



## Non-recurring Engineering (NRE) Projects for Embedded Computing Platforms



### WIN Enterprises WHITE PAPER

WIN Enterprises is an Affiliate Member of the Intel® IoT Solutions Alliance, a global ecosystem of 200+ member companies that provide the performance, connectivity, manageability, and security developers need to create smart, connected systems.



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## Non-recurring Engineering (NRE) Projects for Embedded Platforms

Non-recurring engineering (NRE) projects cover the research, development, design, testing and customer acceptance of new products. NRE is often synonymous with Research & Development (R&D) and Product Development. It can be performed internally by an organization or outsourced. This paper focuses on outsourcing the development of embedded computing platforms by an electronic Original Equipment Manufacturer (OEM) customer to an Original Design Manufacturer (ODM), such as WIN Enterprises.

An embedded platform is the vital hardware of the OEM's solution-level product. The remainder of the solution-level product is the OEM's own unique software and services, plus any additional industrial design (packaging) they may provide the solution with for ergonomic or cosmetic reasons. Solutions based on WIN Enterprises' platforms can address any number of application areas spanning voice/image and data management, medical diagnostics, military, IP PBX, VoIP, firewalls, routers/gateways, SPAM filters, Unified Threat Management (UTM), and more. The embedded solution can be a single board computer (SBC) or box-level device. Form factors may be industry standard, such as Mini-ITX, COM Express, 3.5" SBC, PICMG 1.3, (etc.) or proprietary and totally custom.

The cost of the NRE phase of the product life-cycle has to be carefully considered by an OEM in determining the profitability of a potential product over its lifetime. If NRE is high, the demand for the product must be sufficiently strong to warrant the financial risk.

Outsourcing an embedded platform doesn't always entail NRE charges. The OEM can look for a commercial off-the-shelf (COTS) solution that provides a best-fit vis-à-vis the desired product specifications. If the COTS product more or less meets the required specs, its selection may make the best economic sense, even if not a precise match. If the changes are minor, and the ordering quantities sufficient, the ODM may be willing to totally or partially absorb this cost. The basic choices confronting the OEM include:

- Purchase a best-fit Commercial off-the-shelf (COTS) platform
- Select a best-fit COTS platform and have the Original Design Manufacturer (ODM) modify it to meet more specific market requirements
- Have an ODM design a custom platform based on unique market requirements

Simple COTS product changes can involve streamlining the product to eliminate unneeded features or modifying the LAN configuration. Making these changes at the ODM's expense would indicate a manufacturing order of sufficient size to enable the absorption of the cost. Naturally, proceeding with a change to an existing design requires a commitment from the customer, generally in the form of a purchase order. At the production phase of the project a contract may be required to spell out ownership of the modified design. For instance, an ODM might be willing to partially absorb the cost of modifications if free to openly re-market the modified design to others. However, an OEM customer may choose to absorb some incremental cost for outright ownership of the unique design.

Custom designs fall clearly in the realm of NRE projects. The resultant designs are usually considered proprietary to the OEM customer. There are exceptions. If development costs are shared between ODM and the OEM customer, ownership of the final custom design may be shared in some fashion (e.g., through an agreement where each entity addresses different markets). This might be done if an OEM customer is in start-up mode and lacks sufficient resources to totally fund a NRE/development project.

Some ODM organizations only perform the NRE part of a product's life-cycle – i.e., they are essentially design shops. WIN Enterprises always manufactures what it designs. NRE projects are accepted with a commitment from the OEM customer to have WIN manufacture the final approved design. In WIN Enterprises' business model, NRE projects are generally loss-leaders and represent just the first phase in a long-term business relationship.

WIN Enterprises' flexibility in meeting custom requirements for relatively small projects is a market differentiator in the embedded industry. We first consult with the customer to arrive at a thoughtful recommendation as to which approach works best for the customer between the COTS and custom options. If the customer elects to proceed with a custom platform we have design engineers in both the U.S. and Taiwan that work together on producing a timely design that meets the required specifications.

If the solution is a COTS or modified COTS platform, we recommend the customer first evaluates one of our existing platforms. This is a low-risk approach that enables comparison with other available products. After an initial evaluation, WIN can modify the COTS design based on the OEM's feedback and their exact feature requirements.

Regardless of the approach to the final design, WIN works with the customer to manufacture, install its software, test, and drop-ship the final product to end-customers. As part of the manufacturing process, WIN also handles product branding and packaging. The services are comprehensive so that some OEM customers think of WIN Enterprises as a virtual manufacturing division of their businesses.

Established in 1991, WIN is able to efficiently develop new designs based on its extensive library of development modules.

## **Development Modules**

In modifying existing designs or developing totally new ones, WIN is able to use a robust set of Development Modules for rapid turn-around. These modules are based on hundreds of

successful designs that are used across a breadth of applications, including medical, military, video editing, converged communication, internet security and others. This modular design approach enables the rapid and economical addition of required features.

Custom designs employ the most recent embedded components available in order to provide the maximum product life cycle. WIN is in the Intel® Embedded Alliance and receives product roadmap presentations on the up-coming Intel embedded processors and components. Embedded products have significantly longer life spans compared to their commercial counterparts.

### Design Module Application Areas

- Networking & Network Security
- Internet Appliances
- Mobile/intense computing
- Telecommunications
- Industrial PC / Industrial Automation
- Transaction Terminals / POS Systems
- Gaming/Entertainment/Digital Home
- Medical Devices/Scientific Instrumentation
- Transportation/Automotive
- Military/Aerospace/ Law Enforcement

### THE CUSTOM DESIGN PROCESS

#### System Definition Phase

System definition is the most critical phase in NRE projects. Functionality and performance are defined in this stage. This becomes the basis for determining the product's specifications. In the System Definition phase WIN helps the OEM customer to define a product's objectives and functionality to arrive at the list of final specifications. This entails:

1. Proposing a custom solution if an off-the-shelf solution does not exist
2. Exploring alternatives for components, considering their availability, reliability, and life span

#### Electronic Design / Product Development

WIN's engineering team maximizes performance while minimizing development time and overhead costs, drawing upon years of experience to produce a customized embedded

platform. The design/development phase encompasses:

1. Exploring various form-factors, architectural, and component options
2. Developing the product design and specifying NRE requirements and costs
3. Developing a technology roadmap that will be used in the final phase of development

### **Platform Design Process**

As with any complex engineering process careful planning and documentation are required for NRE projects. The following elements make up the platform design process:

1. Project Plan
2. Statement of Work
3. Develop Final Specification
4. Review Engineering Specification
5. Release Final Specification
6. Develop Final Block Diagram
7. Customer Review
8. Accept Final Block Diagram
9. Develop Schematics
10. Provide Complete Mechanical Specifications
11. Pre-Route
  - A) Signal Integrity Analysis
  - B) Review Specifications
  - C) Support Stack-Up Selection
  - D) Develop Routing Rules
  - E) Develop Pre-Routing Simulations
  - F) Review and Cleanse Models
12. Develop Bill of Materials (BOM)
13. Design Review
14. Acceptance of Schematics
15. Component Placement and Mechanicals
16. Baseline Thermal Model
  - A) Develop Baseline Thermal Profile
  - B) Review Worst Case Voltages and Power
  - C) Review Air Flow Strategy
17. Design Review
18. Accept Placement
19. Final Thermal Simulation
20. Procure Long-Lead Items for Prototypes
21. Routing
22. Support Routing Effort
23. Cross-Reference Design Guides

24. Electrical Simulation (post-route)
  - A) Trace Length / Impedance Analysis
  - B) Signal Integrity
  - C) Cross Talk Screening
  - D) Split Plane Discontinuity Analysis
25. Deliver Design Files
26. Final Design Review
27. Accept Final Design
28. PCB Manufacture
29. Develop Mechanical Samples
30. Assemble Prototypes
31. Board Testing
32. Engineering Validation
33. Customer-Specific Testing
  - A) Application Testing
  - B) Certifications
  - C) HALT/HASS
  - D) MTBF/ORT
34. Deliver Working Prototypes to Customer
35. Release

## Conclusion

WIN Enterprises works closely with OEM customers to deliver embedded solutions that meet or exceed market requirements. These can be COTS, modified COTS or custom design platforms. NRE charges are negotiated with the customer based on the extent of the NRE effort and ultimate production volume. For instance, the cost of minor modifications may be absorbed by WIN Enterprises – production volumes allowing. Ownership of a custom design may be shared by WIN and OEM customer based on the proportion of NRE funding that is absorbed by each - or may be owned outright by the OEM. The use of development modules speeds the NRE process, ensures reliability and helps keep charges low. Designs are maximized for long product life-cycle to provide the OEM with best possible return on investment (ROI).

