



And HPEC  
Software....

mentor  
embedded

# Landfills, iPhones, and the Web

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# Landfills

# Issues with Current HPEC Development

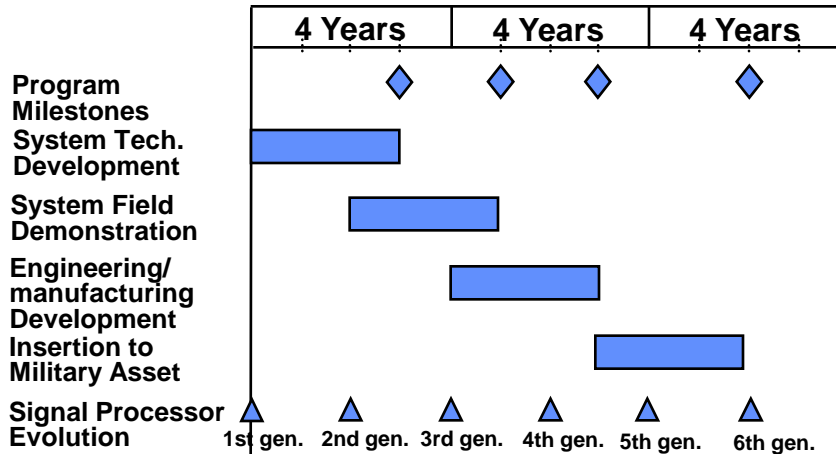
## Inadequacy of Software Practices & Standards



- **High Performance Embedded Computing pervasive through DoD applications**

- Airborne Radar Insertion program  
85% software rewrite for each hardware platform
- Missile common processor  
Processor board costs < \$100k  
Software development costs > \$100M
- Torpedo upgrade  
Two software re-writes required after changes in hardware design

### System Development/Acquisition Stages



### Today – Embedded Software Is:

- Not portable
- Not scalable
- Difficult to develop
- Expensive to maintain



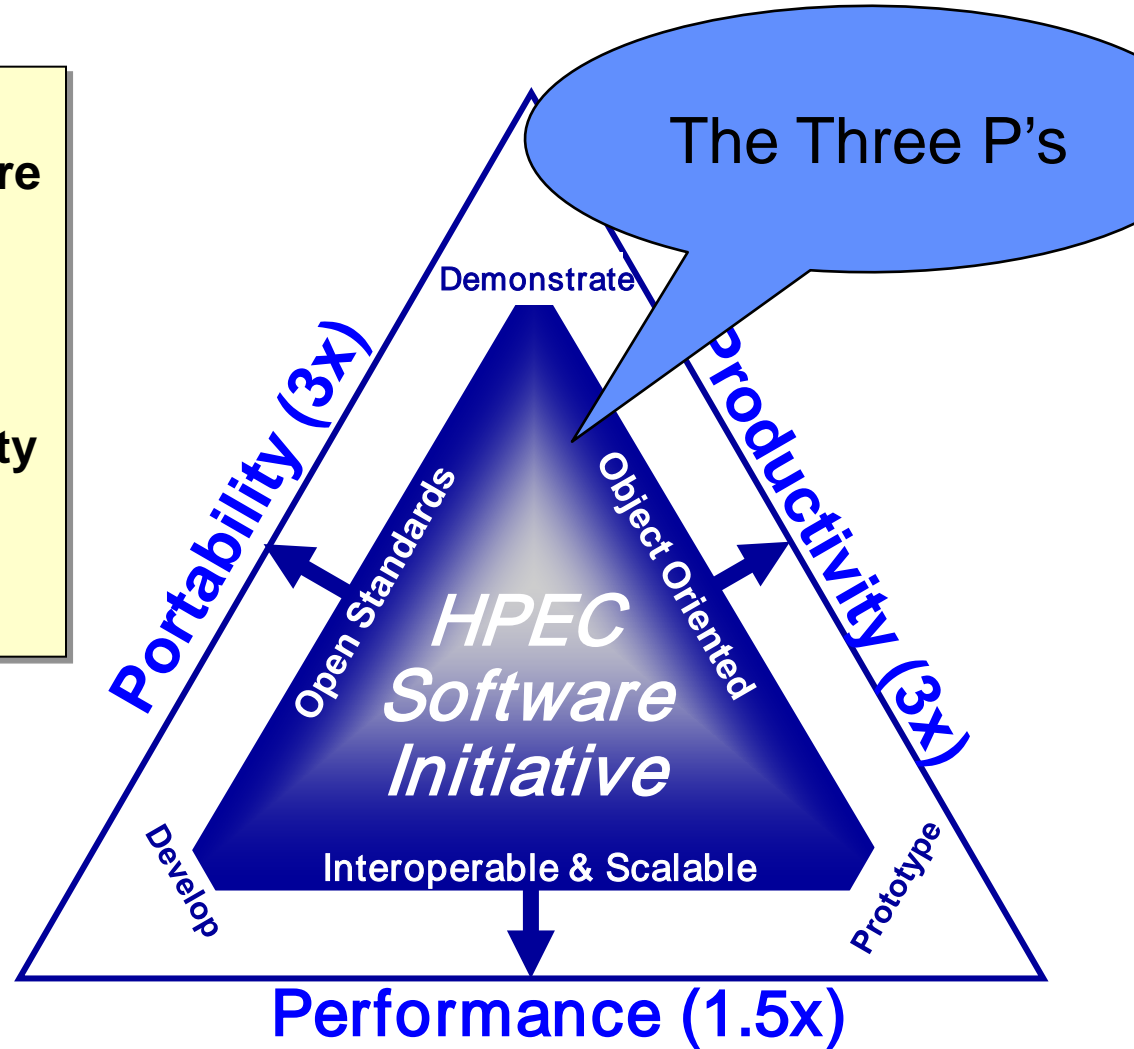
# Quantitative Goals & Impact



## Program Goals

- Develop and integrate software technologies for embedded parallel systems to address portability, productivity, and performance
- Engage acquisition community to promote technology insertion
- **Deliver quantifiable benefits**

- Portability:** reduction in lines-of-code to change port/scale to new system
- Productivity:** reduction in overall lines-of-code
- Performance:** computation and communication benchmarks



# The Three R's – Nice Version

## Reduce

Less  
Code



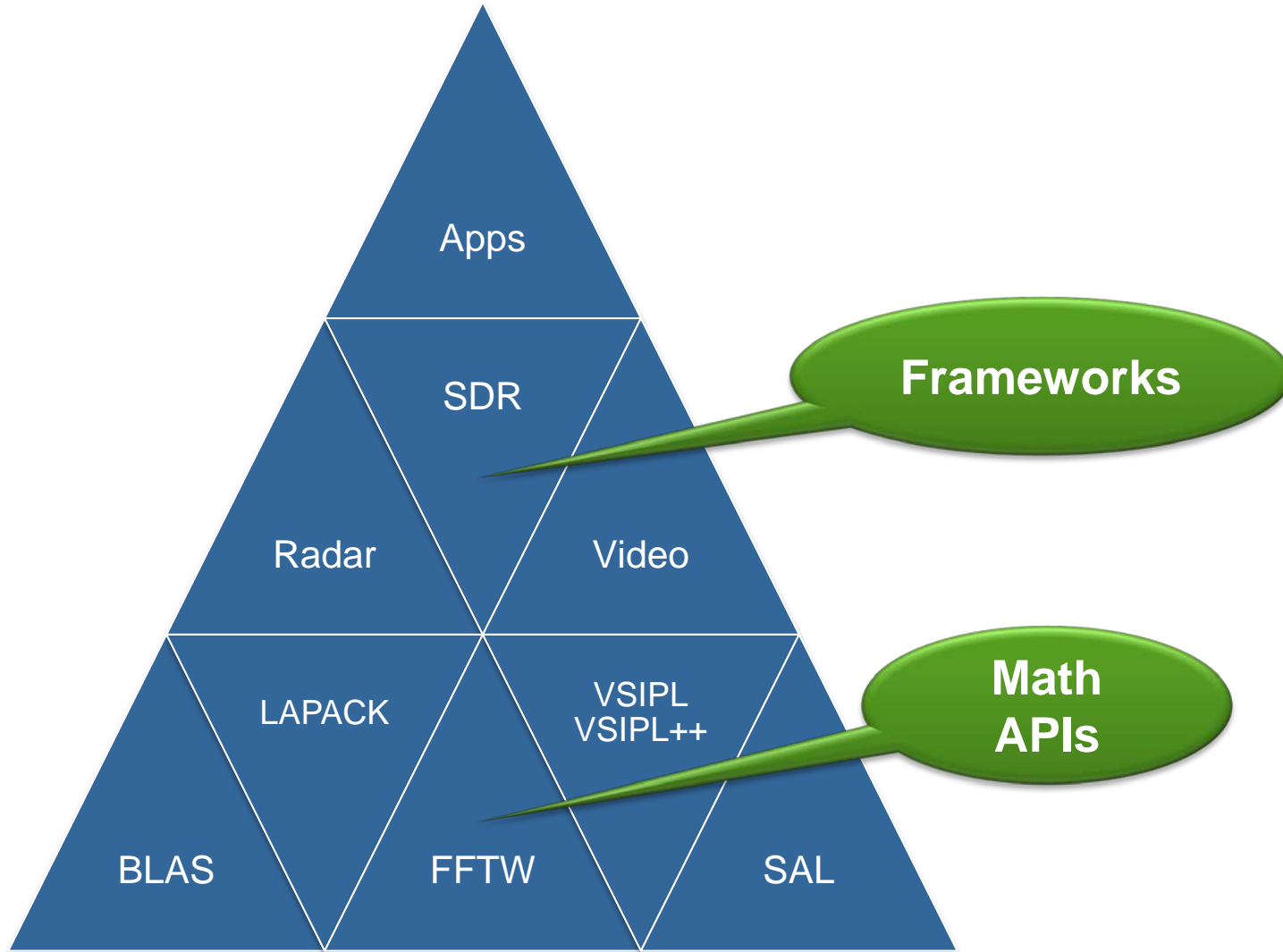
Repurposed  
Code

Shared  
Code

## Recycle

## Reuse

# HPEC Software



# Programming With Frameworks

## Web Server

```
from http.server import
    HTTPServer,
    BaseHTTPRequestHandler

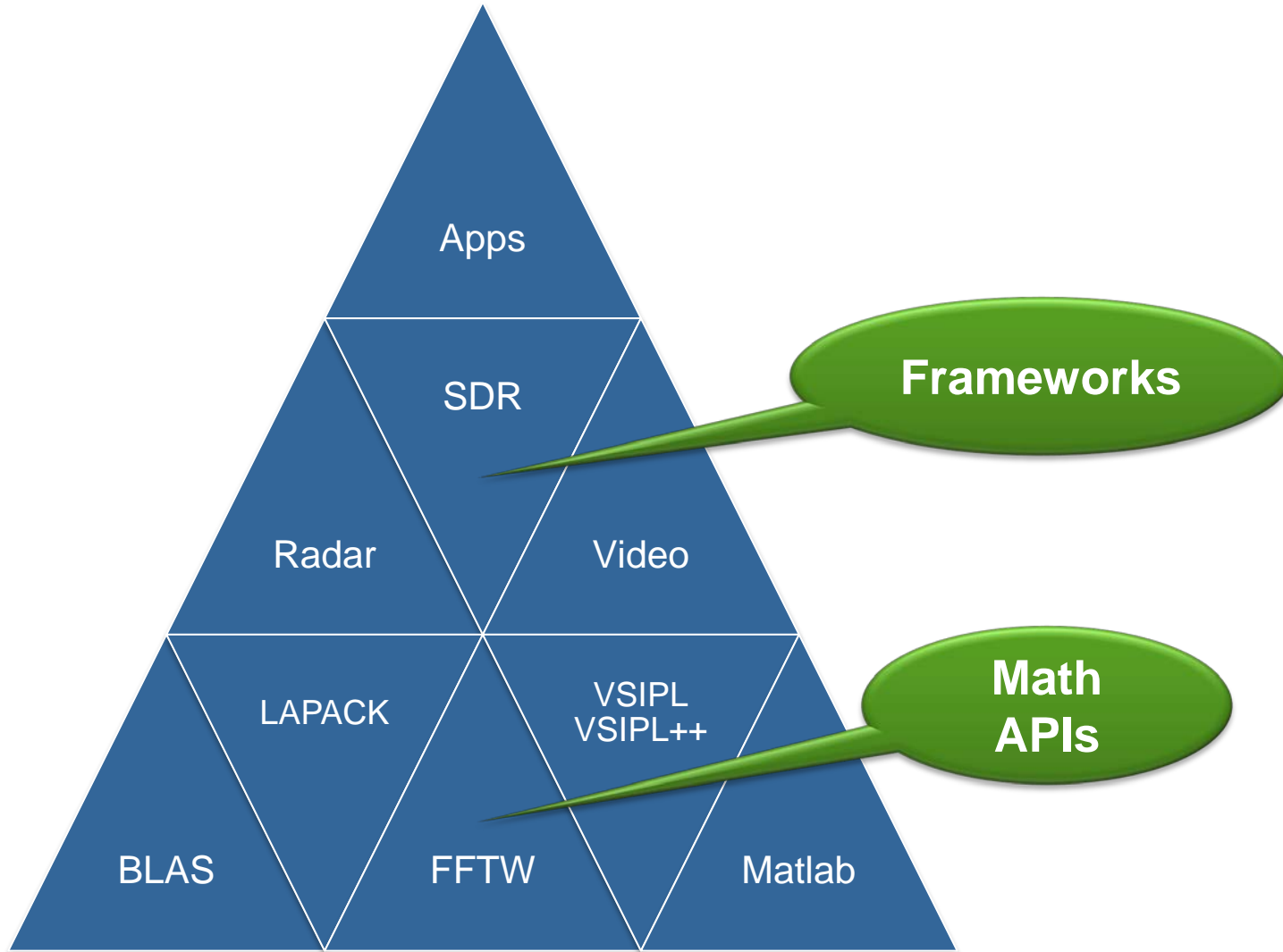
httpd = HTTPServer(
    ("localhost", "8080"),
    BaseHTTPRequestHandler
)

httpd.serve_forever()
```

## L-Band Radar

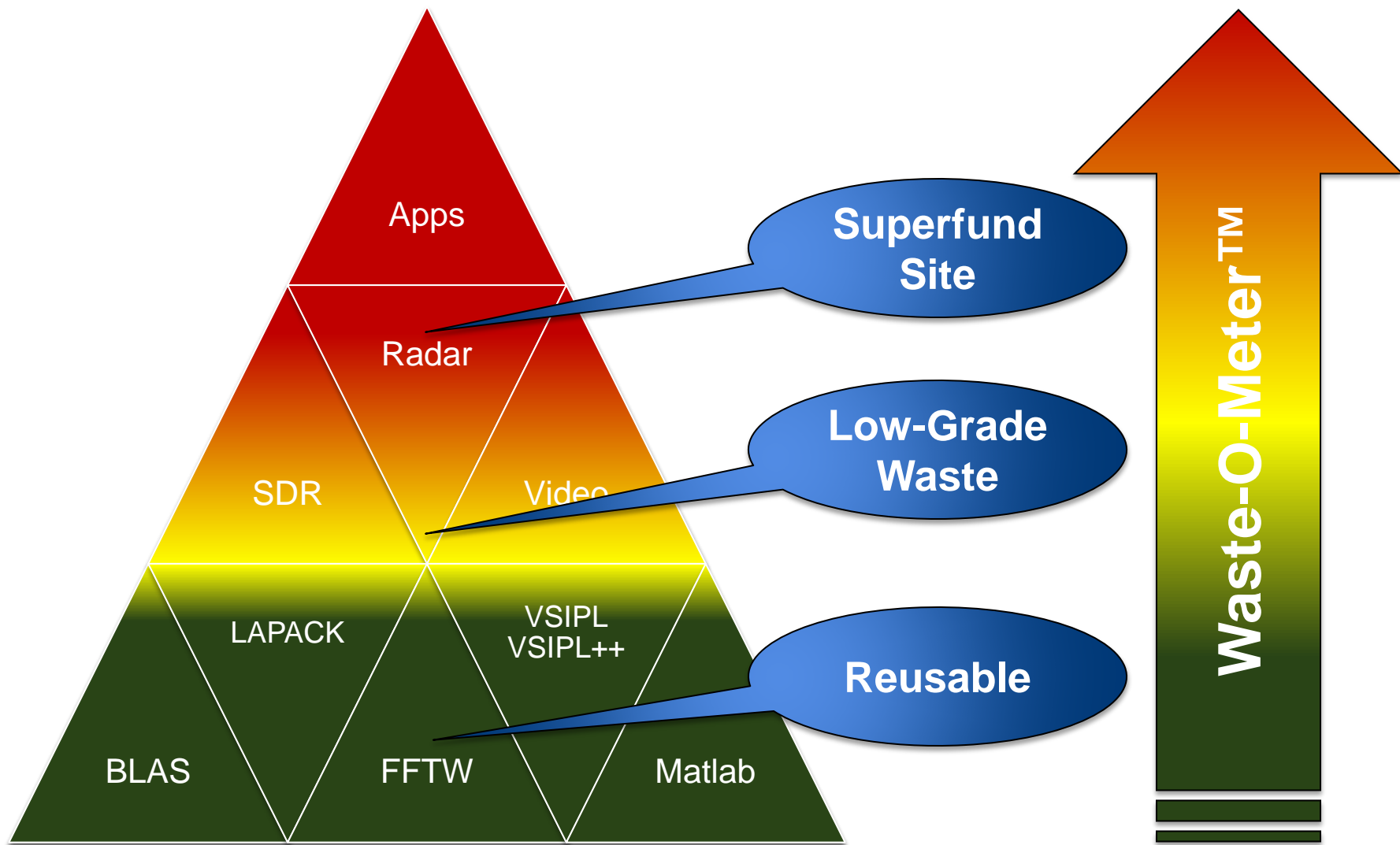


# HPEC Software Landfill





# HPEC Software Landfill



# Three R's – Nasty Version



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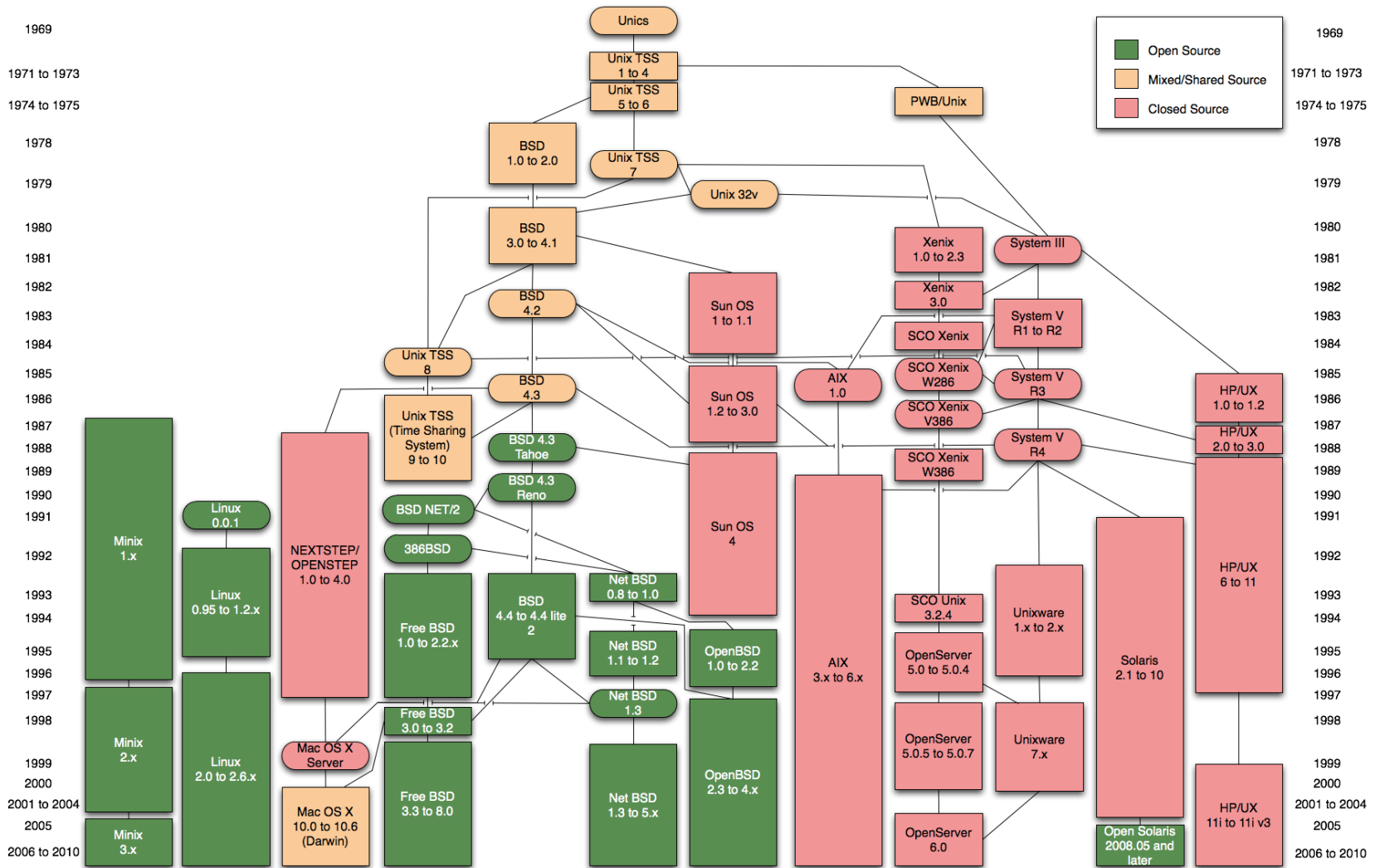
**iPhones**  
**... and Android Phones**  
**... and lots of other stuff.**

# What To Do All Of These Have in Common?



UNIX!

# UNIX History



# UNIX API: Common Vocabulary

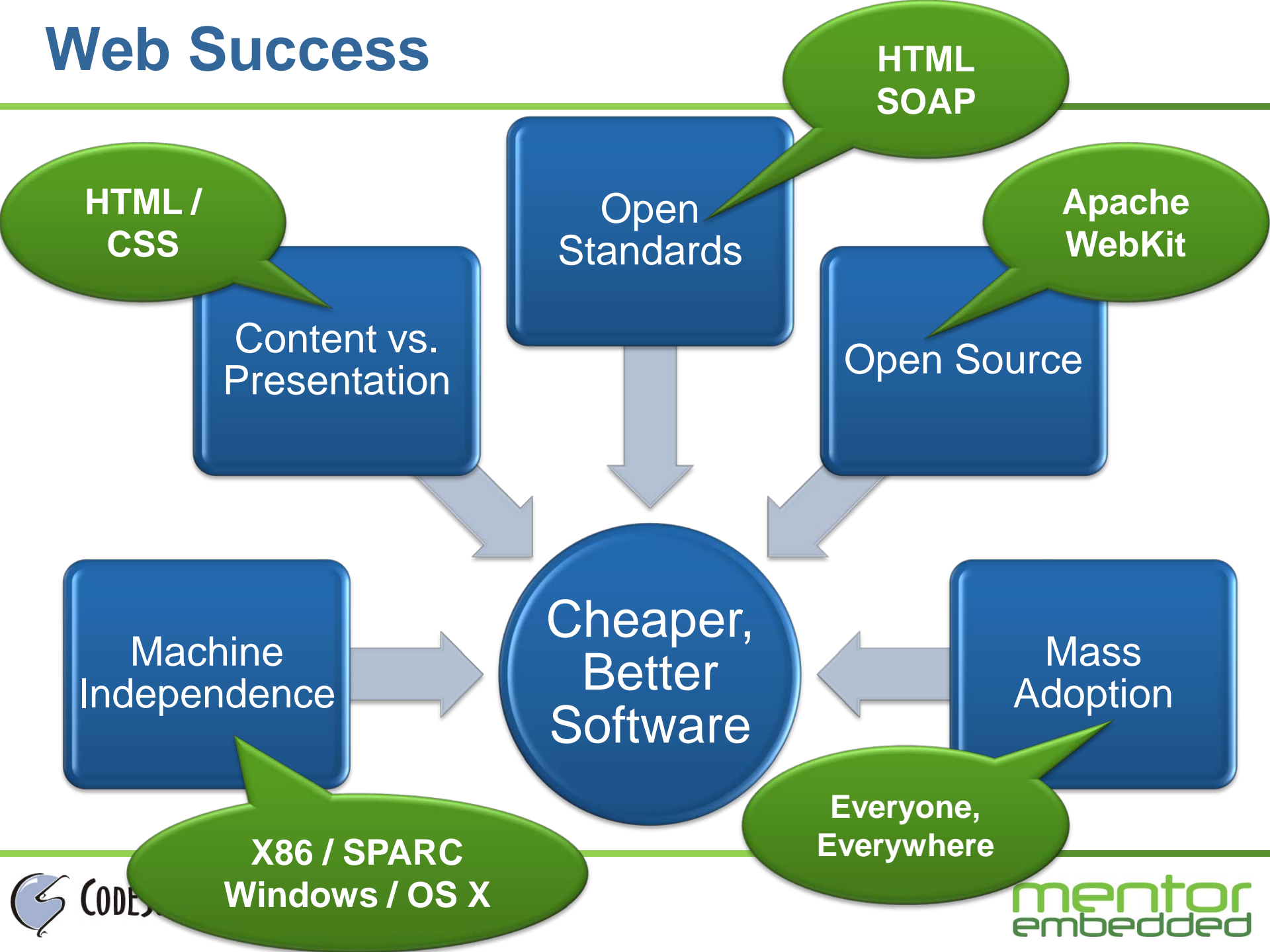
Functionality	System Calls
I/O	<code>open</code> , <code>read</code> , <code>write</code> , <code>close</code>
Memory	<code>sbrk</code> , <code>mmap</code>
Processes	<code>fork</code> , <code>exec</code> , <code>signal</code> , <code>kill</code> , <code>wait</code>
Communication	<code>pipe</code> , <code>socket</code> , <code>mkfifo</code>

**API at the Right  
Level of Abstraction**

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# The Web

# Web Success



HTML  
SOAP

HTML /  
CSS

Content vs.  
Presentation

Open  
Standards

Open Source

Apache  
WebKit

Machine  
Independence

Cheaper,  
Better  
Software

Mass  
Adoption

X86 / SPARC  
Windows / OS X

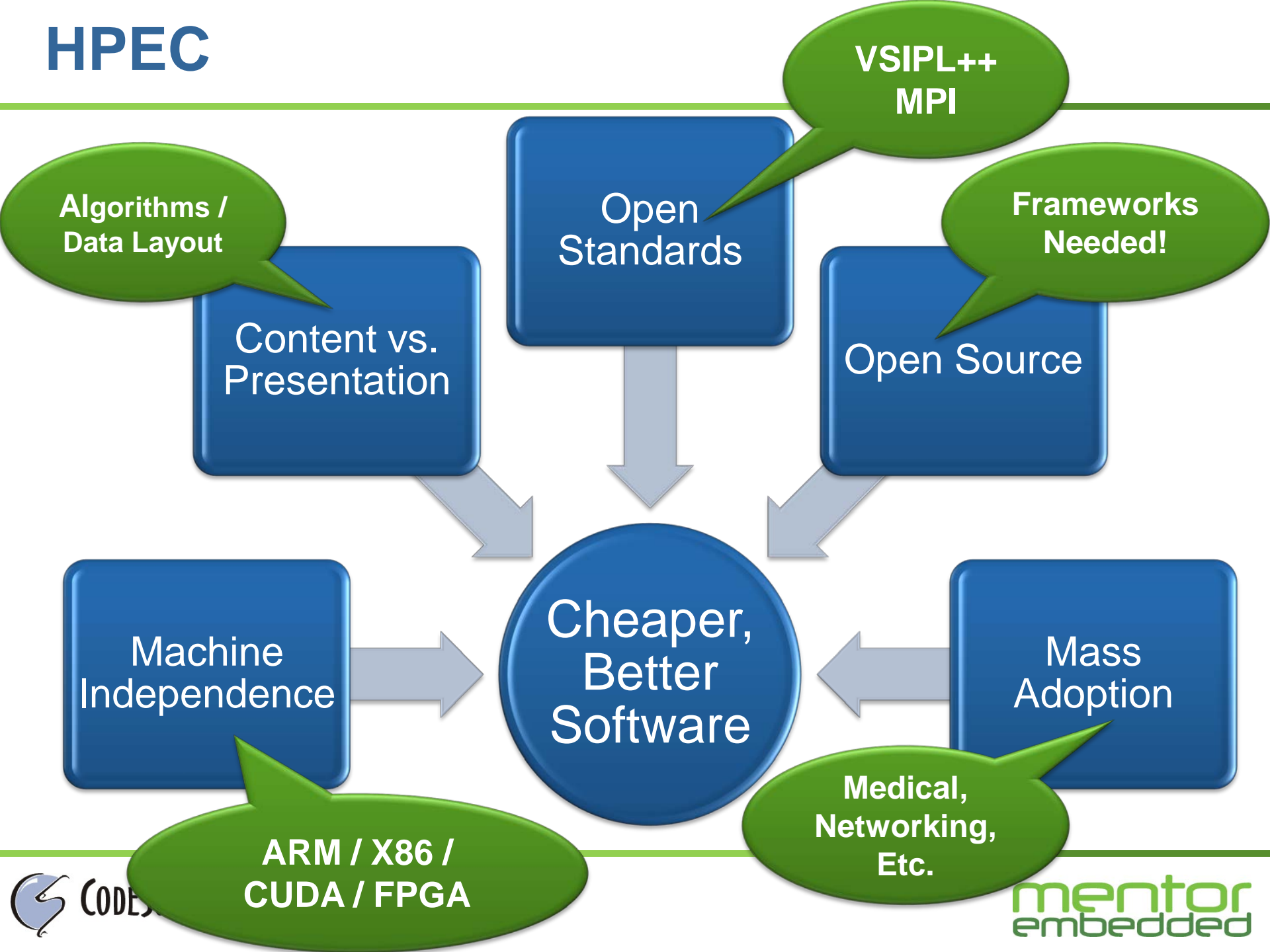
Everyone,  
Everywhere



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# Inspiration for HPEC Software

# HPEC



Algorithms /  
Data Layout

Content vs.  
Presentation

Open  
Standards

VSIPL++  
MPI

Frameworks  
Needed!

Open Source

Machine  
Independence

Cheaper,  
Better  
Software

Mass  
Adoption

ARM / X86 /  
CUDA / FPGA

Medical,  
Networking,  
Etc.

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**Thank You!**