



Case Study: The Role of an Embedded Database in a Secure End-to-End Transport Network

Founded in December 2001, Ceterus Networks is a provider of broadband business Ethernet solutions, using the existing SONET/SDH transport infrastructure. Their Universal Transport System (UTS) decouples client services from transport facilities, allowing transmission of client signals of any format and rate over any line type. Ceterus' products enable Ethernet transport, at up to line-rate Gigabit Ethernet, as well as integrated TDM and Ethernet over any existing infrastructure.

The Universal Transport System platform forms a secure end-to-end transport network using a Ceterus Networks patented technology. This architecture enables service providers to utilize existing copper/fiber infrastructure to form a single point-to-point virtual fat pipe with the



ability to transport multiple 10/100 or GigE clients simultaneously.

As a real-time embedded system, the UTS requires a database to provide high-performance,

have limited impact on system resources, and operate with complete reliability. Ceterus engineering conducted a thorough analysis of database vendors and selected Birdstep's RDM Embedded database for their UTS product family.

The following is an interview with Rodney Spruell, Ceterus Networks Senior Developer.

“Birdstep RDM Embedded has proven itself in meeting the stringent requirement of high data integrity . . .”

- Rodney Spruell, Ceterus Senior Developer

Why did you pick Birdstep Technology?

Birdstep's RDM Embedded database provided for an exact fit when our company evaluated database vendors for its new family of products. We needed a database management system that maintained a small footprint, was robust enough to operate in an embedded PowerPC environment, and provided reliable persistent management of vital provisioned data.

Another deciding factor was that RDM Embedded was certified for development with the Wind River Tornado AE development tool suite.

Other considerations for selecting RDM Embedded were that it supported a relational database model as well as a hierarchical model and a network mode. This breadth of flexibility allowed us to evaluate several implementation models without requiring expensive trials with multiple

vendors. RDM Embedded also came with a feature rich suite of development utility programs that can run on the host development platform or be embedded into the PPC target code for use in real-time debugging.

Explain what your UTS product offers and the role Birdstep's RDM Embedded plays in your product?

The UTS product family provides efficient transport of multiple service formats over an existing infrastructure. By bonding the line-side facilities from DS1/E1 all the way to OC-n into a single pipe, the UTS enables reuse of existing infrastructure line facilities, as well as Add Drop Multiplexers (ADMs) or other network elements for broadband services. The UTS makes the most efficient use of the transmission facilities by combining all client signals from rate-limited 10/100baseT to Gigabit Ethernet and DS1/E1 interfaces into a single payload.

We selected the RDM Embedded database as our database management system (DBMS) because it was tailored to run in a real-time embedded environment. RDM Embedded met our requirements to be small in size, highly dependable, and performance oriented.



What is the best feature Birdstep offers your company?

The most important feature in any database management system is how well the system can ensure the integrity of the data. This requirement becomes particularly more difficult to guarantee when it involves an embedded system. In an embedded system, a system outage can occur at the most unlikely time with the potential of causing a corruption of the database. RDM Embedded provides an exceptional database recovery scheme by utilizing logic that can recover outstanding database transactions during system re-initialization in the event of a total system outage and can be configured for task level protection in a multi-task execution environment.

“We have accomplished satisfying 100% data integrity even after some of the most brutal test scenarios,”

- Rodney Spruell, Ceterus Networks

There is one feature that requires an honorable mention. The db_REVISION utility included with the management tool suite provides the capability to upgrade the schema definition at runtime without losing valuable data. The means by which this is accomplished is unparalleled in the database vendor community. This utility alone saved months of development time that would have been required to design, implement, and test an in-house upgrade tool.

What other options did you consider before choosing Birdstep?

Other databases were considered. We were able to draw on the previous experiences of our engineering team to quickly eliminate possible vendors. And yes, some of our team members had positive

previous experiences with the Raima Database, which was a critical deciding factor for selecting Birdstep.

What problems have been solved by using RDM Embedded?

We have looked at it from a view of what we have been able to accomplish. There are many items we could list, but here are some of the highlights:

- We have accomplished satisfying 100% data integrity even after some of the most brutal test scenarios.
- We have been able to provide a reliable and seamless real-time programmatic schema upgrade process.
- We have accomplished building a robust, dynamic database platform that users can manage persistent data without having to have intimate domain knowledge of the underlying RDM Embedded architecture.
- We have accomplished dynamic configuration through the use of the INI file, which provides an easy means to changes database configuration parameters across our product line.

Finally, and my most favorite, we have created an environment around RDM Embedded that has almost totally eliminated the database as being the first suspect when it comes to early diagnosis of an internal software problem.

Why would you recommend using Birdstep?

Birdstep is a leader when it comes to a full-featured database management system complete with a rich set of development tools. It was designed to run on multiple platforms and can accommodate a variety of database models, including network, hierarchical, and the tried-and-true relational model. Since it is designed to operate in the context of a library, this allows versatility with how it can be implemented into a real-time environment. If a user chooses to, as we have done, a client – server implementation can be constructed with RDM Embedded at the core of the server thus allowing future growth should Ceterus move to a more sophisticated multi-

processor environment.

Integrating RDM Embedded into Wind River's Tornado AE environment has been fairly smooth. When we did encounter an issue, the Birdstep support was quick and responsive to the problem. Since the introduction of RDM 6.1 - 7.0, integration with Tornado AE has gotten much better. The overall architectural layout of the Tornado AE protection domains meshes very well into our development architecture.

The technical support for open issues has been exceptional. I have received one-on-one support help for most issues, if not all. This includes those issues that were sometimes user induced, which shows a real commitment that Birdstep is dedicated to the success of our company.

“Technical support for open issues has been exceptional,”

- Rodney Spruell

Any additional comments:

Birdstep RDM Embedded has proven itself to meet the stringent requirement of high data integrity, while maintaining a small execution footprint and minimal execution times. In the lab environment, the various Ceterus products are reset time after time, and to date, no data has been lost. This comes not with Birdstep alone, but with an in-house implementation of a database mirror scheme that ensures a real-time backup version of the database in the event the primary version becomes corrupt.



About Birdstep Technology

Birdstep Technology is traded on the Oslo Stock Exchange (OSE) under ticker 'BIRD'. The company has headquarters in Oslo and Seattle in addition to offices in Shanghai, London, Boston and San Francisco. Birdstep's small footprint, high performance database technologies combined with its wireless roaming and access software enables companies to build innovative solutions for embedded systems and the Mobile Internet. Birdstep makes your information accessible anytime, anywhere, on any device and on any infrastructure. Birdstep's global customers include 3Com (COMS), VERITAS (VRTS), Harman Becker Automotive Systems, HP (HPQ), Accenture (ACN), Telenor (TELN), PCTel (PCTI), Connect One and the National Stock Exchange of India. For more information, visit <http://www.birdstep.com/>

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About Ceterus Networks

Ceterus Networks has revolutionized the metro telecom market by developing a "single virtual pipe" architecture that supports the delivery of flexible Ethernet services on demand. Ceterus' Universal Transport System delivers all client services over a bonded pool of bandwidth, enabling the re-use of existing infrastructure, both copper and fiber, for Ethernet services. Ceterus Networks is a privately held, venture-funded company founded in 2001 and headquartered in Allen, Texas. For more information, visit the company's web site at <http://www.ceterusnetworks.com/>.

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