Case Study: Voice Interactive Nav/Com System

The Challenge:

Design and develop a prototype for a mobile voice interactive navigation and communication system. The prototype must be operational within six weeks to support demonstrations at the Consumer Electronics Show. Due to the compressed timeframe, written requirements were not available.

The vehicle-based system supported multiple consumer-oriented features, including voice calling, GPS based navigation, MP3 playback, speech-to-text / text-to-speech driven e-mail and web access. Beyond power on/off, the device had no controls and no visual display. The entire UI was voice interactive.

The Team and Technology:

The customer assembled a small team, consisting of experienced staff engineers and a senior consultant from Foresight Systems M&S (Foresight). The team elected to use Foresight's tools for system level design and system integration. Specific applications were to be written in C++ and Java. All applications were targeted to execute in the context of the Foresight environment to support the demo. The team leveraged Foresight's implementation-in-the-loop SDK to connect application modules directly to the executable system model. This enabled them to move quickly from initial design through to an operating prototype without the overhead of constructing a stand-alone demonstration framework.

The Process:

During the initial team meeting, the Foresight consultant captured the requirements electronically, in the form of a Foresight system block diagram. Further questioning during the kick-off meeting allowed the consultant to add the first level of detail to the initial model as the meeting was underway. By employing this rapid prototyping approach, the team was able to move immediately to structure, which allowed somewhat more flexibility within the extremely aggressive schedule. This early high-level view of the system provided a framework that was refined for all prototype and subsequent development efforts.

The Foresight consultant later highlighted the importance of creating a model that clearly reflected the client's perception of the problem. This approach facilitates communication throughout the process by eliminating translation and mental mapping errors. As a best practice, Foresight recommends using the same terms for processes and flow names as are used by the stakeholders.

The requirement for extremely precise management of user interactions was apparent from the outset of the project. Relying solely on voice interaction presented extraordinary human interface challenges. Consider a scenario where the user is following directions from the navigation system and listening to music. A call comes in, and as the user is answering the call, the navigation system needs to issue a directive. The device clearly requires a well-defined alert, command and interrupt priority system. With audible prompts and voice commands as the only interface elements, the team developed a proprietary Voice-Interactive Operating System (VIOS) to oversee the complex interactions between the user and the native applications. The behavior of the VIOS was developed entirely within the context of the Foresight model well before any applications were available. The modeling and analysis that occurred during the development of the VIOS helped flesh out the interface requirements for the applications including voice prompts and interrupt handling.

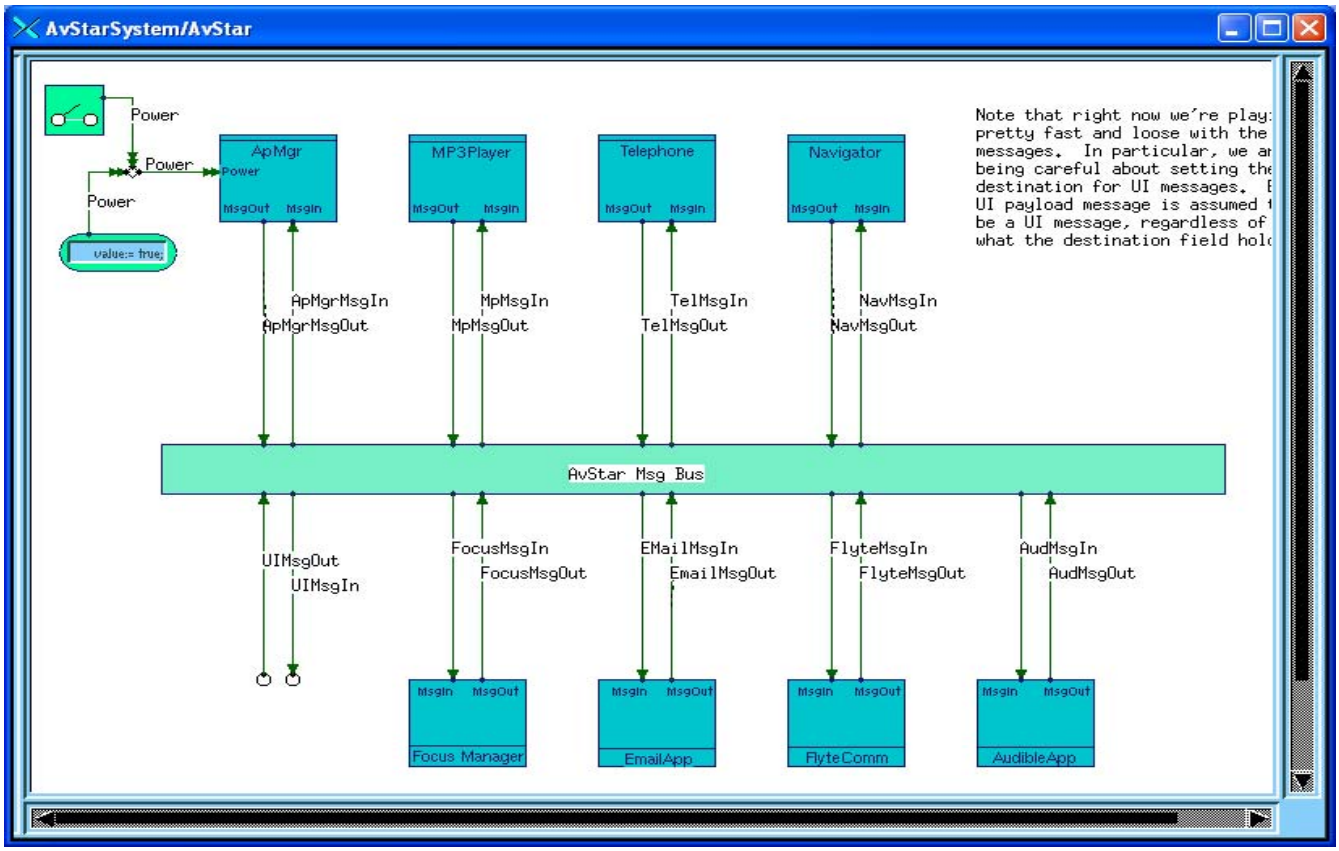
The Foresight simulatable model was connected to a voice recognizer and audio output. This allowed the team to directly "experience" the interactions during the development process

Foresight state transition diagrams were employed to develop the command processing state machines for the VIOS and all of the device's applications. Foresight's powerful graphical modeling language enabled the team to interact with the system while watching the transitions and current state of the state transition diagrams. This made tuning, modifying and debugging the system's behavior extremely straightforward.

A message passing bus provided connectivity with the VIOS as well as between the individual applications. The behavior of this core component was quite complex. It also was designed entirely within the Foresight environment. The team was able to verify that the bus met the system's requirements for prioritized inter-process communication through careful analysis with the Foresight tools.

The team's ability to move forward simultaneously on parallel development tracks for the overall system and the individual applications demonstrated another benefit of the Foresight toolset. The simulatable model served as both a framework and a foundation for the development efforts. The team plugged applications into the executable model for test and further refinement as each component was being built. This approach significantly compressed the overall development time and allowed for early integration testing to flush out interface issues and otherwise hard-to-predict user interaction problems.

For the demo, the team "implemented" some applications, such as E-mail, almost entirely in Foresight. This was possible when the application required only limited external behavior.



Summary

As the CES event grew near, the team decided to build their demonstration prototype around the Foresight simulation, running in batch mode, on a tiny PC with only speakers, microphone, and cell phone attached. This allowed them to continue to tune their prototype's behavior between demos at the event.

Although the schedule was extremely aggressive, and the initial statement of requirements was quite informal, the team burned the midnight oil and completed the prototype for the CES event. They credited the Foresight software as a key factor in their success. The powerful tools accelerated nearly all aspects of the design and development process by allowing the engineers to interact directly with a virtual prototype of the system. The availability of a "tangible" interactive environment throughout the project enabled them to identify, and eliminate, issues before the problems could impact the schedule, or the results.