Thermal Management Technologies for Telecommunications Equipment

By A. Lyons

Heat is the enemy of electronics. Yet, it is an omnipresent byproduct of the electronic devices that use high-speed processors, high-voltage line drivers and so forth. Just as heat affects the engines in our cars (consider the consequences of driving without a cooling system), high temperatures shorten the life of electronic devices. Ironically, moving heat away from equipment takes energy – in some cases, just as much energy as it takes to power the equipment itself. Consider the challenge presented by an advanced telecom equipment cabinet that dissipates 15,000 W (15 kW) of heat in approximately four square feet (600mm x 600mm) of floor space and where many components must be kept below 185 degrees Fahrenheit (85 C) to ensure reliable operation.

At Alcatel-Lucent Bell Labs, we are conducting research to identify new techniques to improve thermal management performance while reducing the energy required to cool our equipment. We are developing innovative materials and components including:

- Thermal interface materials to conduct heat,
- Vapor chambers to spread heat and
- Heat sinks to dissipate heat into the air stream.

We are exploiting advanced manufacturing technologies to control material properties on the micro- and nano-scale to enhance thermal contacts and optimize airflow patterns. Additionally, increased use of photonics in components is resulting in decreased heat generation.

With the aid of these sophisticated thermal "tools," we are constructing a new generation of cabinets to house equipment that will deliver additional functionality to users of communications technology (which theoretically generates more heat) while reducing the energy required to cool these same systems.

Instead of *dispersing* waste heat into the central office, we are developing technologies that *transfer* waste heat to fluids that are pumped outside the building. This waste heat can be used for heating other parts of the building, or in northern climates, melting snow and ice on walkways. These approaches can replace the blowers, air handlers, chillers and compressors that are typically used indoors to move air and cool equipment. Additional benefits can be gained from reducing intake of dust and other contaminants that can compromise equipment reliability.

We are also investigating new amplifier designs that incorporate high-efficiency gallium nitride transistors. These transistors would operate at temperatures high enough to enable thermo-electric modules to efficiently convert waste heat into electricity – further increasing the overall efficiency of the amplifier. ❄

Alan M. Lyons is Project Leader of the Thermal Management Research group, DMTS, Alcatel-Lucent Bell Labs, Murray Hill, NJ, USA.

To contact the author or request additional information, please send e-mail to enrich.editor@alcatel-lucent.com.