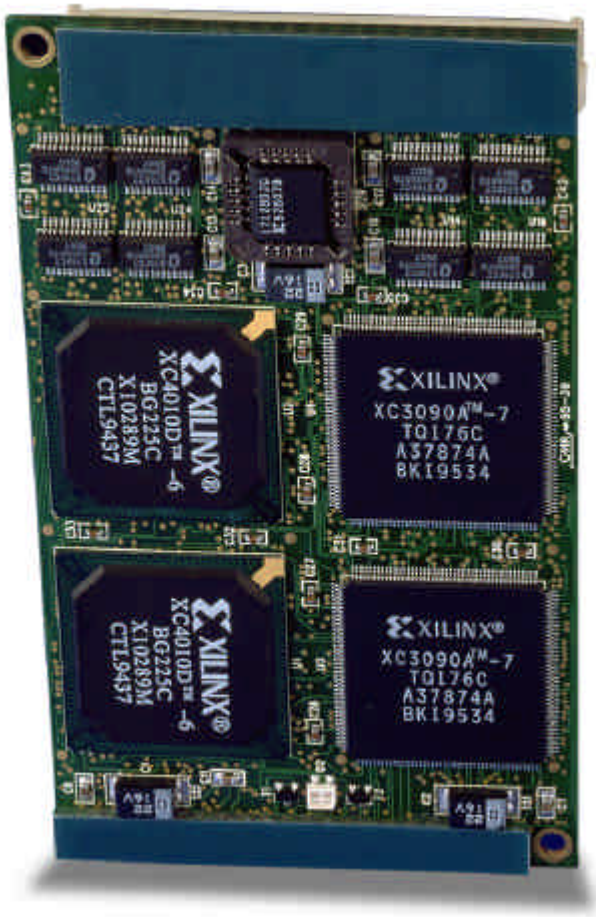
- Brings about an Environment That Guarantees Unanticipated Problems
  - Bugs
  - Incompatibilities
  - The Great Unknown about what is going to be the changes
- Translates to a Steep Learning Curve
  - Virtually mandates a “Ready, Fire, Aim” development model
    - Plan products for the longest life cycles
    - Get a product to market “now”
    - Rapidly integrate refinements and enhancements

Where Does Xilinx Fit In the Electronics Industry

Key components of an electronics system:

- Processor
- Memory
- *Logic*

Xilinx is the Leading Innovator of Complete Programmable Logic Solutions



Strategic Business Model Ensures Focus

- "Fabless" strategy
  - Leading edge IC process technology
  - Wafer capacity at competitive prices
  - Fastest, lowest cost, densest parts
- Independent sales organization (Reps & Distributors)
  - Sales is a variable cost
  - Permits greater reach—over 20,000 Customers
  - Over 10,000 "Feet On The Street"
- Focus on key strengths
  - Product design
  - Marketing
  - Applications & Technical Support

Xilinx Steering Consortiums

Home Phoneline Network CERTIFIED

WLANA The Wireless LAN Association

HiperLAN2 Global Forum

LONMARK INTEROPERABILITY ASSOCIATION

Xilinx Product Portfolio

Advanced Products Group

High Performance
High Density

General Products Division

High Volume
Low Cost

CPLD Division

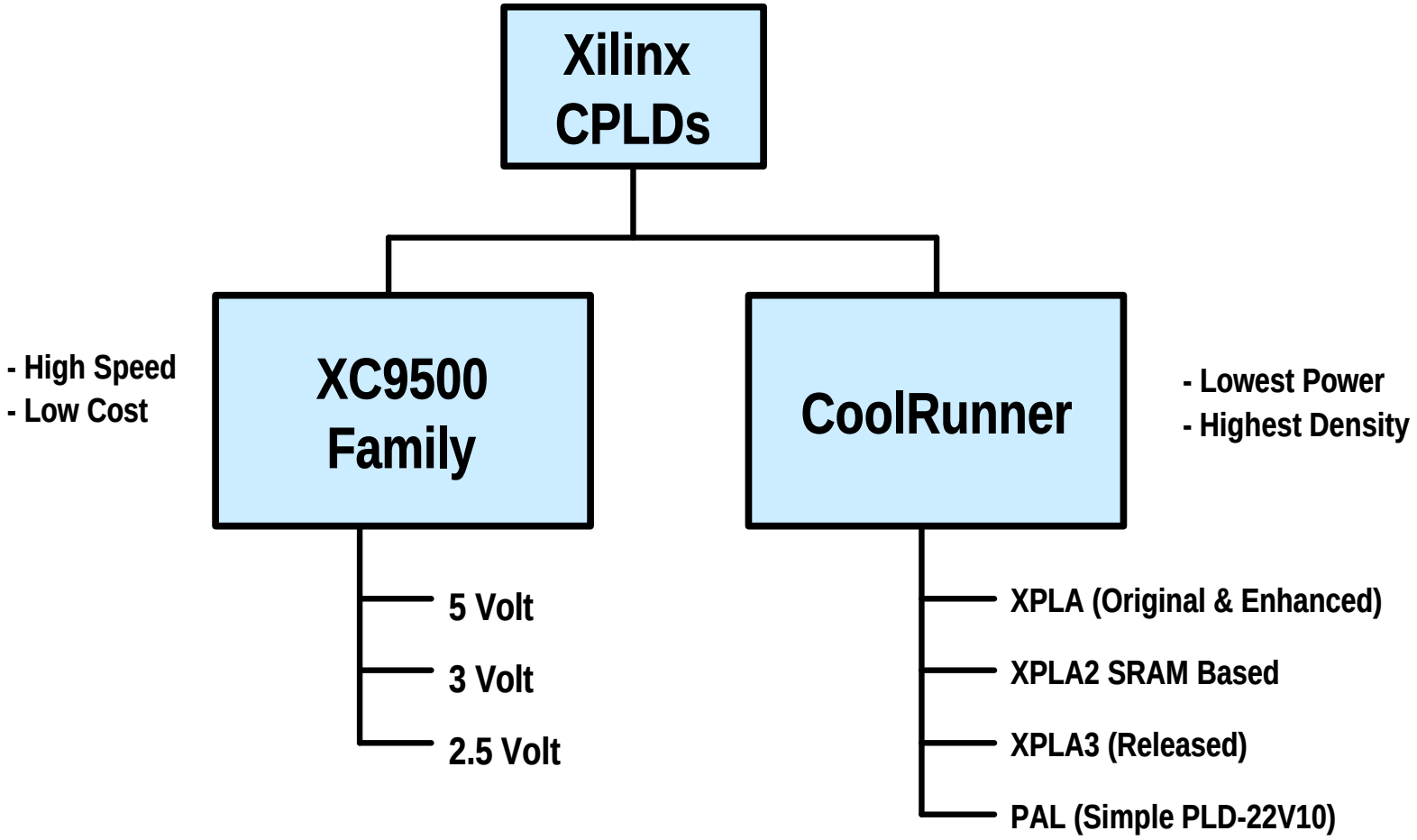
Low Power
Low Cost

Software Solutions

Xilinx - Leader in Core Solutions

	1998	1999	2000	2002	2004
Base Level Functions	- 82xx, UARTs, DMA - 66MHz DRAM, SDRAM I/F - Memory blocks - 29xx - Proprietary RISC Processors	- 8051 - IEEE 1284 - 200MHz SDRAM I/F - SGRAM, ZBTRAM I/F - Multi-channel DMA	- JAVA - Adv 32-bit RISC Processors - 64-bit RISC - DDR/QDR RAM - 622 Mbps LVDS		- 128-bit processors - Reconfigurable processors
Communication & Networking	- Cell assem/delin - CRC - T1 Framer - HDLC - Reed-Solomon - Viterbi - UTOPIA	- 10/100 Ethernet - ATM/IP Over SONET - Cell scram/descram - SONET OC3/12 - ADPCM - IMA	- Network processors - 1Gb Ethernet - SONET OC48/192 - CELP - VoIP - ADSL, HDSL, xDSL - UMTS, wCDMA		- Software Radio - Modems - Neural networking - Emerging Telecom and Networking Standards
DSP Functions	- Basic Math - Correlators - Filters: FIR, Comb - Multipliers - FFT, DFT - Sin/Cos	- DCT - Adaptive filters - Cordic - DES - DES - Divider - NCO - Satellite decoders	- MP3 - QAM - JPEG - Speech Recognition - DSP Processor I/Fs - Wavelet		- MPEG - DSP Functions > 200 MSPS - Programmable DSP Engines
Standard Bus Interfaces	- CAN - ISA PnP - I2C - PCI 32-bit - PCMCIA	- CardBus - FireWire - PCI 64-bit/66MHz - Compact PCI Hot-Swap - PC104 - VME	- AGP - PCI-X 133MHz		- InfiniBand - Emerging High-Speed Standard Interfaces

Xilinx CPLD Families



CoolRunner Technology

- Full density range 32 to 960 macrocells
- World's only TotalCMOS CPLD
  - Bipolar style sense amps eliminated
  - Virtually no static power dissipation
- Advanced PLA Architecture
  - Product term sharing (no redundant logic)
  - No wasted product terms
- 3.3v and 5.0v devices
- ISP/JTAG compatible & full software support

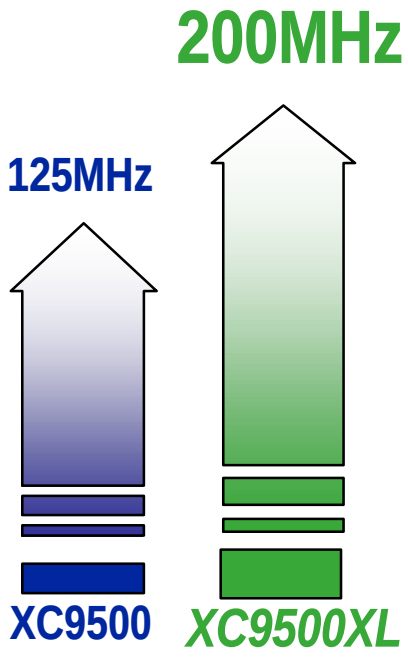
The CoolRunner Advantage

- Industry's lowest power CPLDs
  - Standby current < 100uA
  - High speed TPD = 6 ns
  - Revolutionary XPLA architecture
    - Exceptional routability & pin-locking
    - Fast, predictable timing
  - Small form factor packaging
    - New 0.5mm 56-pin MicroBGA

- No Speed / Power tradeoffs in scaling
  - Can build very large / very fast devices
  - 960 macrocell device @ 7.5 nsec t_{PD}

XC9500XL Key Features

- High performance
  - t_{PD} = 5ns, f_{SYS} = 178MHz
- 36 to 288 macrocell densities
- Lowest price, best value CPLD
- Highest programming reliability
- Most complete IEEE 1149.1 JTAG
- Space-efficient packaging, including chip scale pkg.

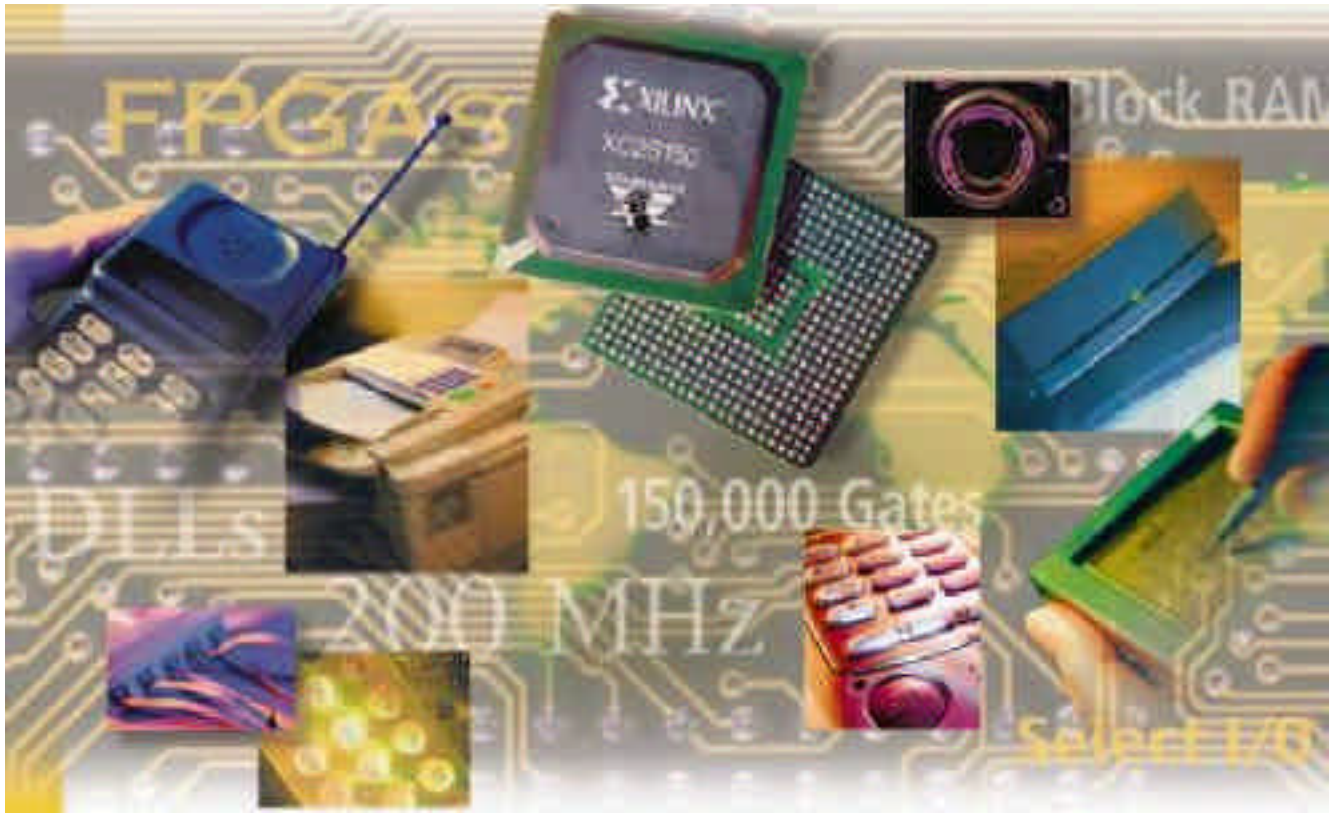


Lowest Price Per Macrocell

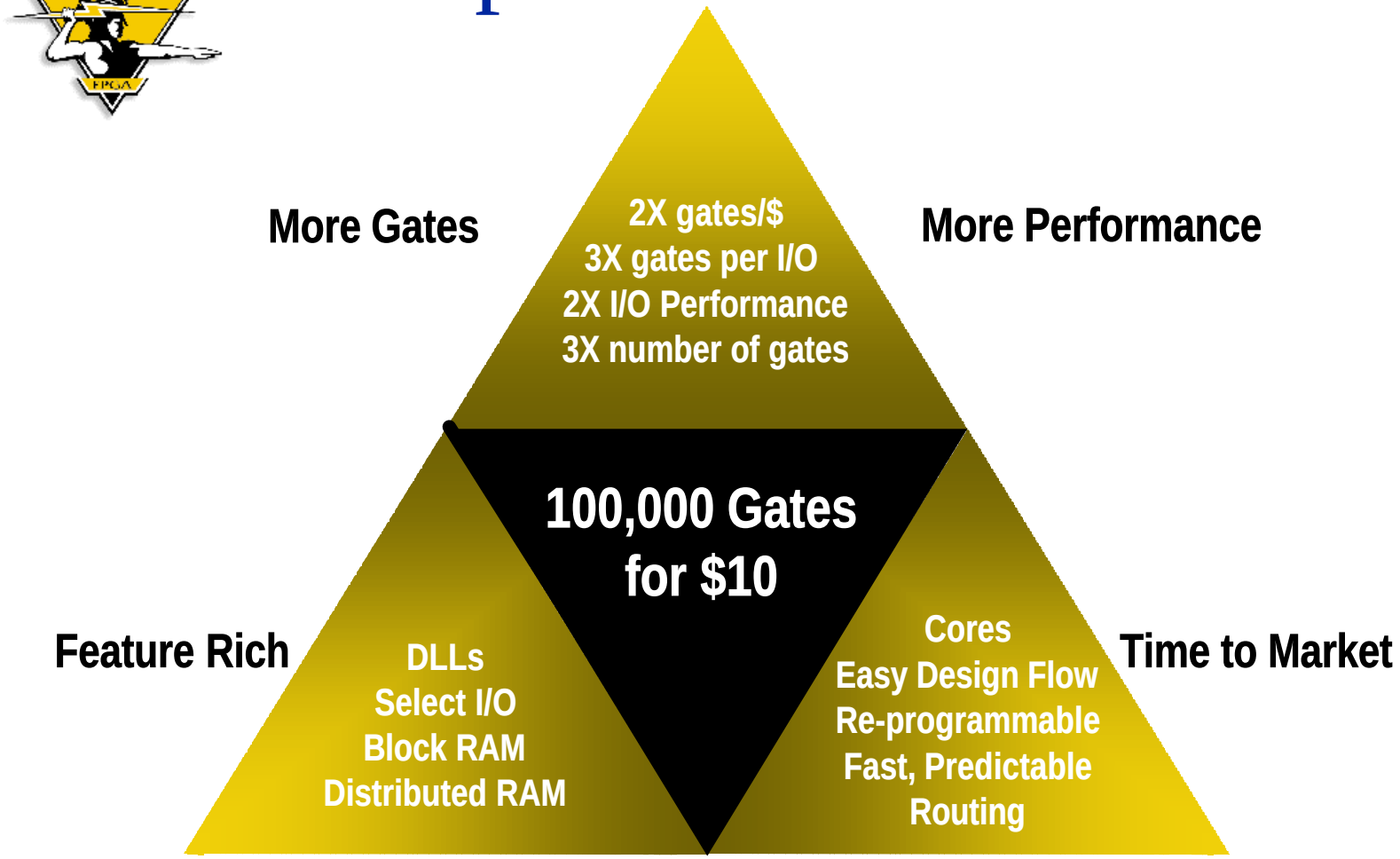
XC9500XL/XV System Features

- I/O Flexibility
  - XL:5v tolerant; direct interface to 3.3V & 2.5V
  - XV:5v tolerant; direct interface to 3.3V, 2.5V & 1.8V
- Input hysteresis on all pins
- User programmable grounds
- Bus hold circuitry for simple bus interface
- Easy ATE integration for ISP & JTAG
  - Fast, concurrent programming times

Introducing the Spartan-II FPGA

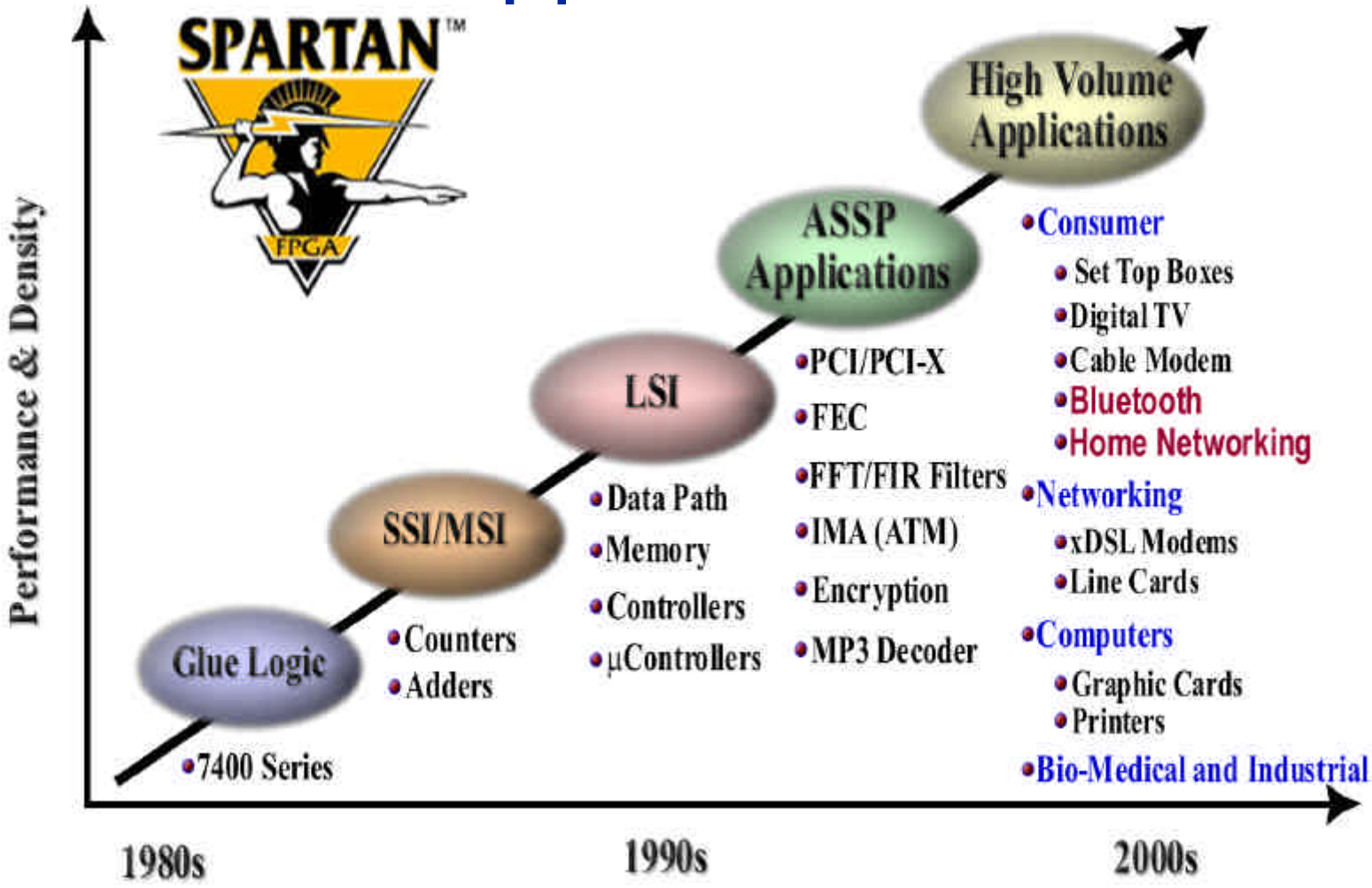


Spartan-II: Extending the Spartan Series



Programmable ASIC/ASSP Replacement!

FPGA Application Trends



Programmable ASIC/ASSP Replacement!

Spartan-II - Architecture Overview

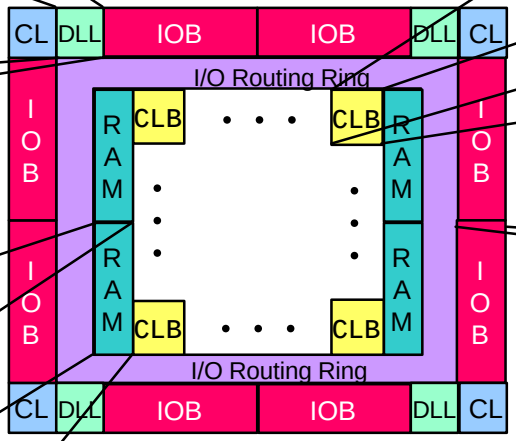
Delay Locked Loop (DLL)

Clock Management:

Multiply clock
Divide clock
De-skew clock

Configurable Logic Blocks (CLB)

Configurable Logic Block Array and Distributed RAM



Select I/O™ Technology

Chip to Backplane
PCI 33MHz 3.3V
PCI 33MHz 5.0V
PCI 66MHz 3.3V
GTL, GTL+, AGP
Chip to Memory
HSTL-I, HSTL-III
HSTL-IV
SSTL3-I, SSTL3-II
SSTL2-I, SSTL2-II
CTT
Chip to Chip
LVTTL, LVCMOS

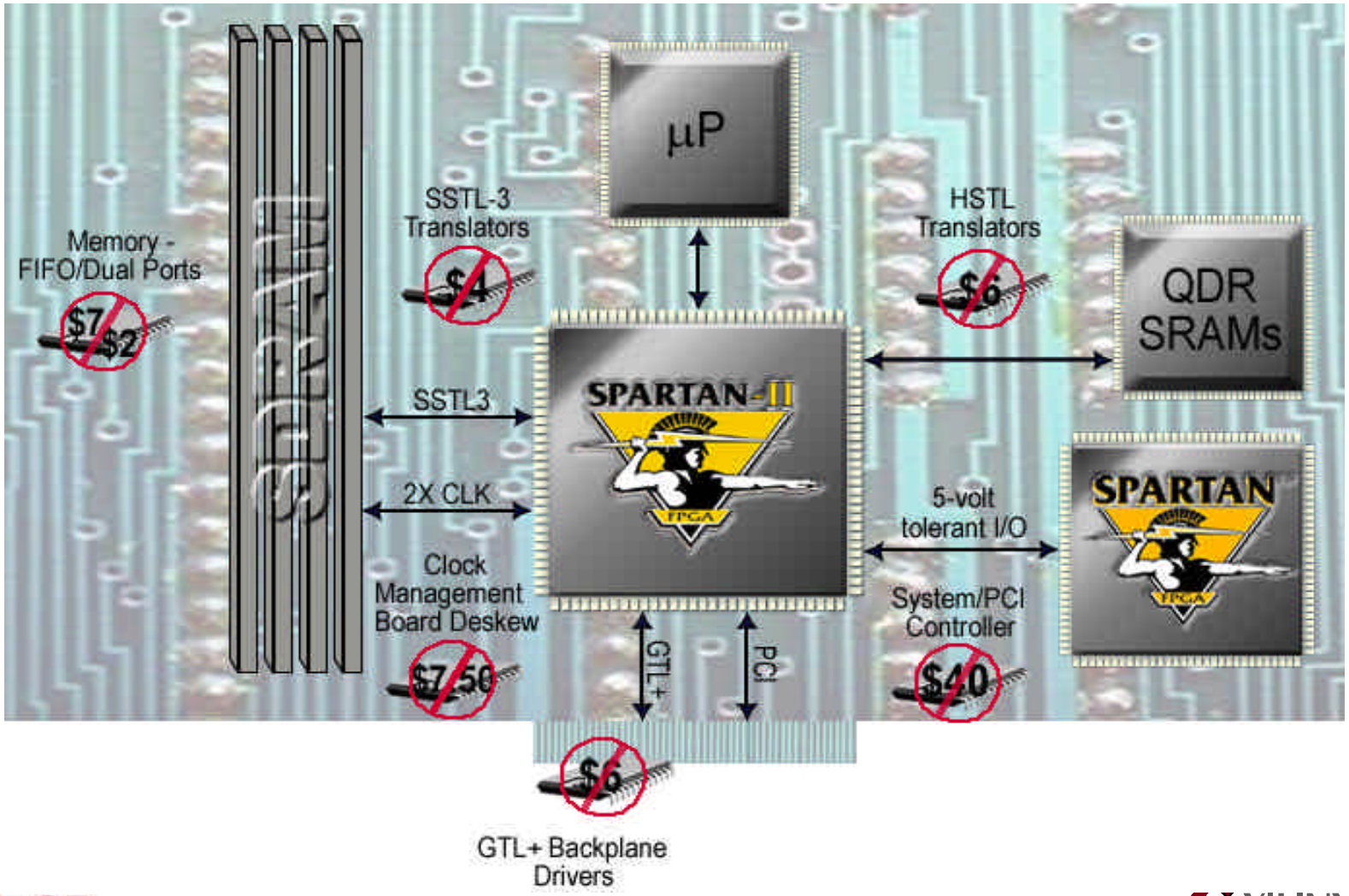
Block Memory

True Dual-Port™ 4K bit RAM

4Kx1
2Kx2
1Kx4
512x8
256x16

"The Spartan-II family, in our opinion, may be the closest that any FPGA has come to being at a low-enough price to compete against an ASIC"
--Dan Niles, Industry Analyst

Spartan-II - System Integration



Spartan-II Core Support

- On-chip memory & storage
  - Distributed, BlockRAM, FIFOs
- Bus products
  - PCI (64- & 32-bit, 33/66MHz), Arbiter, CAN bus interface
- DSP Functions (FIR filter)
- Error correction
  - Reed-Solomon, Viterbi
- Encryption (DES & triple DES)
- Microprocessor
  - ARC 32-bit configurable RISC, 8-bit 8051 microcontroller
- Memory controllers (10+)
  - SDRAM, QDR SRAM
- Communications
  - ATM (IMA, UTOPIA), Fast Ethernet (MAC)
- Telecom
  - CDMA matched filter, HDLC, DVB satellite, ADPCM speech codec
- Video & image processing
  - JPEG codec, DCT/IDCT, color space converter
- UARTs

Spartan-II End Applications

- Consumer
  - Set Top Boxes/Digital VCRs
  - DTV/HDTV
  - Digital Modems
    - xDSL, Cable, Satellite
  - Home Networking products
  - Bluetooth appliances
  - LCD/Flat-Panel Displays
- Networking
  - Telecom linecards
  - DSLAMs
  - LAN Hubs/Switches
  - SOHO Routers
  - Cellular base stations
- Computer/Storage
  - Printer/Scanner
  - Multi-function office equipment
  - Storage devices
  - Home servers
  - Audio/Video add-in cards
- Industrial/Medical
  - Medical Imaging
  - Industrial automation/control
  - Data acquisition
  - Video capture/editing
  - Automated test equipment
  - Automotive Info-tainment systems

System Block Diagrams for HomeRF Solutions

Block Diagram Template / Index

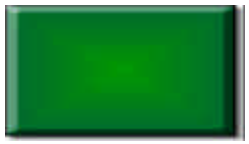
Xilinx Solution

Or

Non-Xilinx Components

Memory

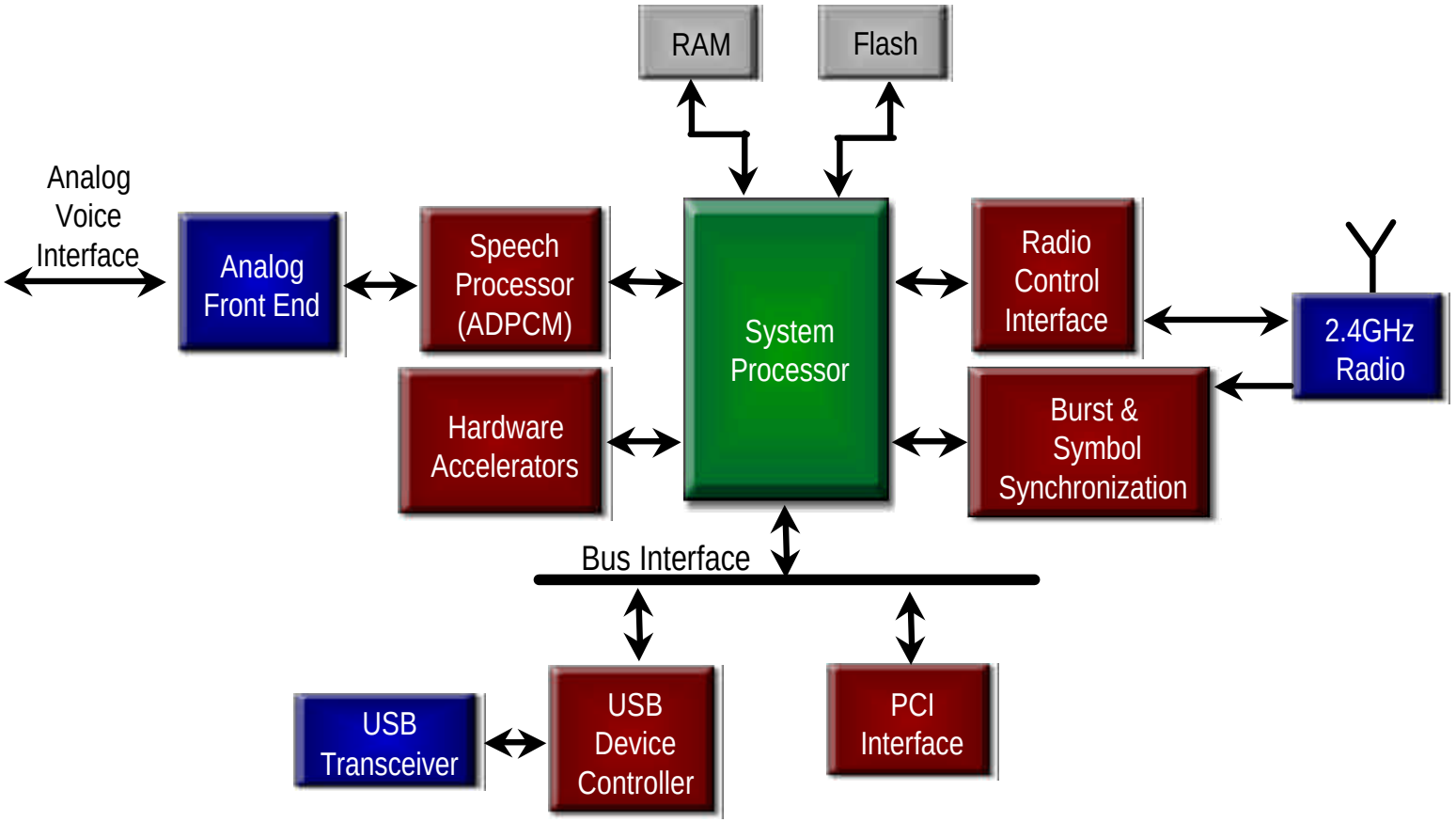
Mixed Signal / RF



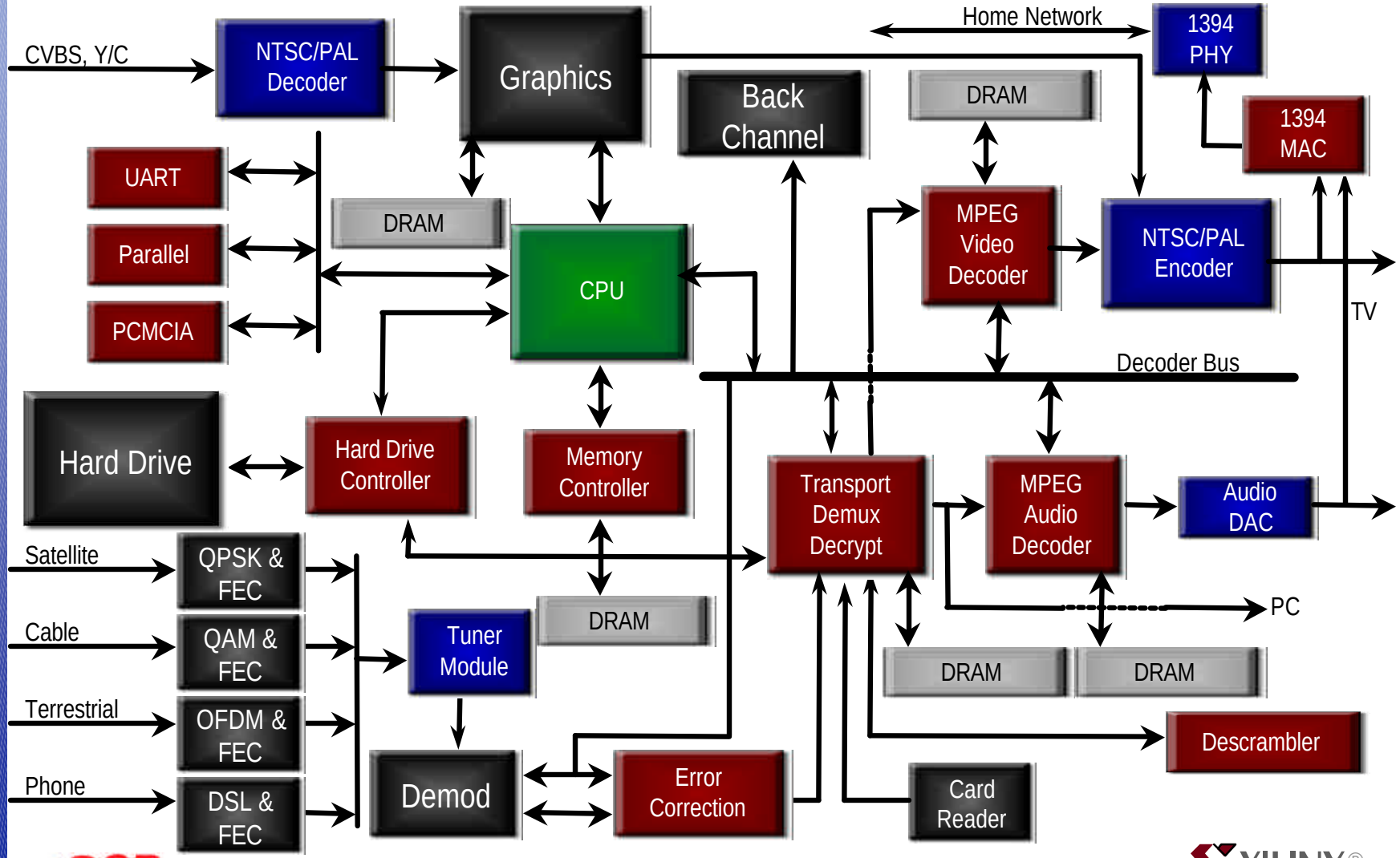
CPU

Embedded Chip

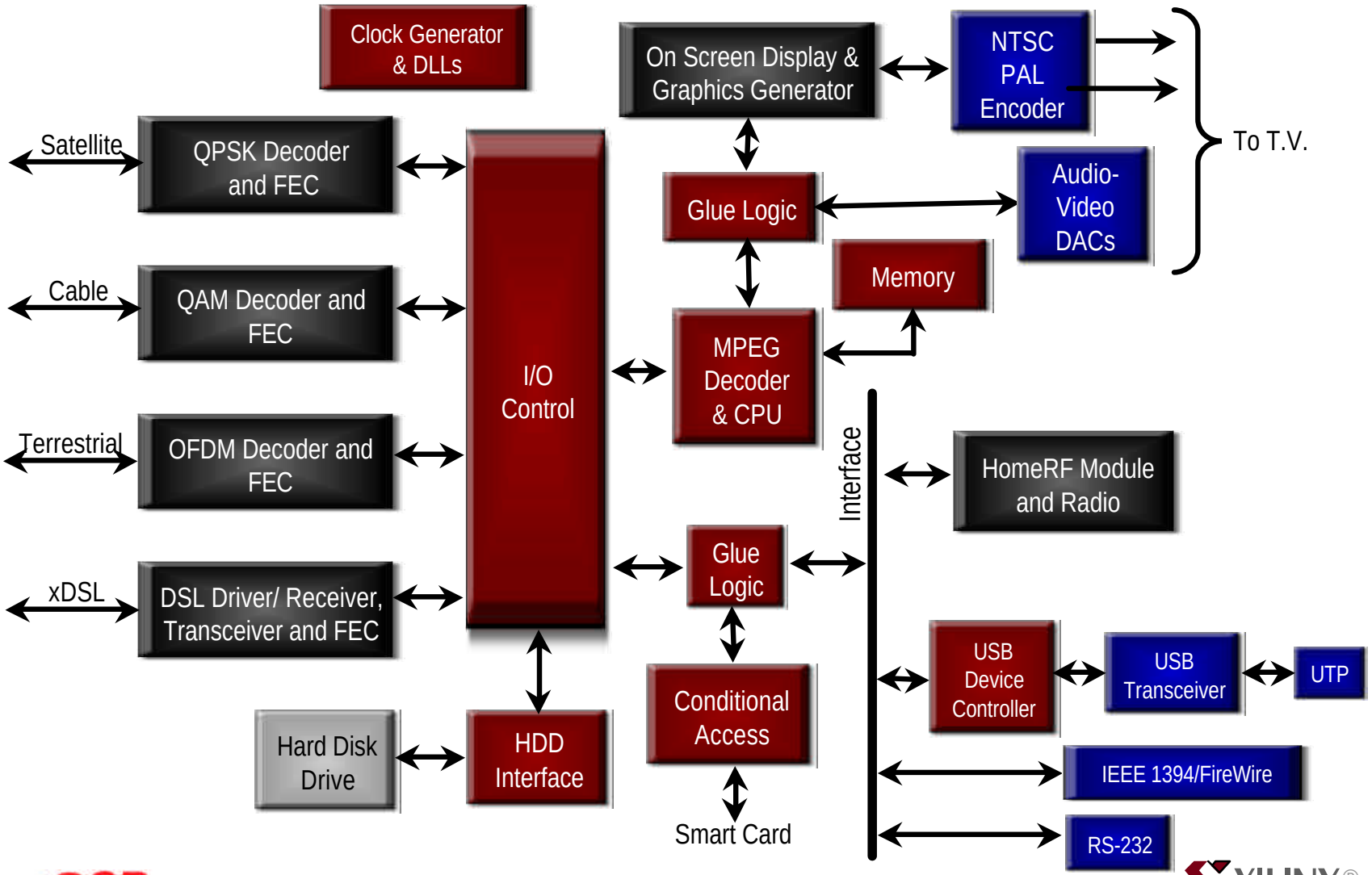
HomeRF Module



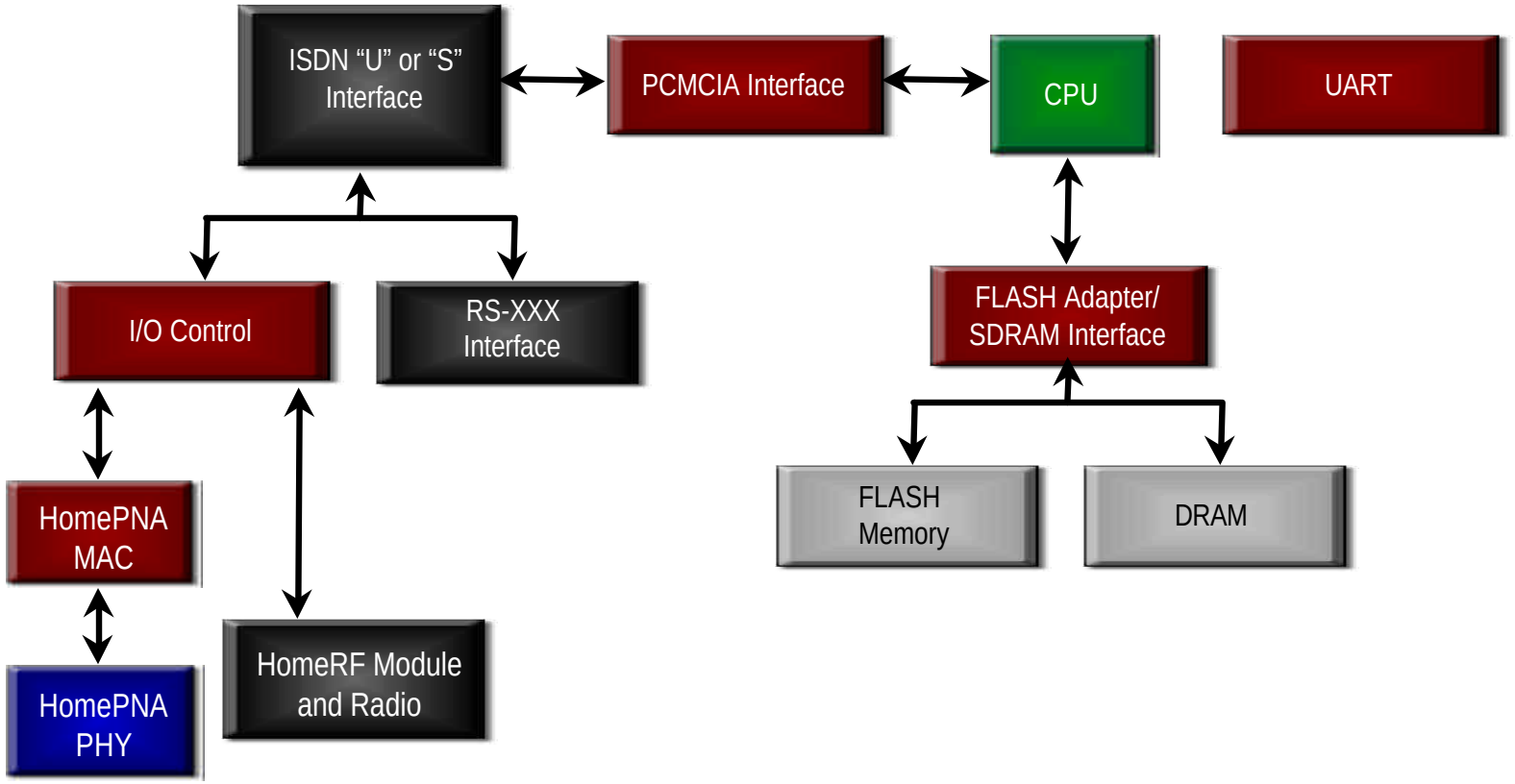
“Super” Set Top Box



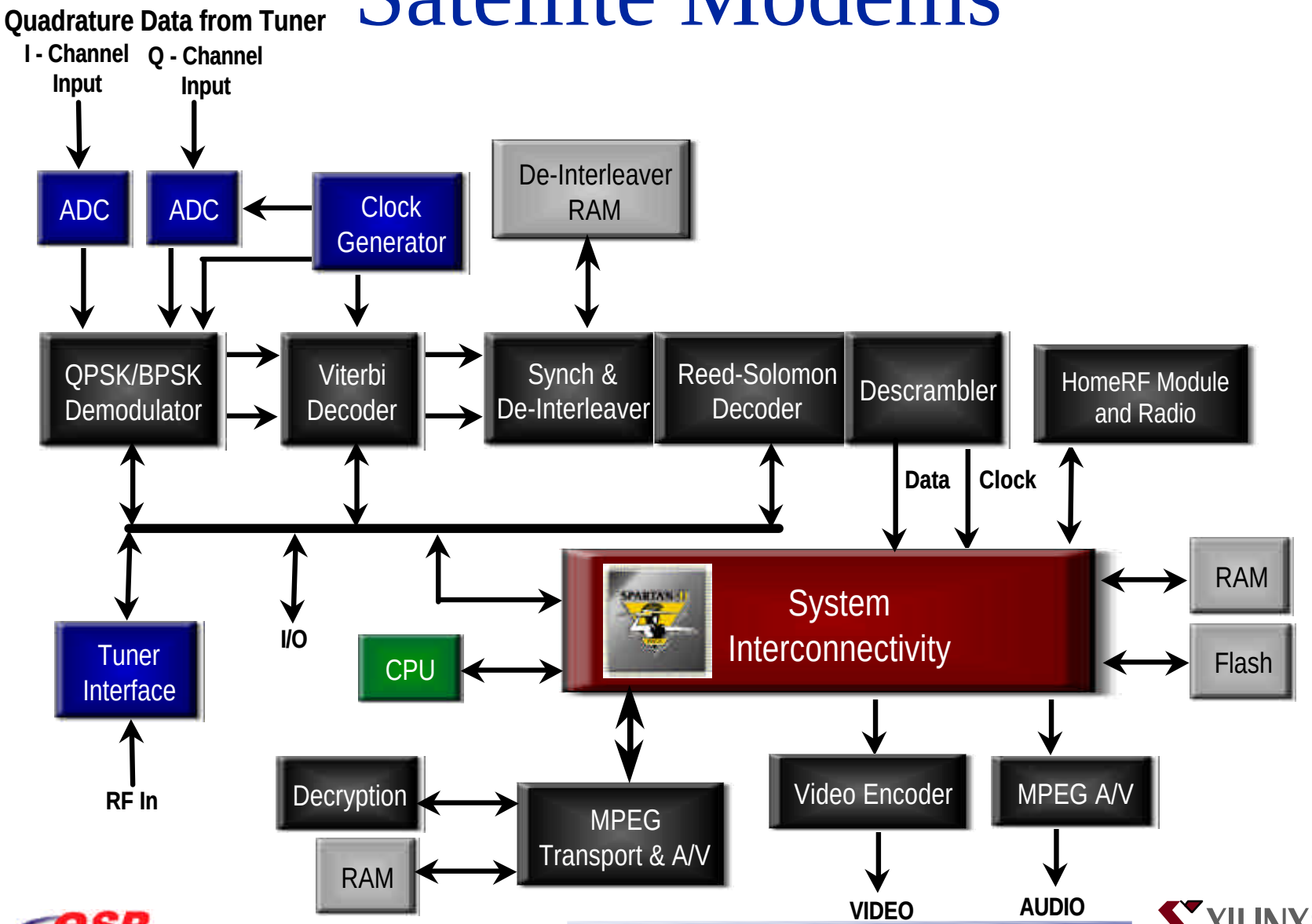
HomeRF- Based Residential Gateway



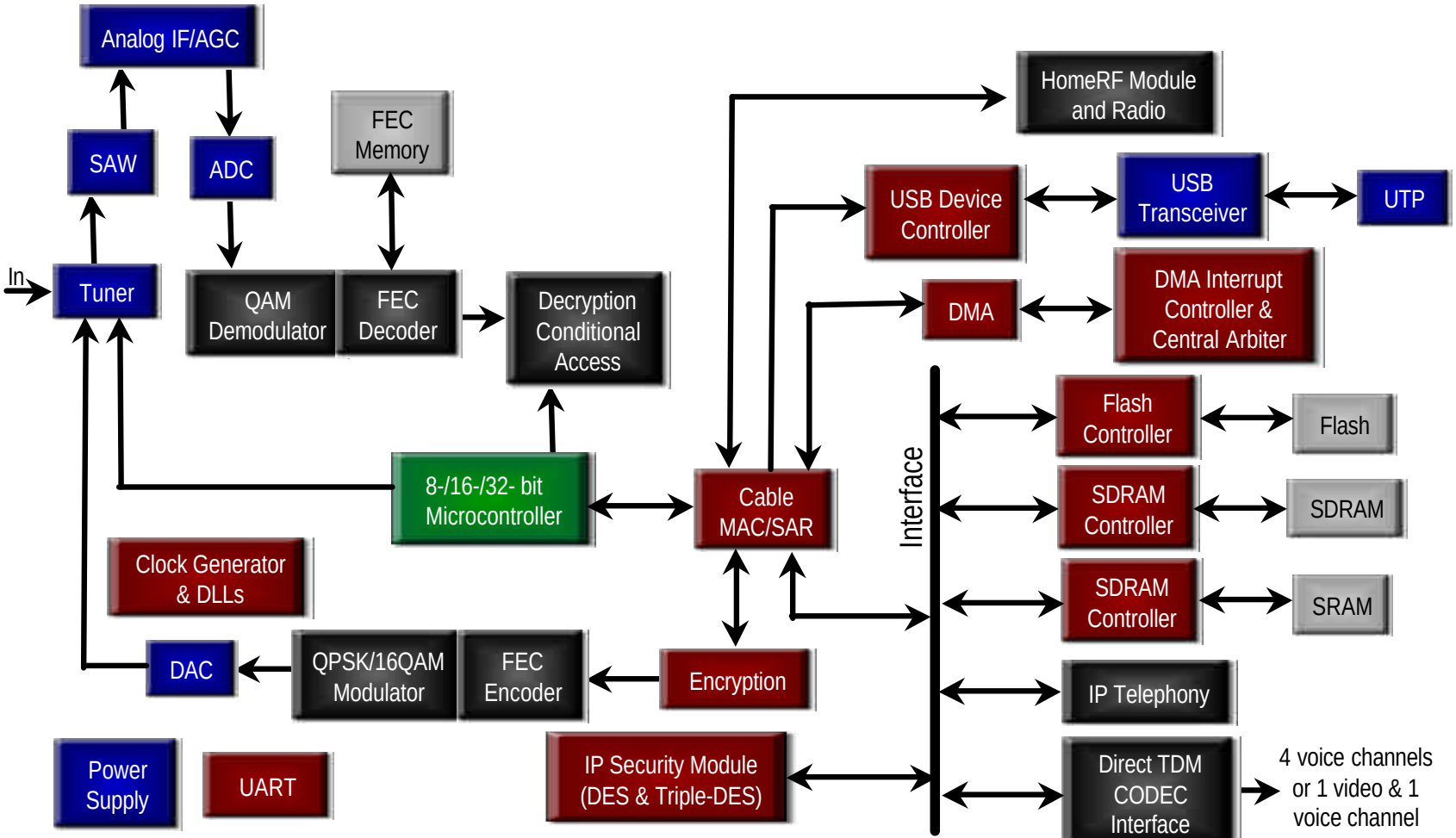
ISDN Modems - HomeRF Residential Gateway



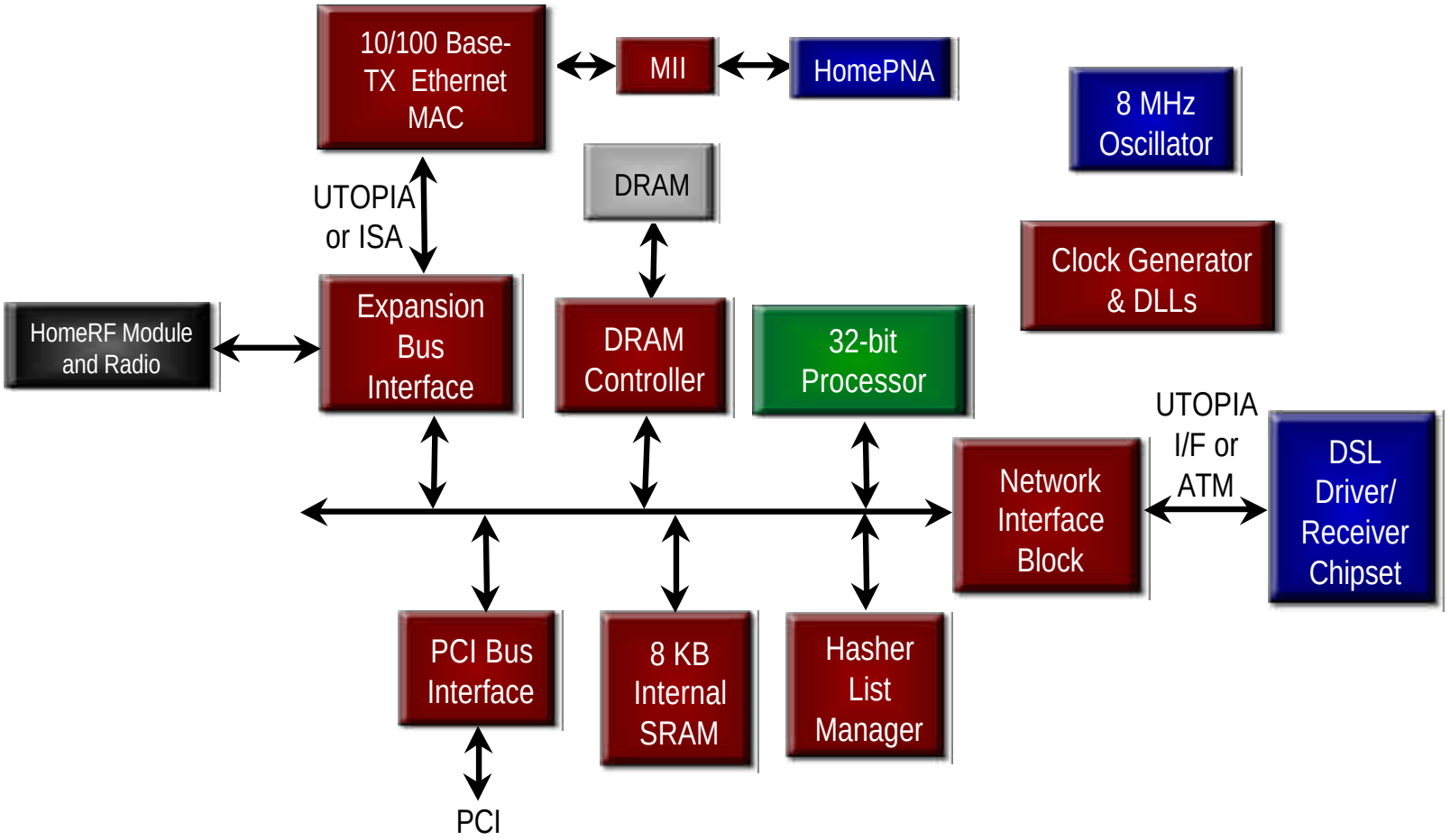
Satellite Modems



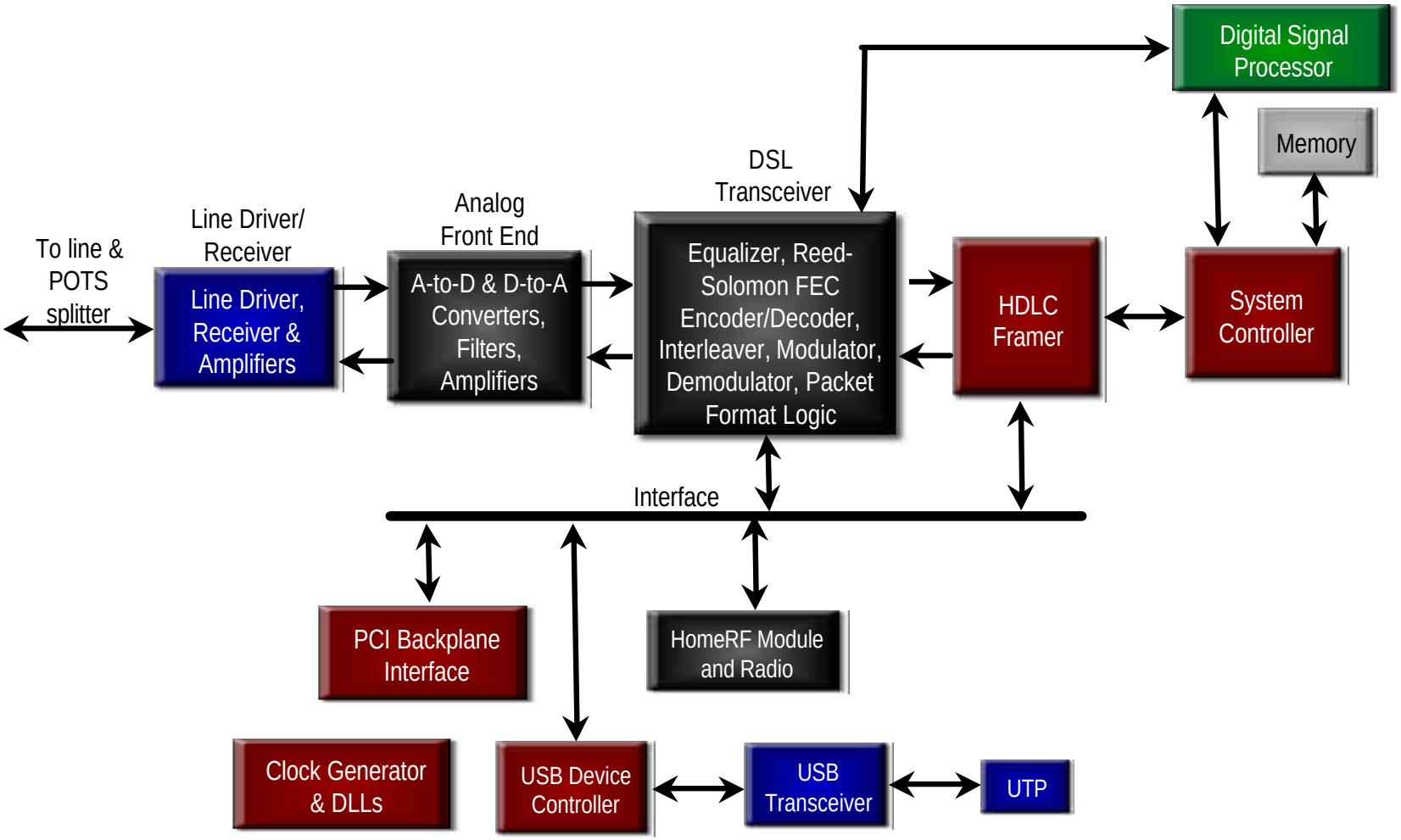
HomeRF - Cable Modem Residential Gateway



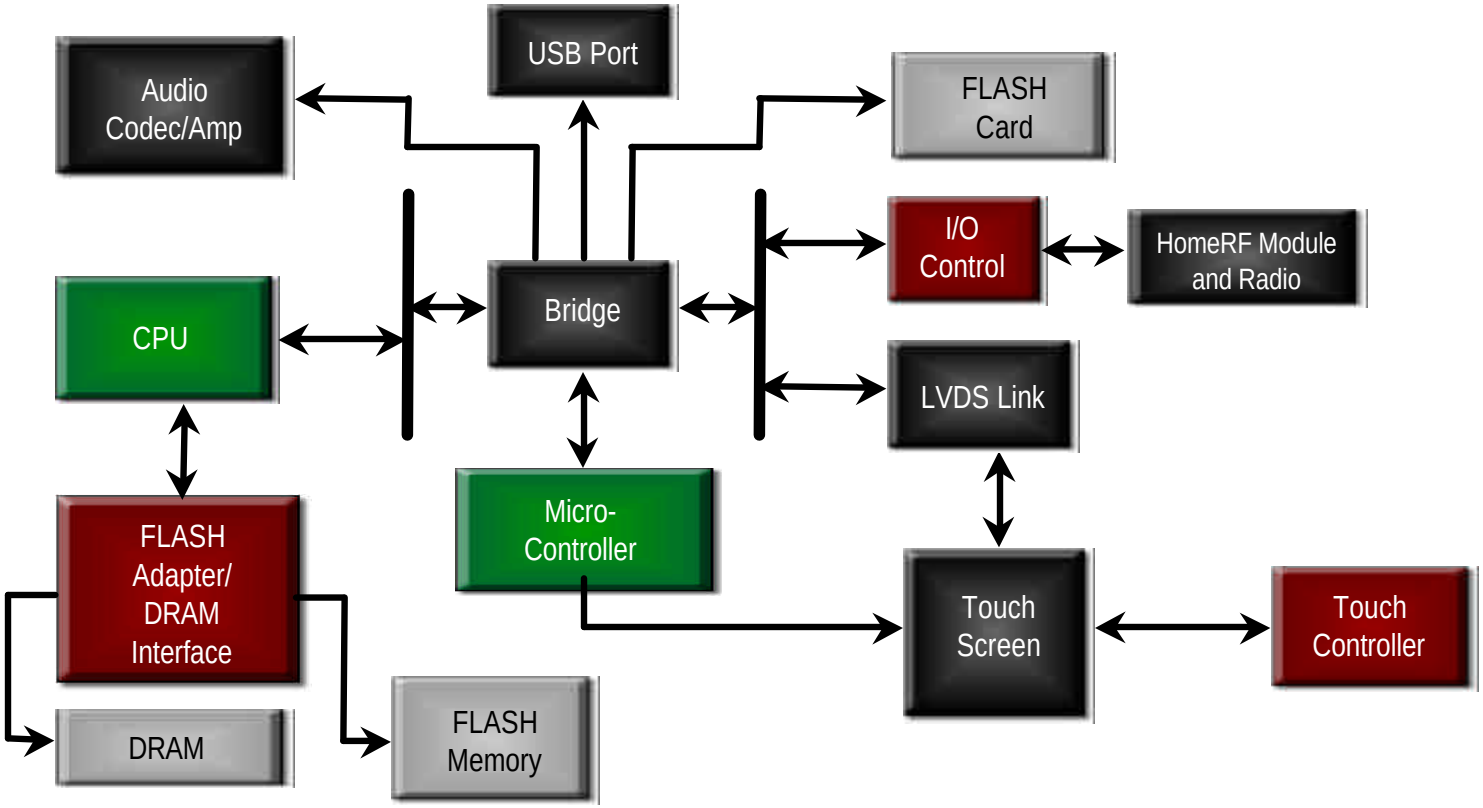
DSL Modem - HomeRF Home Gateway



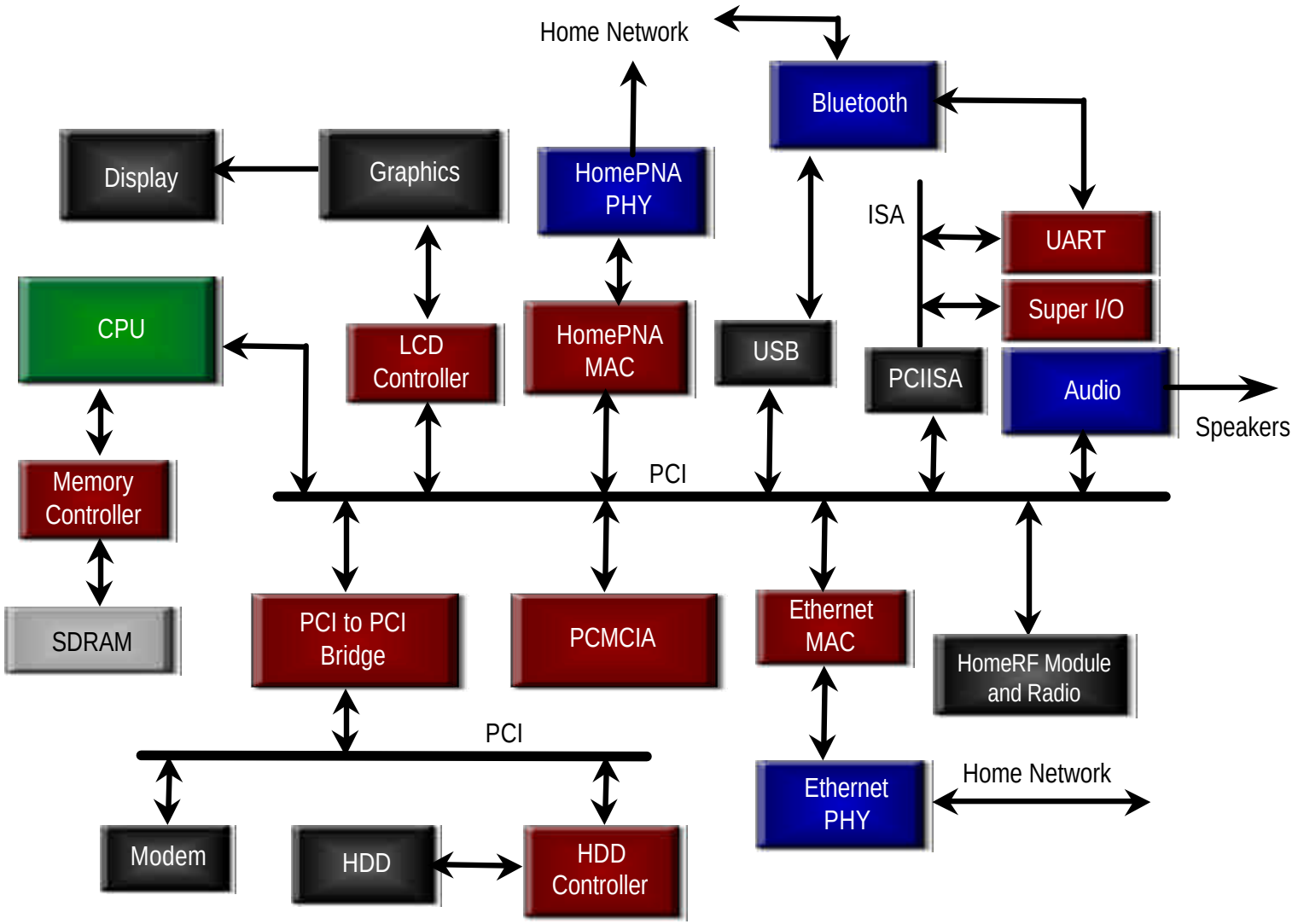
DSL CPE (Customer Premise Equipment)



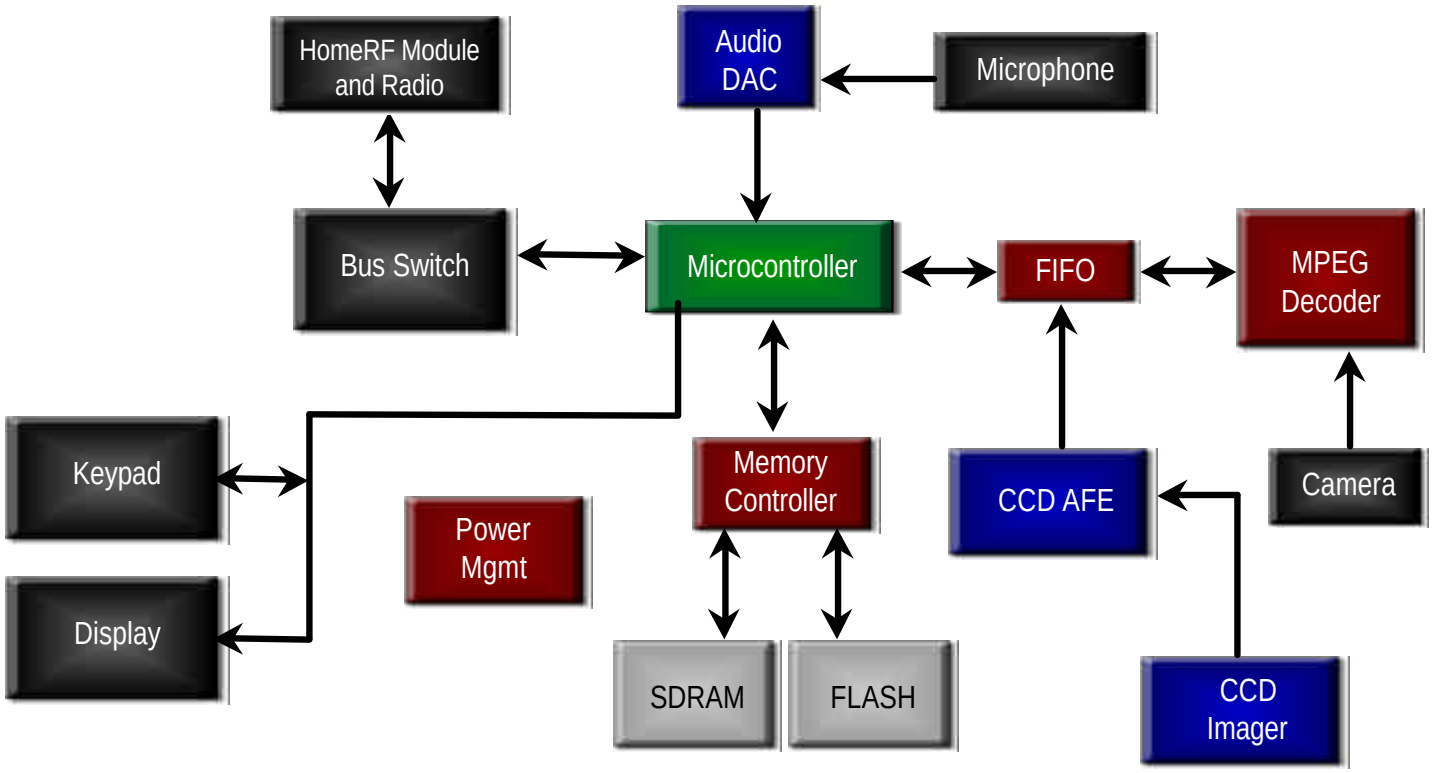
Web Pad / Fridge Pad



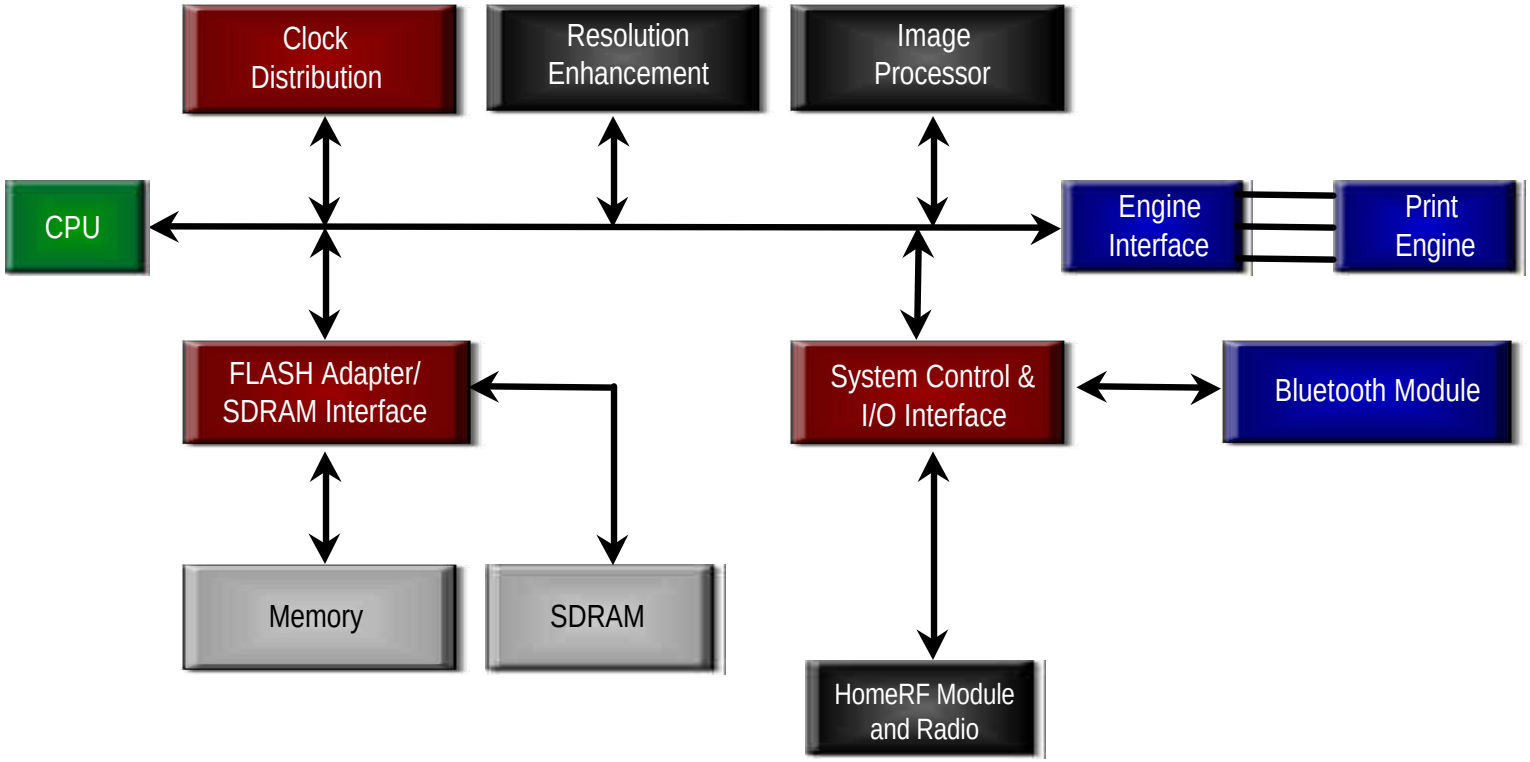
PC


Home Network
Bluetooth
Display
Graphics
HomePNA PHY
ISA
UART
CPU
LCD Controller
HomePNA MAC
USB
Super I/O
PCIISA
Audio
Speakers
Memory Controller
PCI
SDRAM
PCI to PCI Bridge
PCMCIA
Ethernet MAC
HomeRF Module and Radio
PCI
Ethernet PHY
Home Network
Modem
HDD
HDD Controller

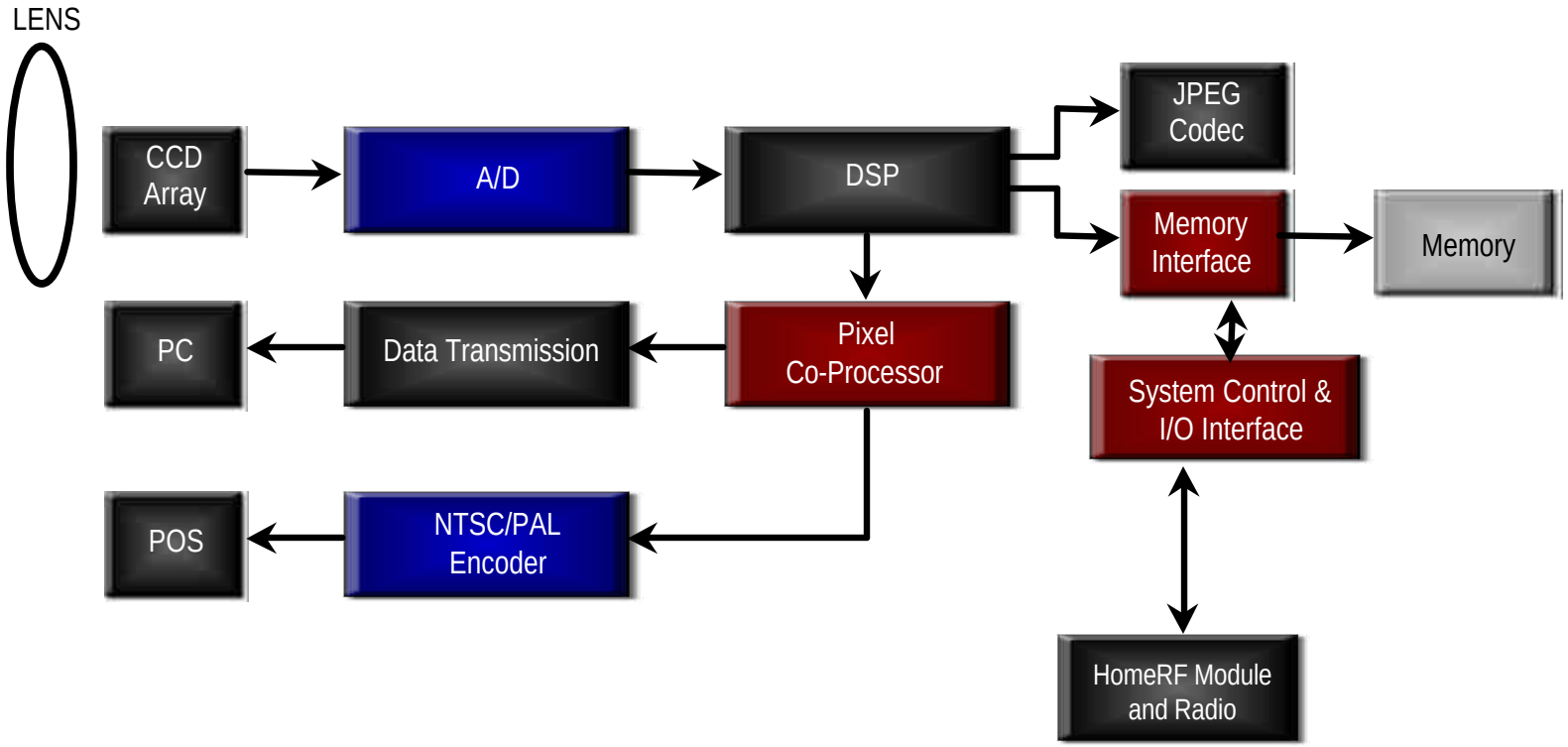
Home Security System



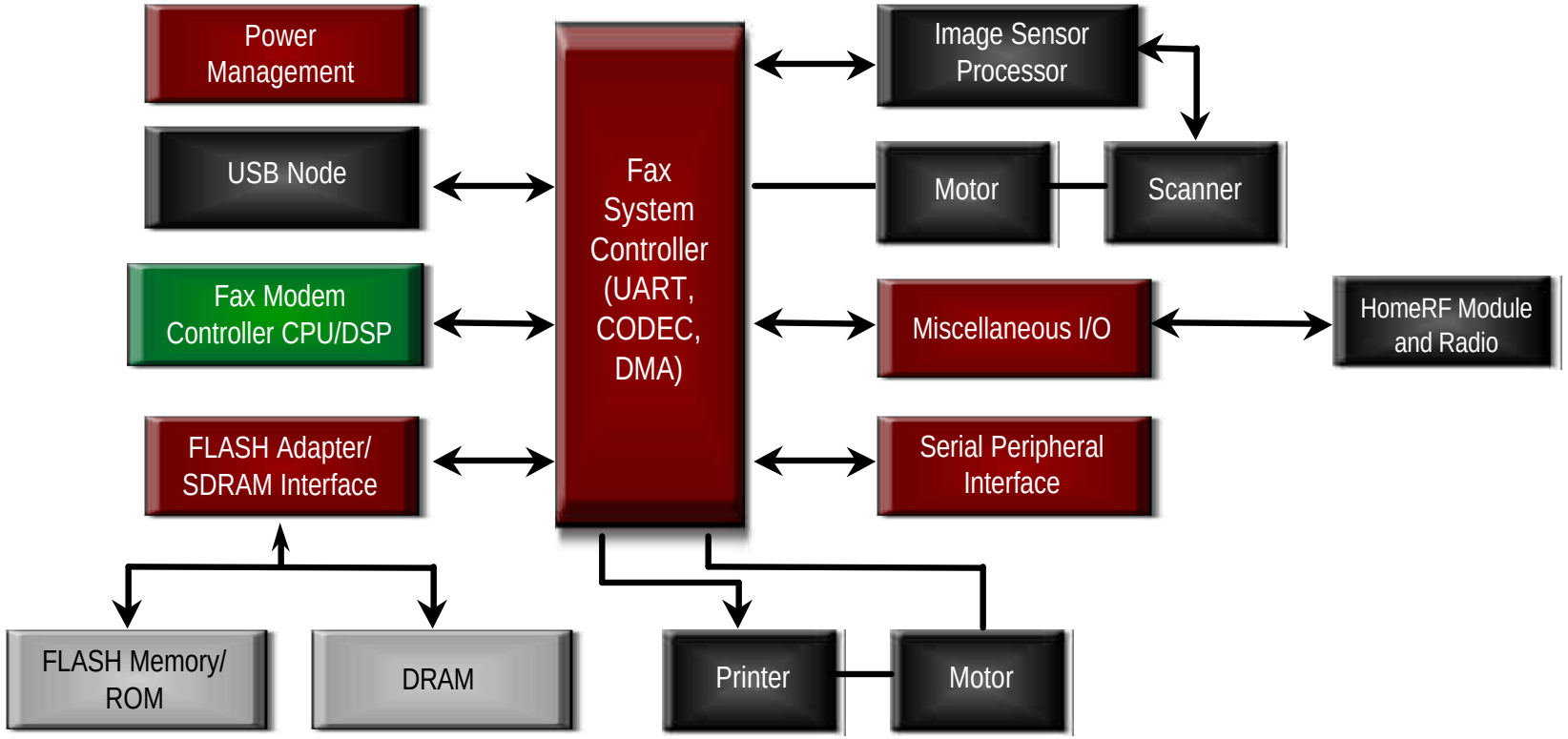
Printer


Clock Distribution
Resolution Enhancement
Image Processor
CPU
Engine Interface
Print Engine
FLASH Adapter/ SDRAM Interface
System Control & I/O Interface
Bluetooth Module
Memory
SDRAM
HomeRF Module and Radio

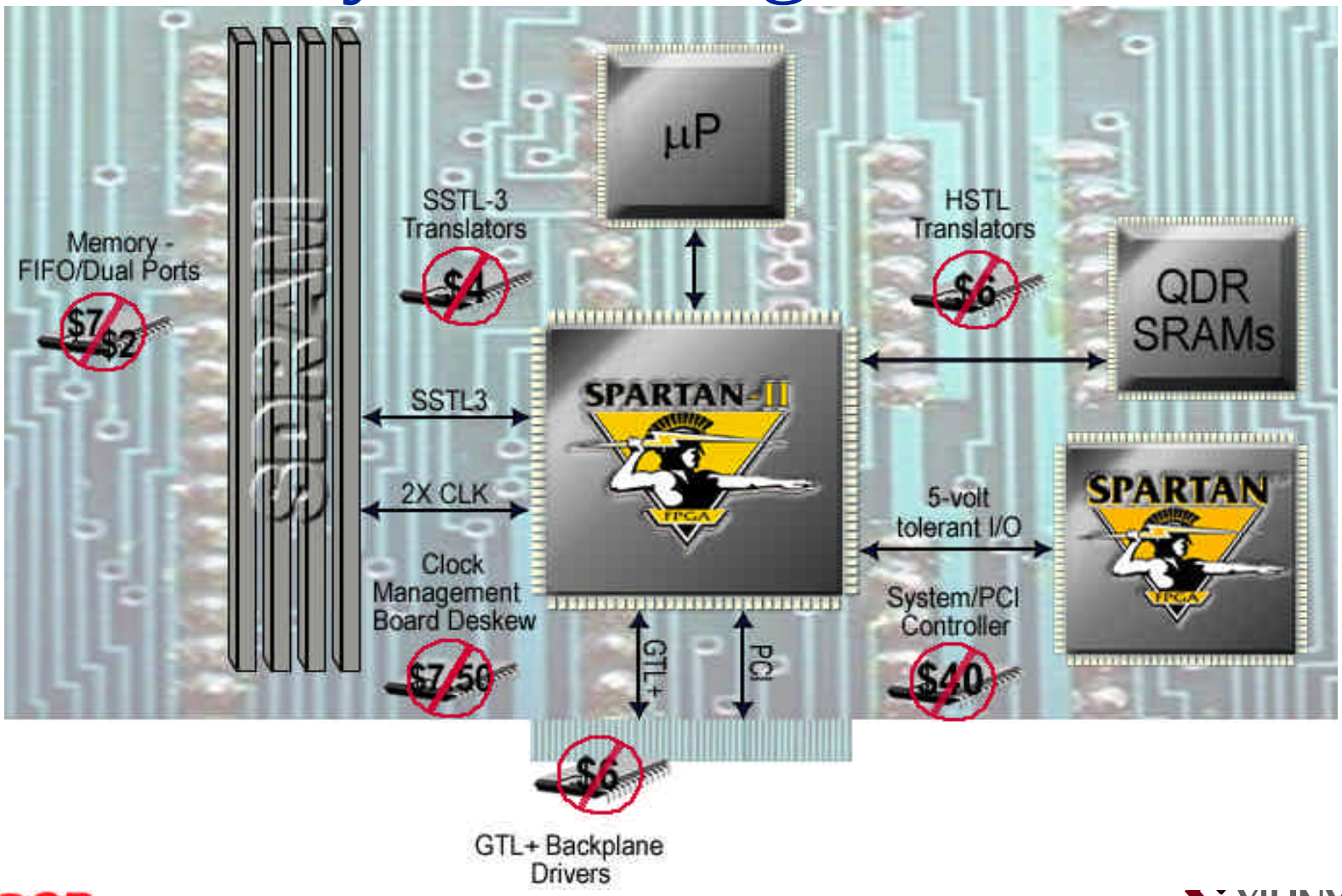
Scanner


LENS
CCD Array
A/D
DSP
JPEG Codec
Memory Interface
Memory
PC
Data Transmission
Pixel Co-Processor
System Control & I/O Interface
POS
NTSC/PAL Encoder
HomeRF Module and Radio

Multi-Function Peripheral



Spartan-II Features Provide System Integration



Where does Xilinx fit in HomeRF?

- Everything!!
  - Enabling broadband local loop in digital modems
    - xDSL, cable, satellite
  - Residential gateways
  - Bridges
    - Enabling different technologies to co-exist
  - Enabling the information appliance network within information appliances
    - Web tablets, screen phones, PCs, printers, scanners

Spartan-II Solutions for HomeRF-Based Products

- I/O control
  - Multiple front end interfaces
  - Multiple back end interfaces
- Hard disk drive interface
- Clock distribution
  - DLLs
- MPEG decoder
- Ethernet MAC
- Error correction
  - Reed-Solomon, Viterbi
- PCI
- Memory solutions
  - On-chip Distributed memory, BlockRAM
  - Memory controllers
- CPU / microcontroller
- HDLC controller
- ADPCM
- Color Space Converters
- Glue logic & system integration
  - LCD controllers, UARTs, DMA controllers

Programmable Solutions Advantages

Xilinx Programmable Solutions Provide Several Benefits

- Time to market
  - Consumer devices require fast time-to-market
  - ASICs & ASSPs take 12-18 months to spin out
- Flexibility
  - Product customization to meet customer needs
  - Accommodate multiple standards & spec updates/changes
  - Feature upgrades
- Testing and verification
  - Re-programmable allows risk aversion
  - Your solutions are built on a proven FPGA technology with pre-verified silicon and IP that guarantees performance

Xilinx Programmable Solutions Provide Several Advantages

- Xilinx On-line - field upgradability
  - Remote update of software and hardware
  - Results in increased lifetime for a product (time-in-market) and allows new, interesting applications
  - Enable product features per end-user needs
- Issues in creating a stand-alone ASIC/ASSP
  - Choosing the right solution
  - Product customization
  - Development cost and amortization
- Low cost

Lifecycle Component Logistics

- Xilinx is an assured source of supply
  - Spartan FPGAs are high volume standard parts
  - Xilinx is a Strategic customer to our fab partners
  - If a device is retired, designs are quickly portable
- Xilinx's solutions reduce exposure to component supply issues
  - Designs can be quickly adapted to efficiently address component supply problems
    - NAND to NOR type Flash support for example
  - Gives latitude in maintaining a cost effective BOM in dealing with the allocation, end of life & generational migration realities of today's component market

Specification Changes

- Emerging markets are exposed to multiple standards and specification changes
  - DSL Modem market
    - 6 different variations
  - DTV market
    - 18 different formats

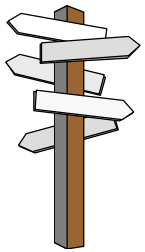
U.S. Networks Select Digital Broadcasting Format

ABC	720-Progressive. For non-HDTV broadcasts, ABC will use 480-line progressive format.
CBS	1,080-Interlaced. Wants to be compatible with HDTV sets as well as normal quality formats on regular analog television sets. Digital broadcasting will begin at select CBS-owned stations in the fall of 1998. By November 1999, CBS plans to be broadcasting digitally into 43% of U.S. households. For other broadcasts, CBS will use the 480-line Interlaced format.
NBC	1,080-Interlaced. NBC is leaning toward 480-line progressive for non-HDTV broadcasts.
FOX	720-Progressive. For non-HDTV broadcasts, Fox will use the 480-line progressive format.
PBS	For HDTV, PBS is undecided. For non-HDTV broadcasts, PBS will use the 480-line interlaced format.
Local Stations	Will have to conform to their network's format for national programming but can select any format for local programming.

Source: IC Insights

OEM/ Vendor

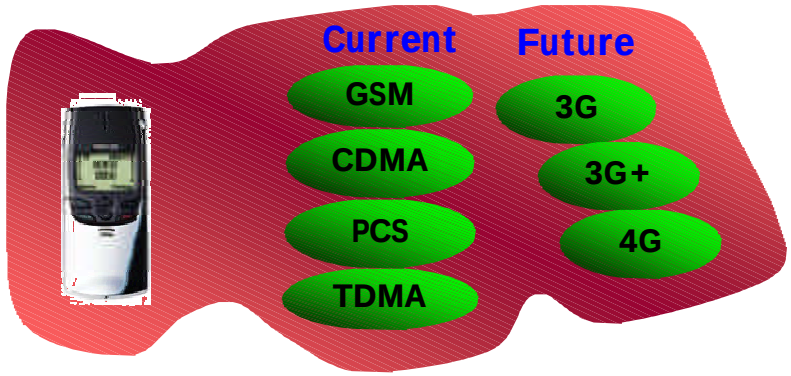
Market



A Programmable Solution Future Proof's Success

New Flexibility from FPGAs

Driving down the cost of consumer products with low cost reprogrammable products



=

Enabling a whole new breed of consumer products

=

Reprogrammable nature allows
- Field upgrades
- Field fixes
  - Mars probe repair from earth
- Support for numerous standards

Xilinx & Replay TV
- Revolutionizing consumer TV

FPGAs, the Unsung Hero

Driving the Consumer Digital Logic Revolution

- The digital consumer world is here
  - Imperatives driving market success
    - Time to market and time-in-market
    - Flexibility
    - Custom digital logic

- Xilinx - The answer for consumer digital applications
  - Introducing the low cost Spartan-II programmable family
    - Cost reduced for the consumer market
    - Fully programmable at the desktop, in the field or in the application
    - Future proofed for changing standards

Xilinx Digital Consumer Logic
A Natural Fit for Home Networking

- Xilinx solutions enable you to thrive in chaos
  - Fastest time-to-market
    - First to market, gains market share and revenue advantage
  - Xilinx Online provides reconfigurability in the field
    - Allows shipped product to support revisions to the spec
    - Enables unique opportunities to add Value
    - Increases life-cycle revenue yield & hence time-in-market
  - Enables rapid product proliferation
    - New designs can be quickly turned into derivatives
  - Feature superior lifecycle component logistics
  - Testing and Verification
    - Proven FPGA technology, software, test benches
- Cost Effective!!!