

TECHNOLOGY

Design house says architecture can hit 25.6 billion connections/s at 50 MHz

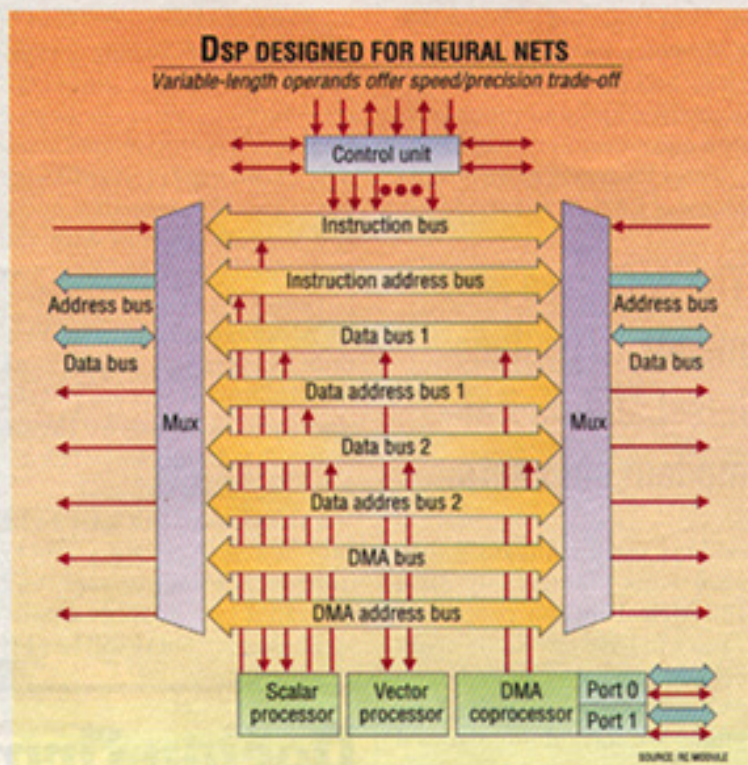
Neural-emulator IC promises scalability

By Peter Clarke

Moscow - RC Module, a joint-venture design house that has been building neural-processing systems based on Texas Instruments DSPs since its inception here in 1990, has developed its own digital superscalar neural-network-emulation IC.

The NeuroMatrix NM6403 provides a programmable operand width and is said to offer scalable performance from 50 million connections per second (Mcps) up to 25.6 Gcps when operating at a 50-MHz clock frequency. The flexible operand and ability to scale performance let designers trade off precision and efficiency to suit their applications.

Aside from performing neural-net tasks, the chip can be used for applications requiring hardware support for matrix/vector calculations. The group already has experience developing neural-network software for target recognition and acquisition, and the IC can be used to accelerate such software. (For videos of the software in action, see www.module.vympel.msk.ru/r&d/neurnew.html. Information about the NeuroMatrix NM-



6403 can be found at www.module.vympel.msk.ru/eng/advertis/new/nm_eng.html.)

The processor's highest performance is produced with single-bit operands, but RC Module claims the ability to vary operand width up to 32 bits while supporting multiple cascaded devices offers critical

flexibility for larger networks. That should make it attractive for building neural-network accelerator engines.

The chip has also been designed to work in multiprocessing arrays using the Texas Instruments TMS320C40 as a switching element.

"At the moment, we have re-

ceived five samples of the NeuroMatrix chip from Samsung, our current ASIC supplier. We have tested these samples, and they are working at a 50-MHz clock rate. That allows us to achieve more than 1 billion multiplication/accumulations per second," said Dmitri Fomin, ASIC section manager at RC Module.

The processor integrates a control unit, address-calculation and scalar-processing units, and nodes to support vector operations with elements of variable bit lengths. The part has two identical programmable interfaces that are said to accommodate most memory types. Its two communication ports are hardware-compatible with those of TI's TMS320C4x.

The chip is designed to emulate a variety of neural-network architectures by providing high multiplication rates in dedicated scalar and vector matrix on-chip processing engines.

"The number of simultaneous multiplications depends on the number and width of the operands. You can choose the necessary width [precision] for your application," Fomin said.

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"Any word length of operands, from 32 to 1 bit, is available, [as is] any performance from 50 to 25,600 Mops or Mcps."

Similarly the number of neurons and synapses depends on the operand data width.

Although the vector processor is the key to the NM6403's performance, Fomin declined to go into detail about its internal architecture because a patent is being pursued.

During calculations, the neuron states and synapse weights are stored into two 32-entry banks of 32-bit registers on-

chip. Off-chip shadow dynamic or static RAM can be used for loading the next portion of weights from the external memory in a background mode.

When asked whether such an approach generates a lot of bus traffic, Fomin replied, "We tried to balance the calculations and the data loading. But we don't have experience with our chip in real applications at a system level yet. Let's [wait and] see."

The company has designed and is debugging an evaluation board for the PC ISA bus that "could be used for software-application design," Fomin said.

"We are designing the neuro pc board for the PCI bus."

It is not yet clear whether RC Module will operate as a fabless semiconductor company or license the design to other companies. "The life of the Neuroprocessor will be depend on the project's success, but the first step is a PC card based on our chip," Fomin said.

RC Module is a joint venture among Vympel, a Russian military- and industrial-systems company; Vympel's Research Institute for Radio Devices; and RC Module's 70-person staff, which owns 51 percent of the company.