Toward Place-Based, Human-Centered Networking Education

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Abstract

Traditional networking courses focus on the protocol stack and rarely make space to address the humans, communities, and places that infrastructure serves. In this position paper, I present the redesign of CS 485/585: Computer Networks at the University of New Mexico (UNM), a core elective reorganized around place-based and human-centered principles. Grounded in New Mexico's distinctive broadband landscape, including rural connectivity gaps, tribal infrastructure, and active state policy efforts, the course asks students to connect core networking concepts to real, local lived experiences. Drawing on prior experience teaching discussion-based seminars on technology and society, and on a teaching fellowship in place-based pedagogy, I describe a course designed to prepare students for the sociotechnical realities of the networks they will build and inhabit. The course launches Fall 2026; this paper shares its design ahead of that launch, invites community feedback, and sketches open questions toward a nascent methodology for place-based, human-centered networking education.

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1 Introduction and Motivation

Traditional computer networking courses move through the protocol stack layer by layer, with little attention to the people, communities, and places that infrastructure connects. Students learn to calculate bandwidth and throughput without considering how those metrics bear on whether a fiber deployment served a community well, or how an ISP's design choices shape who gets connected and who does not. This disconnect limits student motivation and obscures why the concepts matter beyond the classroom, however, this gap is not unique to networking. There are growing calls to weave ethical and human-centered reasoning across the computing curriculum, in addition to existing, standalone ethics courses [1, 14]. Computer science (CS) electives such as networking are a productive site for this integration, as the subject is rich with real-world applications and offers room to discuss issues students can see and feel in their own lives.

This position paper describes a concrete response to that gap at a single institution. I present the redesign of CS 485/585: Computer Networks at the University of New Mexico (UNM), reorganized around place-based and human-centered principles. My goal is to make *place* and *community* central to how the course is taught, rather than topics tacked on at the end. New Mexico offers a particularly rich setting for this: the state has significant rural and tribal connectivity gaps, active state-level broadband policy work, and communities engaging questions of network sovereignty and digital equity in immediate, material ways. A networking course at UNM that ignores this context passes up both a teaching opportunity and a chance to connect students to the realities of their own region.

This redesign is informed by my experience as an Assistant Professor in the Department of Computer Science at UNM's School of Engineering. I have taught discussion-based, human-centered courses to CS students, including a required ethics course and a special-topics seminar, where I found that students engage thoughtfully with the social and political dimensions of technology when the course gives them the structure and the tools to discuss difficult topics productively and with respect. This work is also shaped by a Teaching Innovation Fellowship at UNM, which offered a broader scholarly perspective on teaching as relational and situated in place [19]. I reflect on what I have learned from this approach, and how it might translate to a more technical course, in Section 3.

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2 Approach

CS 485/585: Computer Networks is a core elective and the only dedicated networking course in the UNM Computer Science department. It is cross-listed for undergraduate and graduate credit, enrolling approximately 50 students, and meets twice a week in person. I am teaching it for the first time in Fall 2026, using Kurose & Ross's *Computer Networking: A Top-Down Approach* [12] as the primary text. Course materials, including the evolving reading list, calendar, and assignment details, are available on a public course site [15], which will be updated regularly both in the lead-up to and throughout the Fall 2026 semester.

The redesign uses backwards design [20], working from learning objectives outward to assessments and learning activities. The revised objectives add two new dimensions to the course, first by engaging with current issues and emerging research in networking, and second by connecting technical concepts to real-world, sociotechnical contexts including questions of access and digital opportunity. Graduate students will additionally scope an independent group project at the intersection of networking and a domain of their choosing, and teach the class a new concept or skill through a final presentation.

Student assessment combines weekly homework assignments, three programming labs (including a Wireshark packet-analysis activity), in-class participation, a midterm exam taken by all students, and, for undergraduates, a final exam. Graduate students complete staged milestones for the independent final project in lieu of a final. Undergraduates have an opportunity to sign up for an optional "show-and-tell" slot during the semester for extra credit, which gives them the chance to also teach their peers a new concept or skill.

Each week will include one discussion-based session, using a flipped-classroom approach [2, 13]. In other words, students complete readings and accompanying homework assignment beforehand, either traditional networking problems (such as a timing diagram) or a brief written response to one of the readings, so class time can focus on discussion rather than lecture. These sessions will be marked on the syllabus in advance, so students know when to come ready to engage. A typical discussion-based session may be loosely structured as follows:

(1) Introduce a set of 2-3 warm-up questions related to the day's reading(s). These should be relevant to the week's topic, and respond to or address questions raised in students' homework[1]. For example:
   (a) Early in the semester, a warm-up question may ask students to run a speed test in-class and reflect: have you run one before? Why or why not? Which numbers seem most useful, and do you know what they mean? This works well in an early week paired with Chapter 1 of Kurose & Ross [12], since learning what those numbers mean is much of the point of the course.
   (b) Later in the semester, students may be asked to connect their knowledge of the stack with human-centered topics: how many speed tests would it take to represent the internet experience of this campus? Of Albuquerque? Of New Mexico? There are no right or wrong answers; the questions serve as a springboard for discussing broadband mapping issues in the US [16].
(2) Students discuss these in small groups (8–10 minutes).
(3) Some groups share out what they discussed (5–7 minutes).
(4) Introduce the week's key concepts, inviting the class to help define or work through new ideas rather than presenting them ready-made. (10–15 minutes)
(5) Hand out index cards that ask students to write their name, the date, and to answer one administrative question. Questions can be a simple check-in, e.g., "have you found teammates for your final project yet?" (~3 minutes)
(6) Open the class discussion for students to ask their own questions or share more reflections on the readings through the end of the class period. Collect index cards as students intervene, and grant them full participation points for the day if you receive their card before the end of class[2].

Some weeks will be slower than others. Instructors should come prepared with back-up discussion questions to surface during the open discussion and/or exercises that students could work through on the board with each other's help.

Readings will be sequenced to build critical-thinking skills gradually. Early sessions will draw solely on chapters from Kurose & Ross, to cover core concepts, and later sessions will introduce research papers and other scholarship of increasing complexity. Foundational readings include several classic networking papers: "End-to-End Arguments in System Design" [17], "The Design Philosophy of the DARPA Internet Protocols" [4], "Tussle in Cyberspace" [5], and "Understanding Infrastructure" [8]. Applied readings bring in

[1] Homework for flipped-classroom days is due 48 hours before class, with a short grace period (typically 12–24 hours). This gives me time to skim submissions and see what students focused on or struggled with before finalizing the warm-up questions.

[2] For larger classes, only a subset of students can feasibly participate on a given day. For example, last names A–L have graded participation in odd-numbered weeks and M–Z in even-numbered weeks. This policy should be stated explicitly in the syllabus, and teaching assistants can help track participation.

human-centered and community-grounded perspectives, including Palacios Abad et al.'s "Mending the Fabric" [16], Johnson et al.'s "Network Capacity as Common Pool Resource" [11], Hardy et al.'s "Rural HCI Research" [9], and Woo et al.'s "Anyone, Anywhere, not Everyone, Everywhere" [21]. Optional readings on the course site are grouped by topic to support graduate students exploring different domains for their final projects. Students interested in tribal communities, for example, will find Duarte's *Network Sovereignty* [7] and Dorr et al.'s "Toward Indigenous Presence" [6].

Toward the latter part of the semester, once students have covered enough of the stack to engage bigger questions, the course will dedicate roughly one to two weeks of emphasis on New Mexico's connectivity landscape. These applied topics will be supported by two guest speakers from New Mexico-based organizations, one with a technical focus and one with a policy focus, and by a local site visit giving students direct exposure to networking infrastructure in context. Speaker and site-visit timing will depend on partner availability and may be distributed across the term rather than confined to these weeks; an early speaker, for instance, could help seed context for the human-centered discussions that follow. These activities are being coordinated in partnership with the New Mexico Office of Broadband Access and Expansion (OBAE).

3 Reflections

Two things I have learned from teaching discussion-based seminars shape how I approach this redesign. The first is that a flipped classroom is, in my experience, robust to AI shortcuts, that is, the use of generative tools to produce work without doing the underlying thinking. Students are not only evaluated on written reflections they submit before class, which is precisely the type of work that LLMs can produce convincingly; they must also engage with the reading in person, in discussion with their peers. This engagement is significantly harder to fake. Throughout the semester, it becomes clear who is genuinely working through the material and making connections, and who is saying something only to be counted as present. The second is that the kind of discussion these topics warrant is relational, and that takes time to build. Students were often quiet at first, but week after week in the same format they grew more comfortable, and their willingness to speak improved with practice. One approach I took to support student-led discussion was to always introduce "warm-up" questions at the start of each class with smaller groups of three to four students. This portion was ungraded, and built around specific questions I wrote to get the conversation started on the week's topic. Groups were then encouraged to share a few takeaways before I opened the floor to the whole class. By the end of the semester, I was doing much less prompting and steering, and focused more on keeping the conversation on track. Students shifted from simply answering my questions directly to turning to each other and asking for their opinions.

The Teaching Innovation Fellowship refined this approach. A key takeaway is that incorporating human-centered topics is only half the work; the other half is *how* those topics are taught. For instance, my goal next semester is to decenter myself as the single source of knowledge in the room, and to help students see their peers, and not only their formal instructors, as sources of knowledge. Learning to draw on the people around you is a skill that carries over to almost any path students take after graduation, whether they become engineers, designers, or change careers entirely. To put this into practice, I have added a "teaching" component to the syllabus: graduate students formally teach the class a new concept or skill through their final presentation, and undergraduates can take part more informally through the optional show-and-tell described in Section 2.

Looking ahead, I plan to refine this course iteratively by keeping deliberate track of its strenghts and shortcomings. In particular, I will administer surveys at the start and end of the semester to gauge how students are engaging with the human-centered material, and I will invite students to submit reflections at the end of the course. The end-of-semester reflections will be part of a graded assignment, building on a practice from my special-topics seminar in Spring 2026, where students' final reflections feed a living document of tips and observations for future cohorts. The collection and use of both the survey responses and the shared reflections will go through my university's Institutional Review Board (IRB), given their potential in future scholarly work.

4 Open Questions and Next Steps

My teaching experience so far has been limited to small seminar sections with no more than 20 students, whereas CS 485/585 will enroll closer to 50. To adapt this flipped, discussion-driven format to a larger class, I look to courses I took as a student that sustained it at scale: Amy Bruckman's *Design of Online Communities* [3], which I also supported as a teaching assistant, and Annie Antón and Peter Swire's *Privacy, Technology, Policy, and Law* [18].

Several questions remain open in teaching human-centered networking, and I hope to raise them at this workshop as I finalize the course and begin to iterate on it in future years. The first relates to the limits of the approach. For instance, in-class discussion may hold up well against surface-level AI use, but integrity on homework and programming assignments remains unaddressed. A second question concerns how well human-centered, place-based networking travels to other contexts. The New Mexico framing for my course

is deliberate and specific, but could an instructor elsewhere apply the same method, grounding the course in the infrastructure and communities of their own region, to a similar effect? Furthermore, when incorporating human-centered topics and projects that connect with real-world issues, it is crucial for us as educators in this space to understand how to sustain community partnerships ethically and responsibly. How can we maintain meaningful partnerships, while recognizing that community timelines often differ from academic ones, especially when a course or project ends? This challenge is not unique to teaching; it runs through community-engaged work more broadly, particularly action research [10]. Additionally, including human-centered topics in systems-oriented classes raise questions about how we evaluate student work. How do we assess whether a place-based framing actually deepens students' technical understanding?

Ultimately, this redesign rests on a conviction that students will understand networks more deeply when they see the people and places involved in and impacted by the infrastructure. In a state like New Mexico, that understanding is timely and urgent. I wish to close in the spirit of conviviality and relational pedagogy that this work is built on. My approach to teaching reflects what I have learned from colleagues, mentors, and friends at Georgia Tech, Michigan State, the University of California Santa Barbara, Virginia Tech, the University of Washington, and UNM. This course, and this paper, are better for their influence.

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