

Two Phase Cooling of Rack Based Electronic Systems

Alfonso Ortega
PI and Director Villanova ES2

Abstract

This tutorial will introduce basic principles of liquid cooling of electronic systems when the fluid is allowed to change phase from liquid to vapor, so-called two-phase cooling. We will start by reviewing some fundamentals of thermodynamics of working fluids, in particular the concept of the liquid-vapor saturation line (the “thermodynamic dome”) in order to demonstrate why two-phase cooling is fundamentally different from single phase cooling. Next we will briefly discuss boiling in cold-plates and evaporators and condensation in heat exchangers in order to understand why boiling is such an effective way to cool electronic systems. We will then give an overview of the design of both pumped and non-pumped two-phase cooling system for rack based electronics by referring to our ES2 research data from Project 11. The tutorial will focus on engineering principles and design rather than scientific details.