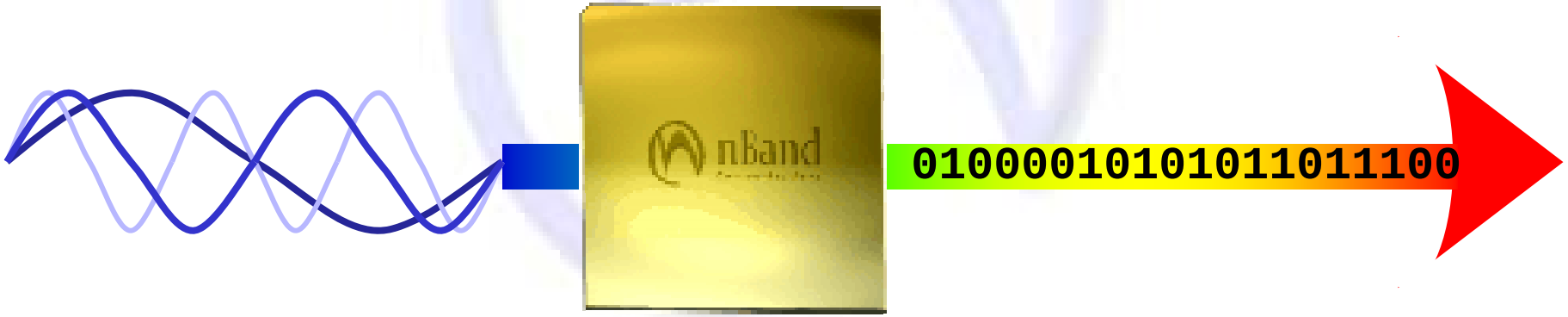
nBand Communications

nBand is a Fabless Broadband Access Chip Company Serving a Multi-Billion Dollar Market



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nBand Overview

- Low cost single chip solution for multi-service broadband access products
- Large, fast-growing broadband market opportunity
  - Semiconductor TAM => $800M ’02, $2.2b ‘03, $9b ‘04
- Strong team (Stanford Telecom, Alcatel, Arraycom, Sun, SGI, Philips, Alantro, 3dfx. . .)
- Disruptive technology
  - nBand fundamentally improves the price-performance, time-to-market, and feature landscape for broadband access products

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Programmable Broadband: Fundamental Improvement in Customer (OEM) Economics

- Rapid Time-to-Market
  - nBand's programmable technology cuts development time by factor of 3
- Reduces system cost
- Increases product longevity (future proofing)
- Lowers risk => insurance against standards changes and field trial surprises
- Fosters interoperability
- Only cost effective multi-protocol solution available
- Eliminates need for ASIC development team

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Programmable Broadband: Fundamental Improvement in Carrier Economics

- Denser, faster, AND lower cost networks
- Dramatically reduces cost of network changes
- Multi-service = reduced churn
- Enables cost effective multi-protocol networks
- Rapid incremental low-cost rollout

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nBand is Positioned to Dominate FBWA

- The incumbents have failed to provide a solution
- Other startups are behind
- nBand has customer traction
- FBWA market characteristics
  - Emerging market with no entrenched competition
  - Changing standards and rapid innovation
  - Clearly defined market requirements
  - High growth with time-to-market pressure

- Each market success provides the reusable tools, code base, and technology to dominate adjacent markets.

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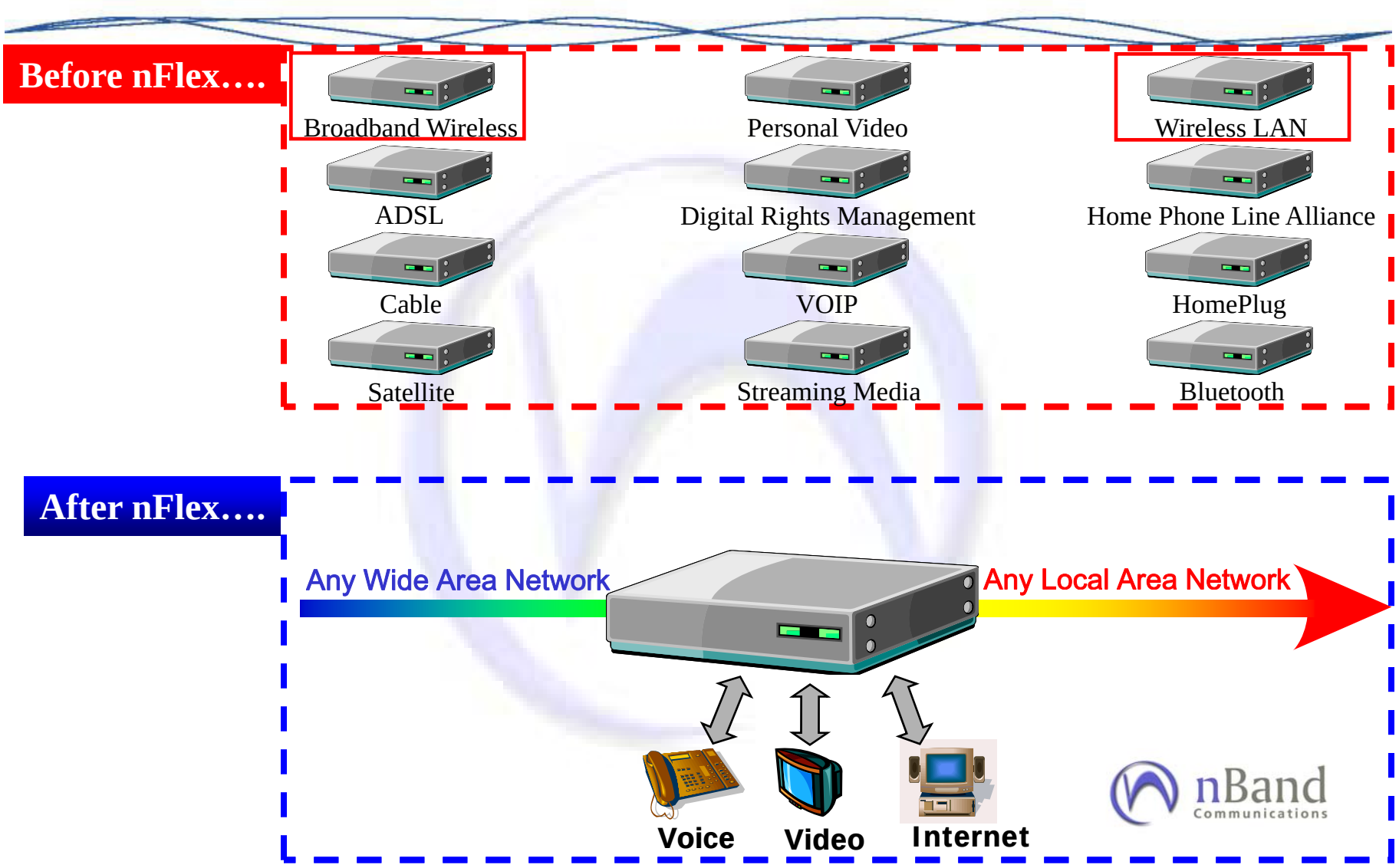
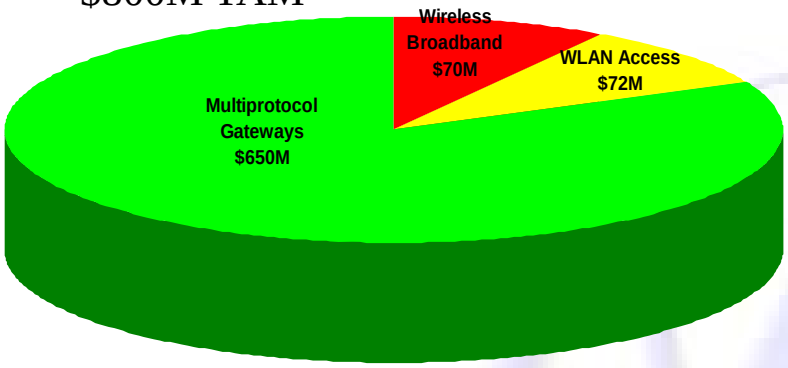
nFlex: The Ideal Platform for Software Defined Multi-standard Products



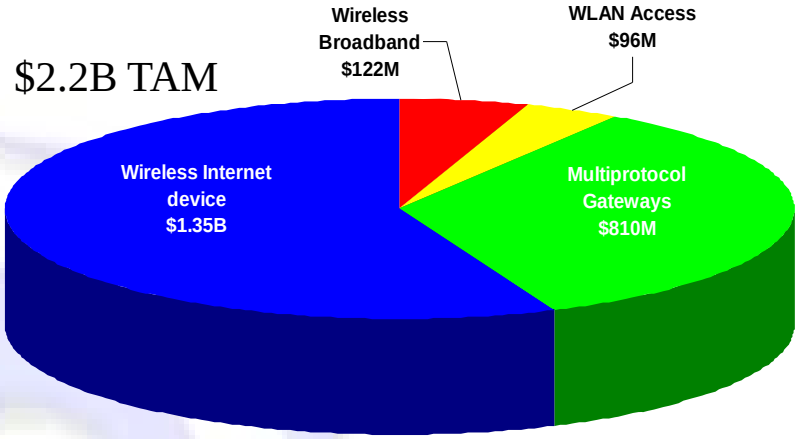
nBand's Market Opportunity

$800M TAM



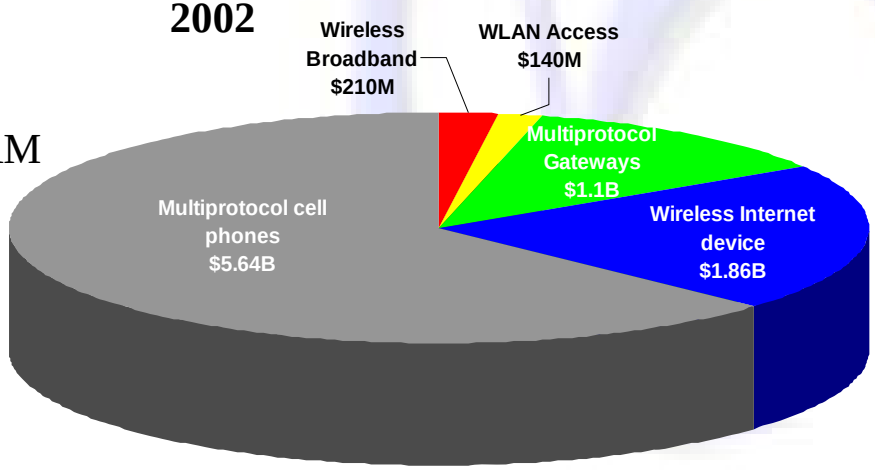
2002

$2.2B TAM



2003

$9B TAM



2004

FWBA: Nokia, PipingHot, Spike, Alcatel, Toshiba, Broadstorm . . .

WLAN Access: Axis, Nokia, Alcatel. . .

Gateways: Matsushita, Nokia, Sony, Sci Atl . . .

Wireless Inet: Sony, Nokia, Matsushita . .

Phones: Nokia, Sony, Samsung . . .

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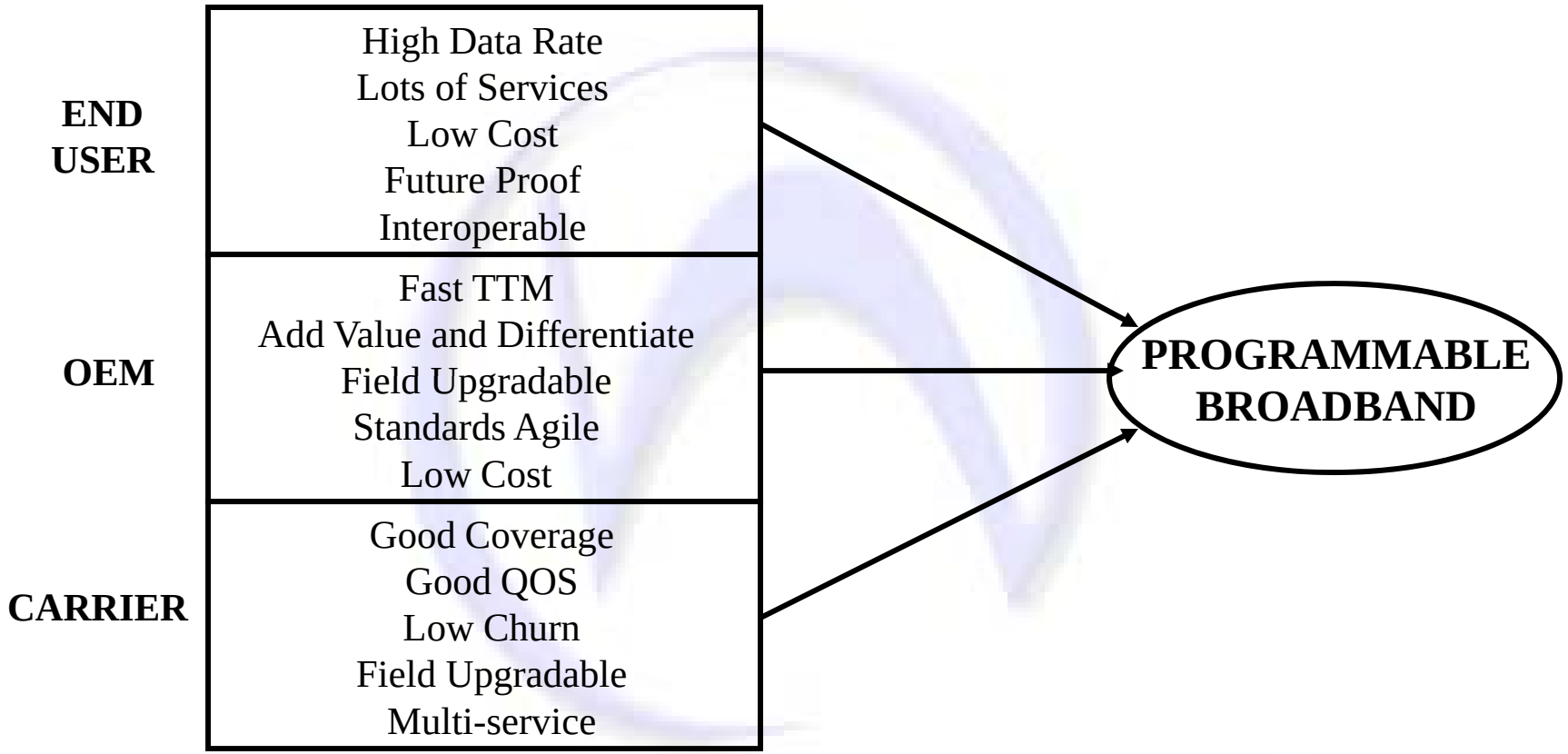
nBand Semiconductor TAM Projections. Sources: Strategis, Gartner, ABI

Programmable Broadband Meets the Needs of the Broadband Value Chain



Analyst Data on Residential Gateways

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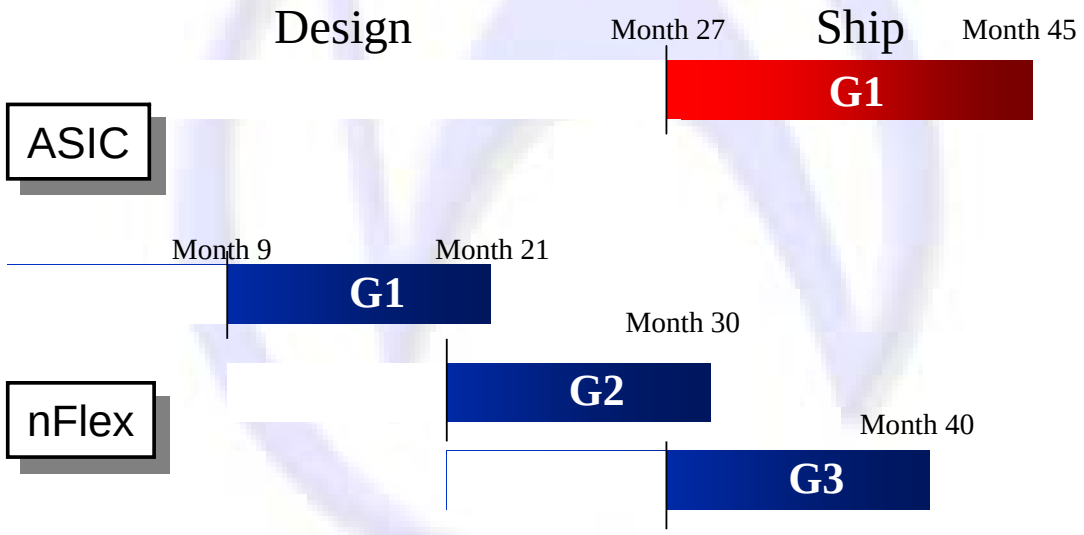
Software Driven ROI Advantage

- Software-based 4X ROI over fixed-function solutions
  - 1/3 the development time
  - 1/6 the development cost
  - Future-proofing



Gx = Product Generation

PC Analogy

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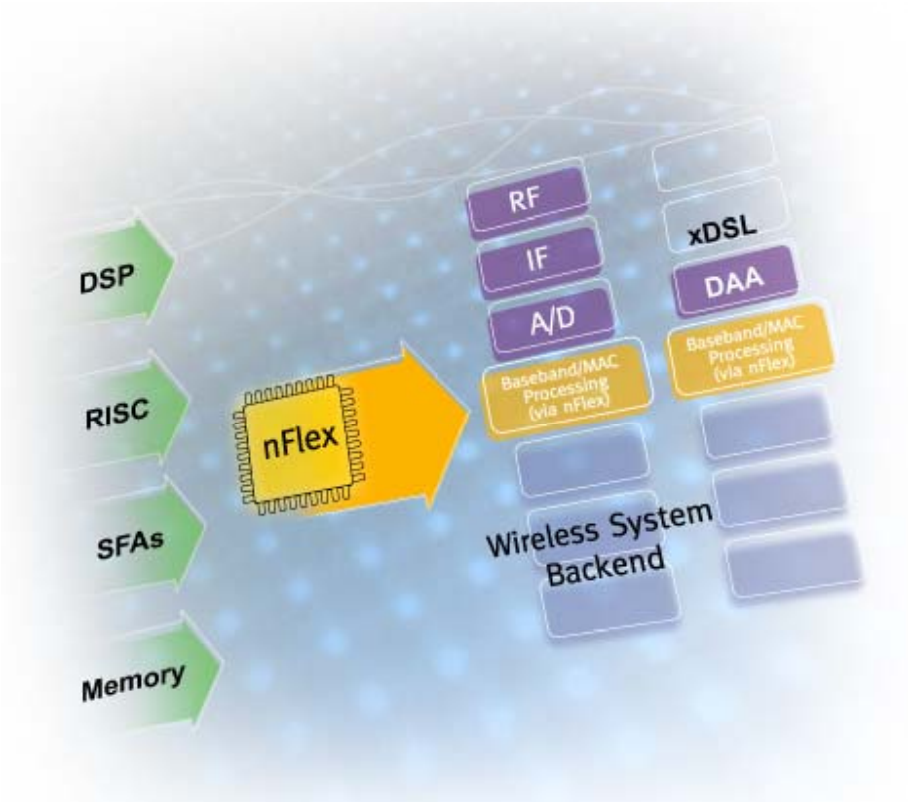
nBand's Solution => nFlex!



- Multi-services, standards, cost
  - "Embedded communications supercomputer"
  - Single-chip software baseband and MAC layer processing
  - Multiple simultaneous protocols
- nFlex unifies
  - RISC processor (no ARM or MIPS)
  - Vector processor (no separate DSP)
  - Dataflow accelerator subsystem (no separate ASIC or FPGA)
  - Embedded memory (no off-chip memory)

Architecture Rationale

Requirements Mapping

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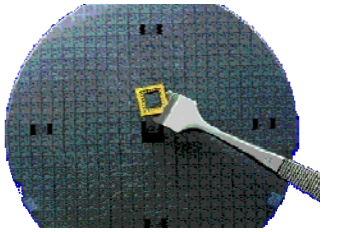
nFlex Architecture



Scalar RISC Processor

Data Cache

Instruction Cache

Additional RISC Processor(s)
For MAC and Other Upper Layer Functions

Architecture Detail

Scalar RISC Processor

Super Scalar

Instruction Cache

Data Cache

M Bus

PCI

Timers

ICU

UART/SPI

GPIO

Palm Bus

Bus Bridge

Ext Memory Controller

Standard Public Domain RISC Instruction Set Processor

Super Pipeline

Extended Vector Elements

Vector Processor

Direct Matrix Math Processing Extension

Cross Bar

Pin Virtualization Logic (PVL)

Streaming Interface Unit (SIU)

DMA Router

Viterbi

FIR Filters

Interleaver

CRC

Data Flow Engine With Internal & External Programmable Accelerators

Embedded Memory

Additional Memory

Additional Hardware Accelerators

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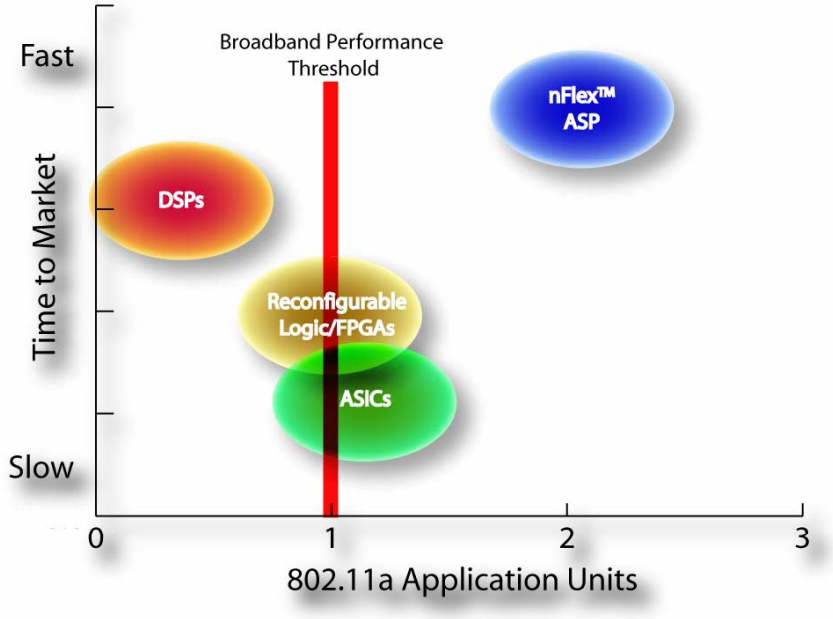
nFlex Beats the Competition

- "Off-the-shelf" DSP suppliers:
  Analog Devices, TI, Lucent
  - Insufficient performance
  - Insufficient applications focus
  - Lack integrated RISC scalar processor and tools focus
- Fixed-function /ASICs:
  Broadcom, TI
  - Slow time-to-market
  - Not multi-protocol
  - Inflexible
- Reconfigurable:
  Chameleon, Xilinx
  - Not easily programmable
  - Cost
- Embedded supercomputers:
  IBM, Sony, Toshiba collaboration
  - Far into the future (2005)!



Product Examples

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nFlex Sustainable Advantage

- Scalability
  - Preserving legacy nFlex code investment
  - Hardware architecture retained in subsequent generations
- Code re-use for rapid application to new products and markets
- Software Development Productivity Focus
  - RISC uniprocessor programming model
  - Application specific
    - Targeting Comms PHY and MAC layer needs
  - Enabling the innovator
    - Communications systems engineer coding in MATLAB
- Systems cost savings
- Enabling customer to differentiate and add value
- Meeting customer application needs
  - Multiple protocols
  - Field upgradable

Software Development

System Cost Savings

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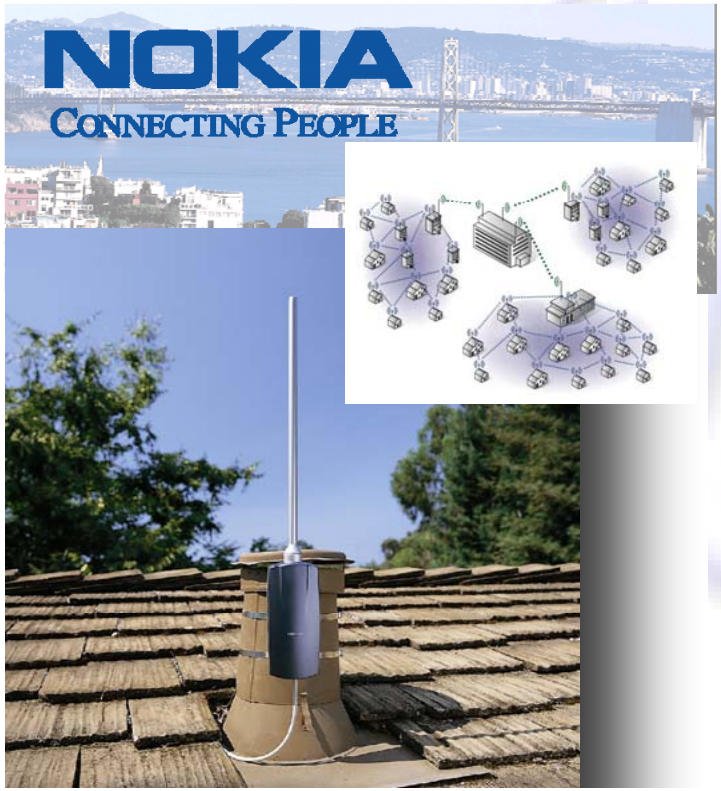
Corporate Partners

$2,000,000 investment
Wireless broadband/Home PNA CPE
nBand's nFlex technology offers:

- Fast development of their rooftop mesh network products
- Ability to differentiate with their IP
- Future-proof software-based radio



AXIS COMMUNICATIONS

$3,650,000 Investment
802.11a wireless LAN access point
Comprehensive joint development agreement

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Accomplishments Since Series B

- Technical
  - 1st nFlex chip sampling Oct
    - nFlex-I logic design completed
    - Team moving on to next generation
  - nFlex (RedHat GNUpro) development tools in beta
  - Eleven patents filed (one granted)
  - Application specific development underway
    - 802.11a PHY developed and ported
    - 802.11 MAC program well along
    - VOFDM (Cisco BWIF) PHY port underway
    - DOCSIS MAC and PHY acquired (MAC port underway)
  - UNII band radio development well along
- Company
  - Key talent acquired in finance, marketing, processor design, RF/radio, wireless systems

Patents

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Market Accomplishments

- Business Development
  - Tools installed on early customer sites
  - In technical due diligence with broadband access OEMs worldwide
  - In final negotiations with volume customers
- Achieving industry recognition
  - nBand presented at: Network Outlook, DesignCon, Embedded Systems
  - Upcoming: WCAI, RS Semiconductor Conference, HotChips, CommVerge ...
  - Positive reaction from media and analysts
    - **"nBand's unique communications processor architecture promises to provide a breakthrough in performance for today's exploding broadband wireless networks for homes and businesses. Forward Concepts believes that nBand will play a major role the growth of this fast-growing market segment."**

      Electronic News quoting Will Strauss of Forward Concepts (9/18/00)
    - **"What I've found is a very interesting product with a very interesting marketing strategy. Basically, nBand has come up with a rather unique processor architecture…"**

      Lee Goldberg, *ChipCenter*, "Product of the Week" (11/11/00)

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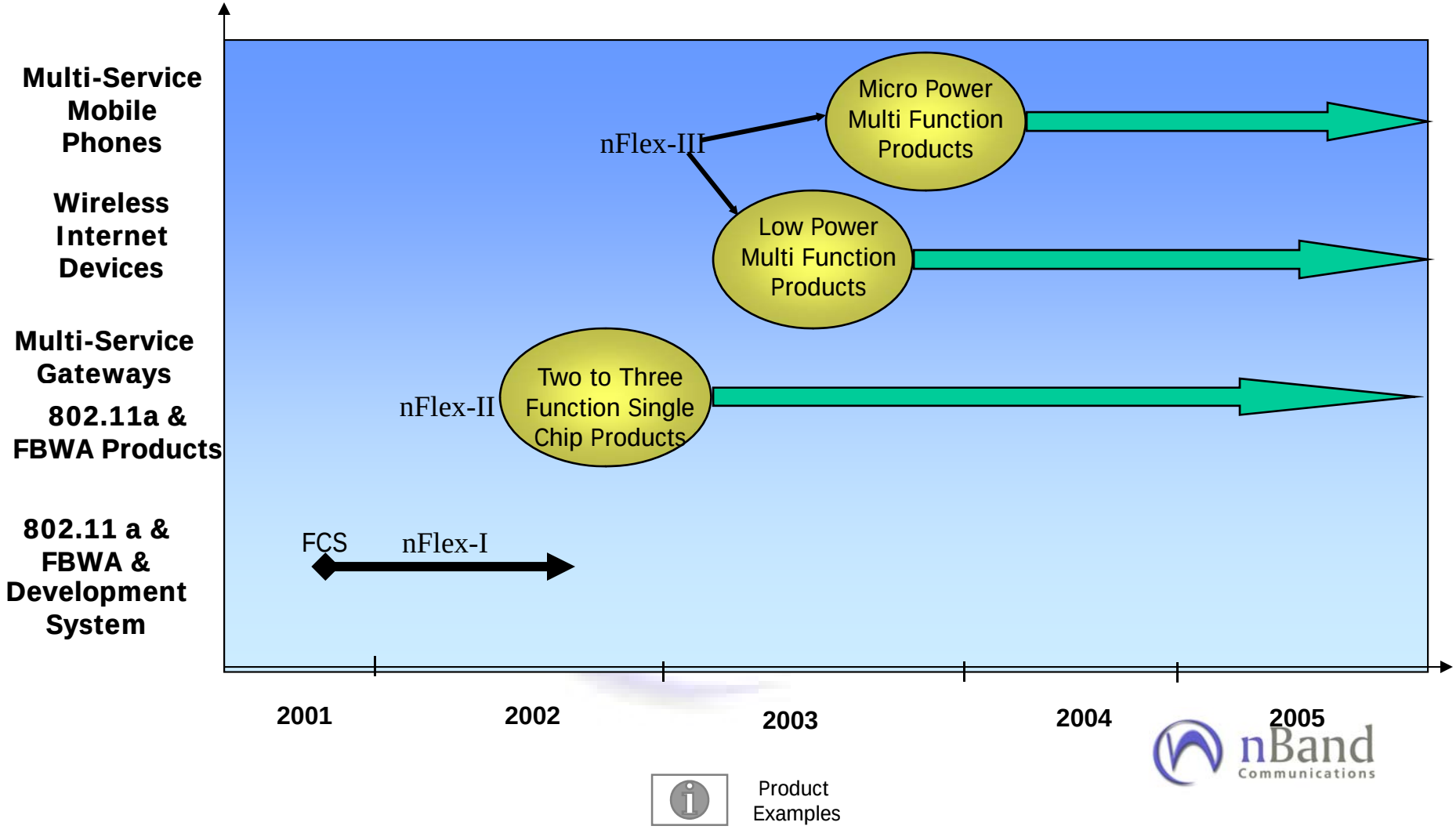
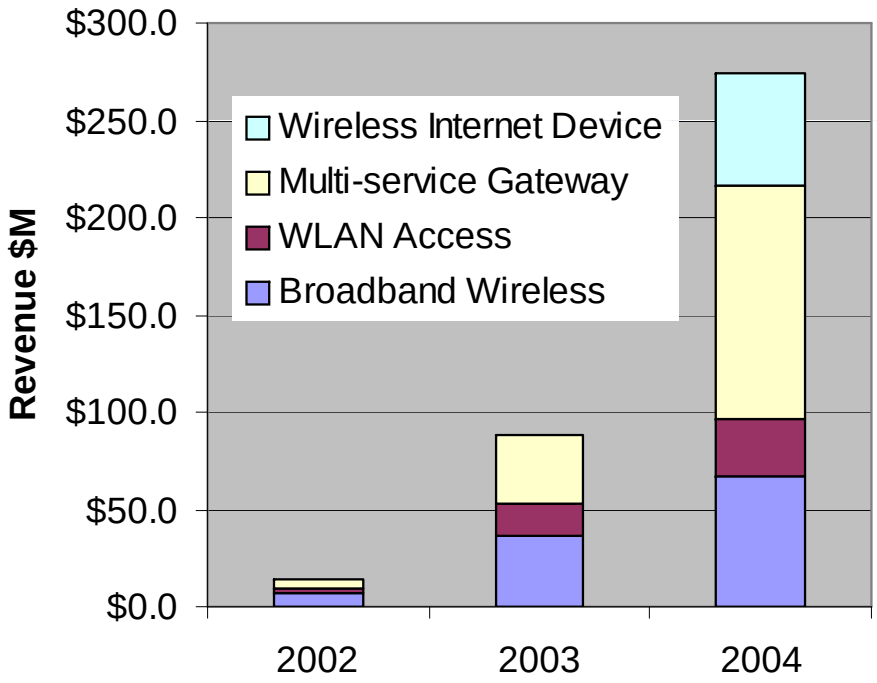
Market/Product Roadmap



Financial Plan



- Financing to date
  - Investment to date: $21M
    B round closed in August 2000
  - Lead investor: VantagePoint Venture Partners;
    two corporate investors

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Experienced Team

- Founders:
  - Pete Foley
    - Travertine Systems (home networking), Chromatic Research, Apple Computer (Mac I/II, Newton)
  - Sanjay Vishin
    - Sun (Picojava, Microsparc-I/II)
  - Srinivas Lingam
    - ZSP, CDoT
- Experienced management team
- 50 employees

- Engineering track record (average 11 years experience)
  - Wireless systems companies
    - Alcatel, Stanford Telecom, Arraycomm, Solectek, Trimble, Lockheed-Martin, Ensemble Communications
  - Chip companies
    - National, Motorola, Fujitsu, Analog Devices, S3, Intel, LSI, Chromatic Research, VLSI, Philips, Alantro, 3dfx
  - Computer companies
    - Sun, SGI, Apple, HP

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nBand “Assets”

- nFlex Communications Processor
  - Scalar and vector processor IP developed by nBand
- Software Dev Environment/Tools
  - Industry standard GNUPro
  - Compiler, linker, loader, simulator, debugger + nBand enhancements
  - DSP library + vector intrinsics
  - Direct MATLAB compiler under development
- nFlex real-time kernel
- eCOS port to nFlex
- PCI based PC evaluation board
  - +board support software
- 802.11a baseband
- 802.11 MAC
  - Applicable to 802.11, .11a, .11b, .11g
- DOCSIS MAC (software) + PHY
  - 1.0 (now) => 1.1
  - VxWorks (now) => eCOS
- BWIF Baseband (VOFDM) Source
  - Port to nFlex underway
- High performance middle UNII band radio
- 11 Patents filed, 1 granted, 10 more in the pipeline
- Complete VLSI COT tools flow
  - Verilog, Synopsys, Avant!
- Baseband IP stacks identified for
  - ADSL
  - 802.11b

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nBand: Fueling the Future of Broadband Access

- **Large fast-growing market opportunity**
- **nBand's technology is the only solution that addresses all the broadband access market forces**
- **nBand positioned to dominate broadband access**
- **Clear high leverage path to adjacent (multifunction) markets**

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Backup Slides

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Patents

1. Low power Memory system with incorporated Vector processor.
2. Cycle skipping DRAM for power savings
3. A method to increase the throughput of eDRAMs
4. In-Phase and Quadrature-Phase Rebalancer
5. Method and Apparatus calculating Clear Channel Assessment based upon received energy estimates within a physical channel.
6. Coarse frequency offset estimation
7. OFDM data demodulator synchronization
8. Fine frequency offset estimation
9. Timing misalignment estimation
10. Method and apparatus using pseudo-inverses of linear transformations in multi-carrier modulation receivers and transceivers
11. Method and apparatus for peak-to-average ratio reduction in multi-carrier modulation systems.

- Granted
- Filed
- Described

12. A functional unit for generating synchronized random sequences.

13. A method for accelerating Viterbi decoding in vector functional units.

14. An economical way of accelerating FFT memory accesses on vector computers.

15. Accelerating bit shuffling for packet processing.

16. Vector prefetch method for an eDRAM based vector memory system.

17. Multi headed stores.

18. An Integrated prefetch and locking/unlocking mechanism to guarantee the hit rate in an I-cache.

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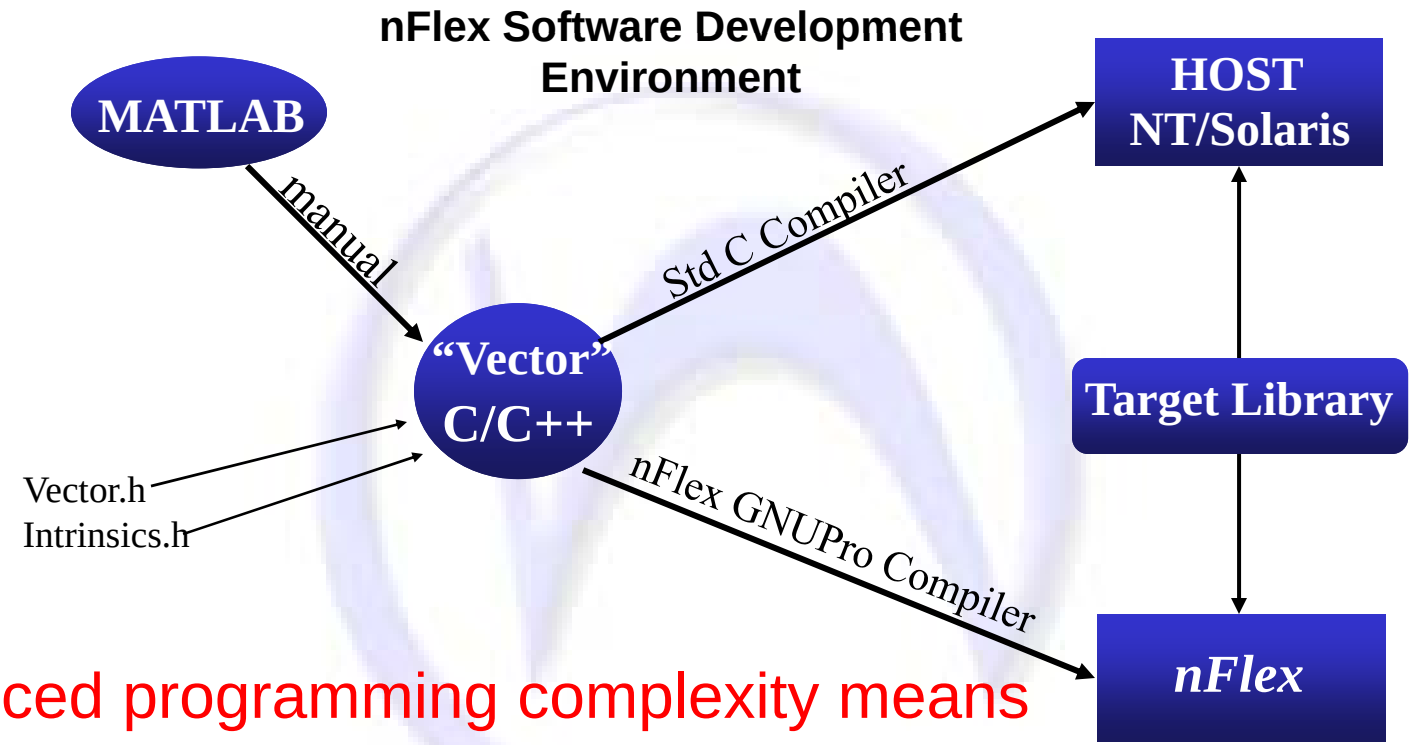
Return to Presentation

The Key is Simplified Development Flow



Reduced programming complexity means more time for innovations

And Faster Time to Market

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Complex FIR Filter Example

MATLAB Code

```
function z = complex_FIR (x,y,M)

% inputs
%   x = [1,N] vector
%   y = [1,N] vector
%   M = # points starting from 0
%
% output
%   z = [1,M-1] vector

% Initializations
N = length(x); % Determine # elements of x

% Main loop
for i = 1:M
  r = y(i:i+N-1)*x(N:-1:1).'; % Compute sample
  z(i) = r ;          % Save result
end
```

Vector Oriented C Code

```
_vector ComplexFIR(complex *ComplexInput, complex *ComplexCoef, word16
Order)
{
      _vector TempVector,Result;
      _vector_pair TempVectorPair1,TempVectorPair2;
      word16 i;
      word32 Temp;

/* Initialization */
      SetVectorLength(Order);
      SetProductShift(LEFT_SHIFT_1);
      TempVectorPair2 =_vmov_ext_from_scalar(0);


      for(i=0; i < Order; i++)
      {
/* Read data from the memory starts here */
      TempVector = (*_vector *)(ComplexInput+Order-1-i);
      Temp = *(word32 *)(ComplexCoef+i);
/* Read data from the memory ends here */
      TempVectorPair1 = _vcmul_vs(TempVector,(unsigned int)Temp);
      TempVectorPair2 = _vaccx_w(TempVectorPair2,TempVectorPair1);

      }
      Result = _vmix_hh(_vget_high(TempVectorPair2),_vget_low(TempVectorPair2));
      return(Result);
}
```

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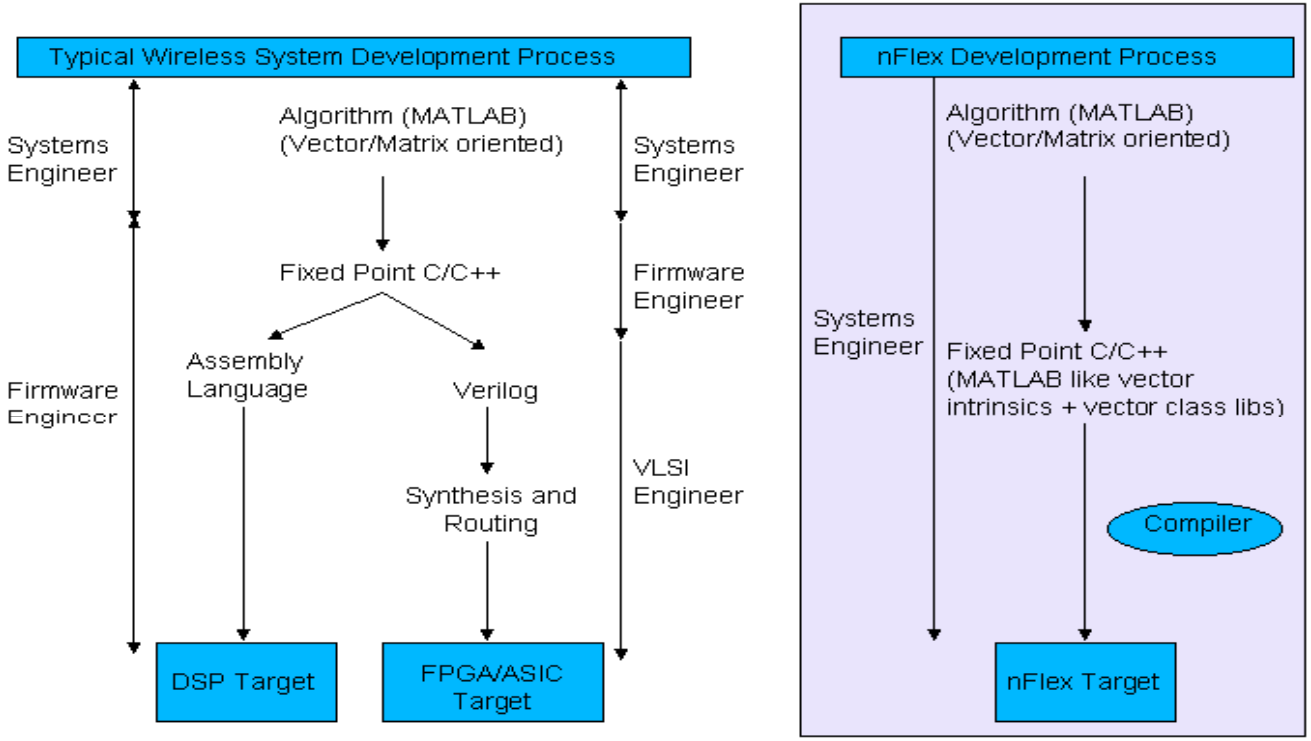
nFlex simplifies the development process



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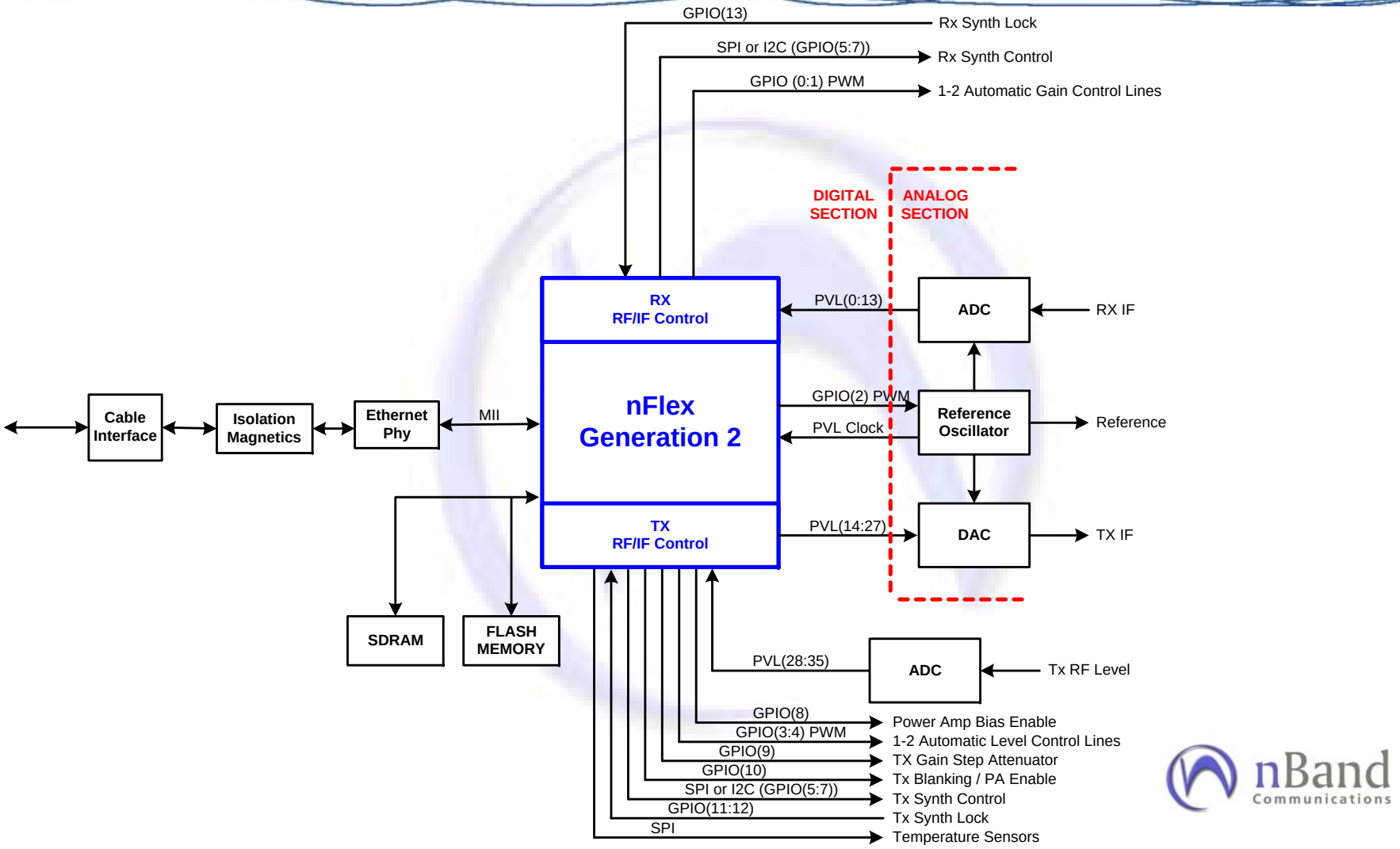
BWIF System



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End Backing Group

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