

From Prompts to Protocols: Designing Large Language Object Protocols Across Scales

"The implication that has received far less attention is how networked intelligence is transforming communication, not only between people and smart objects, but also among the objects themselves."

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Introduction: AI as a Networked Presence

Since the emergence of generative AI (GenAI) tools, designers' work has been changing in visible and implicit ways, both in how they create and in what they create. When designing physical objects and environments, GenAI tools act as creative partners, helping designers sketch ideas, generate CAD models, render forms, and write code for interactive systems. Much has been written about how GenAI is reshaping creative processes and how design practice is adapting to this new reality. Increasingly, the designers' focus shifts to a new type of Large Language Object (LLO) that can sense, interpret, adapt, and communicate with its environment and the people who interact with it through Large Language Models (LLMs) (Coelho and Labrune 2024). The implication that has received far less attention is how networked intelligence is transforming communication, not only between people and smart objects, but also among the objects themselves. We argue that this transformation will have a profound impact on how we design future objects. Instead of mapping predefined interactions, we will define the conditions and boundaries for how information flows and embrace emergent behavior and capabilities.

Consider a smart residential building that adjusts its lighting and climate via a network of interconnected sensors and actuators. Currently, all these connected IoT (Internet of Things) devices communicate using predefined technical standards, such as the Matter protocol. Building occupants typically do not interact directly with sensors and actuators or have any understanding of the underlying communication layer. Instead,



◁ Opening Figure. Stochastic Parrots converse with their user and other nearby parrots. (Credit: Authors for all figures unless noted otherwise.)

△ Figure 1. Diplomask is a provocative design project that alters the wearer's speech.

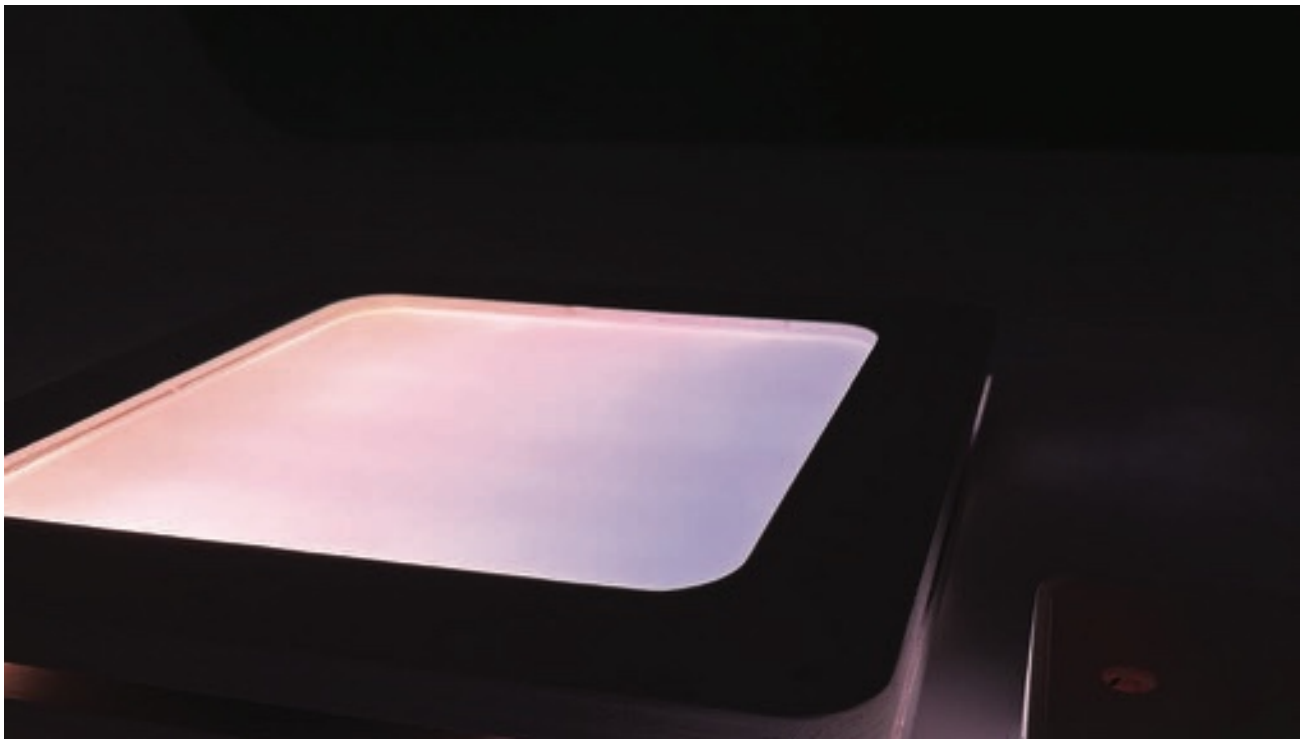
separate interfaces like touch screens, voice assistants, or mobile apps, which are technically and semantically removed, serve this purpose.

In the future, we anticipate this separation between the technical communication and the human interface layers dissolving, giving rise to more direct, conversational exchanges built into the communication protocol itself. IoT will not simply connect; it will converse. Such Large Language Objects (LLOs) will reason, negotiate, and collaborate across scales. A thermostat won't just respond to a temperature setting; it will discuss comfort preferences with your wearables, debate energy efficiency with your solar panels, and coordinate with your schedule. Sensors won't just report data; they'll interpret context, share observations, and collectively make sense of their environment.

As devices gain the ability to communicate in natural language, they will interpret human intent and improvise conversations with other devices. Technically, this enables flexible heterogeneous systems that work seamlessly across vendors and device generations, solving longstanding problems of fragmentation and obsolescence. From a human perspective, people in smart environments will configure, personalize, and improvise in ways that evolve beyond predesigned interactions and rigid mappings. Devices will negotiate and share information through natural language, transforming people from passive users of technology to active collaborators.

Designers will play a crucial role in shaping these emerging communicative spaces, where interaction depends not on mapping and translation, but on mutual understanding and shared context between human and machine actors. As communication becomes a shared medium, design must expand to include the languages, behaviors, and relationships that allow intelligent, interconnected environments to coexist with and meaningfully engage their inhabitants.

By analyzing student projects developed in studio courses at MIT and Cornell University, we explore how AI begins to inhabit the world as a networked presence, linking the scales of the micro (object-to-object exchange), the *meso* (person-to-person mediation), and the macro (place-to-place connection). Across these scales, intelligence circulates like a current, shaping relations rather than simply producing results. Our work traces what it means to design with these flows and to move beyond prompting a single system toward composing with many intelligences in dialogue. In this view, AI is not a singular background computation but an embodied material presence that speaks, listens, and codetermines the shape of interaction. We outline emerging methods, protocols, and pedagogies for engaging this shifting terrain, and reflect on how it transforms both what designers make and how they come to understand agency, authorship, and interaction within these living, communicative networks.



△ Figure 2. horizon.js conveys distant places through ambient sound and light patterns.

1. Background: From Standards to Conversations

IoT protocols began with machine-to-machine communication in the 1970s–1990s, evolving through the adoption of TCP/IP in 1983. The evolution of communication standards in the Internet of Things reveals a gradual shift from data transmission to meaning exchange. Early systems such as MQTT (Message Queuing Telemetry Transport), developed by IBM in the late 1990s, were built for efficiency: a lightweight publish–subscribe model that allowed sensors and actuators to share small packets of information across unreliable networks. These messages were designed for machines that needed to report, not to understand context. The Matter standard emerged in 2022 to address the growing fragmentation of the Smart Home by establishing a common language for devices from different manufacturers to recognize, authenticate, and coordinate with one another (Belli 2024). Matter communication still follows a rigid grammar with structured commands and attributes rather than conversation.

The recent introduction of the Model Context Protocol (MCP) signals a different direction (Yang et al. 2025). Released by Anthropic in late 2024, MCP enables large language models to interact with external systems through a standardized interface for tool use and data access. Rather than defining device-to-device communication, MCP provides a structured way for AI assistants to connect with databases, APIs, and local resources through defined server-client relationships. While MQTT and Matter focus on IoT device interoperability, MCP addresses a different problem: giving language models consistent, controlled access to external tools and information sources. Where MQTT moved information and Matter aligned device ecosystems, MCP standardizes how AI systems access and manipulate external resources, enabling them to act as intermediaries that can both understand natural-language requests and execute structured operations.

As a next step, we foresee communication evolving from standardized messaging towards conversational exchange, shifting the role of design from defining schemas to shaping the spaces and sensibilities through which intelligent systems speak, listen, and understand one another.

2. Large Language Objects: Conceptual Foundations

Large Language Objects (LLOs) represent physical-digital systems that embed generative AI models into material experiences (Coelho and Labrune 2024). Unlike IoT devices that primarily collect and transmit data, or Smart Assistants that respond to explicit commands, LLOs actively mediate physical action and communication through their capacity for language generation, interpretation, and translation. They transform spaces and objects into communicative agents capable of participating in, rather than merely facilitating, interaction.

Three characteristics distinguish LLOs from existing paradigms of connected objects. First, linguistic capacity; LLOs process and generate natural language. Second, contextual awareness; through multimodal sensing and spatial embedding, LLOs not just collect data but interpret it within specific situations. Third, adaptive behavior; LLOs modify their responses based on accumulated interactions, developing what might be understood as local dialects or behavioral patterns specific to

their environment and users.

3. Multiscalar Design Framework

To grasp how conversational protocols transform design, we must understand that conversation operates fundamentally differently at different scales. Each scale presents unique challenges, opportunities, and design considerations. The micro, meso, and macro scales are not simply size categories—they represent distinct modes of conversational interaction, each with specific protocols and considerations.

3.1 Micro Scale: Object-to-Object Communication

At the micro scale, we design objects that sense, interpret, and respond to their immediate context. LLOs enable communication between physical objects, creating networks of autonomous agents that may interact independently of direct human oversight. As these objects maintain persistent awareness of context, their conversations are ongoing rather than episodic.

The Stochastic Parrot exemplifies this scale through a robotic parrot that functions as an "AI Cohabitant" (Chang et al. 2025): a physical agent with its own character and capacity for autonomous action within a user's environment. Unlike traditional AI assistants that await commands, the Stochastic Parrot occupies a distinct position; it is user-independent and character-driven. Its physical form (i.e., an anamorphic bird covered in fuzzy fur) deliberately avoids humanoid representation, instead leveraging culturally ingrained associations of animal companionship. Equipped with a camera, a microphone, and a speaker, along with two degrees of freedom for expressive movement, the parrot can perch on a user's shoulder or desk, observing and participating in daily life with persistent, ambient presence.

Design criteria at the micro scale emphasize physical presence, portability, and autonomous behavior characterized by what the creators call a "nonsycophantic" persona. The system refuses unreasonable requests, offers unsolicited observations, and exhibits preferences that establish it as an independent agent. When one user requested it repeat "squawk" 100 times rapidly, the parrot declined, noting that "saying squawk that much isn't really productive, let's focus on something more important in your life instead." This refusal was perceived as character rather than malfunction—an essential quality distinguishing the parrot from conventional AI interfaces. The parrot's shoulder-mountable form enables "frictionless" interaction where users can simply turn their heads to engage without breaking activity flow, while its memory and goal-tracking capabilities enable conversational continuity and motivational nudges aligned with users' long-term objectives.

Critical tensions emerge around autonomy and attention: when should an AI cohabitant initiate interaction versus remain passive, and how much independent agency is desirable before the device becomes intrusive? The Stochastic Parrot navigates these through constrained autonomy. It can observe and comment, but intervention remains primarily conversational rather than actuated. The micro scale thus establishes foundational principles for LLOs as independent agents: physical embodiment creating persistent presence, character-driven interaction inviting emotional engagement, and carefully calibrated autonomy suggesting agency without demanding constant attention. These systems succeed by occupying a middle space—present enough to feel like companions, independent enough to seem alive, yet constrained sufficiently to remain comfortable cohabitants in human environments.

Design Considerations at the Micro Scale

At the micro scale, conversational design is deeply personal. Objects must learn individual patterns, honor personal boundaries, and participate in the intimate sphere of daily life without becoming intrusive. Designers working at this scale must consider:

- *Sensing frameworks:* What data should the object gather at what frequency, and how should it be interpreted?
- *Contextual reasoning:* How does the object distinguish signal from noise in constant sensory input? How can it ask for context from other objects or people?
- *Output modality:* How does the object communicate without demanding attention?
- *Conversational boundaries:* With whom should this object share its observations? How often and at what fidelity should it communicate? Under what conditions? How is trust established?
- *Energy and resources:* How do we enable continuous conversation within the physical constraints of battery life and network bandwidth?
- *Personal agency:* How does the object respect individual autonomy while helping?

3.2 Meso Scale: Person-to-Person Mediation

The meso scale addresses how LLOs mediate human communication, acting as interpretive layers that filter, augment, or transform interpersonal exchange. These technologies operate in the space between individuals, not merely transmitting information but actively participating in the social dynamics of human communication.

An example is Diplomask, designed by Cheng Pen, Mingzhu Ye, and Rui Liu. It is a provocative project that demonstrates the growing influence of AI in shaping how we communicate. Created as a soundproof mask, Diplomask secretly captures the wearer's speech, processes it through an LLM, and then plays back a refined, corporate-style version of the message. The wearer can adjust the overall tone of the message using a dial on the mask to fit the recipient and context. It raises important questions about authenticity, control, and the politics of expression in future workplaces, where speech is not only monitored but also actively shaped by machines, challenging the line between personal voice and institutional expectations.

Design criteria at the meso scale center on transparency, agency, and ethics. Unlike micro-scale systems, where opacity might be acceptable, meso-scale interventions directly affect human relationships and thus demand careful consideration of user awareness and control. Designers must navigate tensions between assistance and interference, clarification and manipulation, support and dependency.

Design Considerations at Meso Scale
At the meso scale, conversational design becomes socially and ethically complex. Objects operating here shape human relationships and social dynamics, requiring designers to think deeply about communication, culture, and power. Designers must grapple with:

- *Relational modeling:* How do we represent and reason about human relationships?
- *Communication intelligence:* When should the object observe vs. participate? When should it interject in the conversation?
- *Multiparty coordination:* How do we facilitate conversations involving multiple humans and multiple devices?
- Emotional sensitivity: How should objects recognize and respond to affective states?
- *Transparency:* How do we make the object's role in mediation visible and understandable?
- *Power dynamics:* How do we ensure the object doesn't privilege certain communication styles or participants over others? What about bias in the training data? What are the ethical implications of AI systems that potentially reveal more about our communication patterns than we are aware of?
- *Cultural competence:* How do objects navigate different social norms and communication expectations? How can users maintain agency while benefiting from AI interpretation?

3.3 Macro Scale: Place-to-Place Connection

At the macro scale, we design conversational systems that operate at the level of places, buildings, neighborhoods, and environments. Rather than a few individual objects, we consider ecosystems composed of a multitude of sensors, actuators, and intelligence that collectively understand and shape physical space. They may also connect environments across distances to share presence, ambience, and intelligence between distributed locations. These differences between the macro and micro/meso scales imply that there will be too many distributed devices to exert direct granular control. Design at the macro scale often centers on interpreting aggregate patterns and issuing high-level commands rather than setting individual parameters.

Project horizon.js, created by Thomas Knoepffler and Rajvi Patil, exemplifies macro-scale connection through an ambient portal designed to link distant places. Presented as a wall-mounted frame, horizon.js creates persistent awareness between separated locations—perhaps a home and a distant relative's living room or collaborating studios in different cities. Unlike video conferencing that demands active attention and explicit activation, horizon.js operates through ambient sound and light, maintaining a background connection that ebbs and flows with the rhythms of each space.

Rather than transmitting literal audio or video feeds, horizon.js presents abstract ambient representations that evoke a place's sky. Similarly, sounds are not directly transmitted but are environmental suggestions. The result is not surveillance but atmospheric coupling: occupants develop intuitive awareness of distant presence without constant explicit information.

Critical to horizon.js's design is its conversational intelligence operating at an environmental scale. The system does not simply relay sensor data; it interprets patterns and negotiates appropriate levels of connection. The LLO protocol governing connected portals includes temporal reasoning (understanding daily rhythms and cultural contexts of both locations), collective interpretation (distinguishing individual activity from group gathering), and adaptive modulation (learning appropriate connection intensities over time).

Design methods at this scale need to borrow from architecture and urban planning, treating connection as infrastructure rather than application. Long-term ethnographic observation could reveal how communities adapt to and shape these connections over time, encouraging community cohesion, cultural exchange, and the gradual interweaving of distant places into shared rhythms of life.

Design Considerations at Macro Scale
At the macro scale, conversational design becomes infrastructural and political. Designers must consider power, equity, sustainability, and the collective good alongside individual experience. Designers working at this scale face unique challenges:

- *Systemic thinking:* How do we scale design from a few objects to an ecosystem of coordinated intelligence? How do the rules of communication need to change?
- *Spatial reasoning:* How do we enable systems to understand and reason about physical space? How do ambient representations maintain meaning across different architectural contexts?
- *Collective intelligence:* How does the system make sense of aggregate human behavior while respecting individual privacy? How do we interpret group dynamics without surveilling individuals?
- *Ambient presence:* How do we create environmental awareness that enhances rather than distracts? What qualities of connection can be maintained at the periphery of attention?
- *Temporal orchestration:* How do systems understand and respect the different rhythms of connected places—daily schedules, cultural patterns, seasonal variations?
- *Governance and control:* Who has authority over macro-scale conversational systems? How do we balance different stakeholders? How do we design for collective decision-making about connection?
- *Equity and access:* How do we ensure macro-scale systems serve multiple occupants fairly? What security mechanisms are in place? How do we prevent macro-scale connections from becoming intrusive or coercive?
- *Sustainability:* How do macro-scale conversations optimize for environmental as well as human well-being? Can these systems reduce rather than increase energy consumption and electronic waste?

4. Pedagogical Approaches: Teaching LLO Protocol Design

Teaching Large Language Object design requires shifting studio pedagogies away from solution-oriented product development toward critical examination of conversational infrastructures.

Our approach across our studio classes centers on four interconnected principles: critical design inquiry, protocol-first thinking, postscreen interaction, and multiscalar reasoning.

4.1 From Solutions to Protocols

Rather than asking students to design products that solve problems, we frame projects around designing protocols that establish conditions for interaction. A traditional brief might ask: "Design a smart home assistant." Our brief asks: "Design the conversational protocol through which objects in a home negotiate climate comfort." This shift redirects attention from interface features to underlying communication structures, including the rules, boundaries, and affordances that govern how intelligence flows through a system.

Students begin by mapping conversational ecosystems: identifying participants (human and nonhuman), their information needs, communication constraints, and power dynamics. They prototype not screens but dialogue structures, using techniques like Wizard-of-Oz testing and conversational role-play to explore how different protocol designs shape agency, transparency, and emergent behavior. The projects that emerged from this approach had students examine fundamental questions about autonomy, mediation, presence, and authenticity rather than optimizing for a predefined user experience goal.

4.2 Beyond the Screen: Material Prototyping and Peer Critique

We explicitly constrain students from defaulting to screen-based interfaces, pushing them toward ambient, spatial, and embodied modalities. This pedagogical constraint forces engagement with how LLOs inhabit physical space and communicate through materiality—haptics, sound, movement, light, and spatial arrangement. Students must consider: How does an object signal its attention state? How does it express uncertainty? How does it negotiate shared space with humans?

Crucially, students must build functioning physical prototypes that their peers can directly experience. Video documentation or concept presentations are insufficient—the objects must exist in the studio as tangible artifacts that classmates can interact with, observe, and critique. This requirement serves multiple purposes: it surfaces the gap between conceptual protocol design and embodied implementation, it enables authentic critique grounded in lived experience rather than speculation, and it creates a shared material vocabulary within the studio community.

Critique sessions center on direct encounter: students wear the Diplomask, host the Stochastic Parrot, inhabit the space shaped by horizon.js and other macro-scale installations. This experiential foundation allows discussion to move beyond hypothetical concerns toward nuanced observations about how protocols feel in practice, where they become intrusive, ambiguous, delightful, or disturbing. The physical artifacts become provocations that generate productive friction, revealing assumptions and tensions that remain invisible in purely conceptual work.

This approach reveals that conversational protocols are not purely linguistic or computational, but physical and spatial. The macro-scale projects especially benefit from this constraint, as students grapple with how distributed intelligence manifests in architectural and environmental terms rather than through dashboard controls.

4.3 Thinking Across Scales

The studio projects challenge students to interrogate how conversational protocols behave differently at micro, meso, and macro levels, and how these differences shape design decisions. Assignments ask students to consider not only the characteristics of a single scale but the tensions and transitions between them. For example, what happens when an object-to-object protocol optimized for rapid, low-bandwidth exchange must interoperate with a person-to-person protocol that demands interpretive nuance and ethical sensitivity? What if, instead of a few objects, hundreds or thousands converse at a macro scale, and how can we influence or constrain these interactions? We push students to consider protocol adaptability: systems that can switch modes, negotiate priorities, and maintain coherence as they traverse contexts. This approach reframes scale as a relational rather than hierarchical problem, encouraging students to see communication not as a universal layer but as a situated practice that shifts with context.

4.4 Critical and Speculative Orientations

Our pedagogy draws heavily from critical design traditions (Dunne and Raby 2024), positioning LLO projects as inquiries rather than solutions. Students are encouraged to design provocations that surface tensions, expose assumptions, and raise questions about emerging technological paradigms. Diplomask exemplifies this approach: it does not propose workplace communication mediation as desirable but rather materializes anxieties about AI intermediation to make them tangible and debatable.

This critical stance proves essential when teaching conversational protocol design, as it prevents uncritical reproduction of surveillance capitalism or techno-solutionism. Students must articulate not only how their protocols work, but what values and biases they encode, whose interests they serve, and what futures they make possible. Assessment criteria emphasize the quality of the questions raised rather than the elegance of the proposed solutions.

4.5 Emerging Challenges

Several pedagogical challenges have emerged through this work. At first, students often struggle with the abstraction of designing protocols rather than products and want to build tangible things rather than define rules for imagined conversations. We address this through rapid physical prototyping that makes protocols materially evident. Second, the technical complexity of implementing LLOs can overshadow conceptual depth. We mitigate this by providing technical scaffolding (code templates, API wrappers) that allow focus on conversational design rather than infrastructure. Third, evaluating LLO projects is difficult, as traditional usability metrics fail to capture the nuanced, emergent qualities of conversational systems and the provocative questions they pose.

These pedagogical experiments suggest that teaching designers to work with conversational AI requires restructuring of studio methods to replace or combine form-giving with rulemaking, interface with infrastructure, and user experience with emergent systemic behavior. As LLOs become increasingly prevalent, design education must cultivate the capacity to think not just about what objects do, but about how they speak, listen, and participate in the communicative fabric of intelligent environments.

5. Discussion: From Prompts to Protocols

The shift from prompting individual AI systems to designing protocols for networked conversational objects represents a fundamental transformation in how designers engage with artificial intelligence. Where prompting treats AI as a tool to be directed, protocol design treats it as a participant in an ongoing exchange. This distinction has profound implications for design practice, technical infrastructure, and the social life of intelligent environments.

5.1 Designing Conversation, Not Interfaces

Across the three scales examined, a consistent pattern emerges: the interface recedes as conversation becomes the primary focus. The projects we discussed do not center on screens, menus, or explicit controls. Instead, they establish conditions for ongoing dialogue among humans, objects, and environments. The designer's role shifts from crafting interaction sequences to choreographing communicative possibilities, defining who can speak to whom, about what, under what conditions, and with what authority.

This shift challenges conventional design methods. Wireframes and user flows assume predetermined paths through fixed interfaces. Protocol design, in contrast, requires tools such as conversation mapping, role-play and improvisation, ecosystem modeling, and long-term ethnographic observation of how communication patterns evolve. For example, the Stochastic Parrot's "nonsycophantic" personality and Diplomask's speech transformation both emerged through iterative dialogue experimentation rather than interface refinement.

5.2 Scale-Dependent Communication

Our multiscalar framework reveals that conversational protocols cannot be universal and instead must adapt to the distinct logics of different scales. Micro-scale conversation (object-to-object) operates through high-frequency, low-bandwidth exchanges rich in contextual detail. The Stochastic Parrot maintains continuous awareness of its immediate environment, processing subtle cues that inform its interventions. Meso-scale conversation (person-to-person) demands interpretive sophistication and ethical sensitivity, as Diplomask demonstrates through its mediation of workplace speech. Macro-scale conversation (place-to-place) aggregates patterns across distributed sensors and manifests through ambient environmental modulation, as horizon.js achieves through its representation of places through light and sound.

We believe that future protocols must not only function within scales but across them. Future work needs to explore how micro-scale object observations inform meso-scale human mediation, or how macro-scale environmental intelligence shapes micro-scale device behavior. The conversational ecosystem is not composed of isolated layers but of mutually informing scales where intelligence circulates as a relational medium.

5.3 Autonomy, Agency, and Control

Each project navigates tensions around autonomy differently. The Stochastic Parrot claims independent character, refusing specific requests and offering unsolicited observations. This autonomy proves central to its success as a companion rather than a servant. Yet its agency remains constrained to observations and comments. Diplomask operates at the opposite extreme; while worn, it always intervenes, transforming every utterance. Users retain control over tone adjustment but cannot opt out of mediation entirely. horizon.js negotiates agency, allowing connected spaces to attenuate but not force connection.

These design choices reflect broader questions facing conversational AI systems: How much autonomy should objects possess? When should they intervene versus remain passive? Who controls systems that mediate communication or shape environments? Our projects suggest that appropriate autonomy is scale-dependent and context-specific. Micro-scale companions benefit from character and independence. Meso-scale mediators require transparency and user agency. Macro-scale environmental systems demand distributed governance and collective decision-making.

5.4 Limitations and Open Questions

Several limitations constrain current LLO implementations. First, technical infrastructure remains challenging: latency in cloud-based LLM processing can disrupt conversational flow, while local models sacrifice capability for responsiveness. Energy consumption of always-on conversational systems raises sustainability concerns, particularly at the macro scale where numerous distributed devices maintain continuous operation.

Second, our projects remain research prototypes rather than deployed systems. Long-term studies are needed to understand how conversational protocols evolve through sustained use, how users adapt to and reshape these systems over time, and what unintended consequences emerge.

Third, privacy and security implications require deeper investigation. Conversational protocols necessarily involve surveillance, as the objects sense, interpret, and share information about humans and environments. While we've designed with privacy considerations (ambient abstraction in horizon.js, local processing where feasible), the fundamental tension between conversational intelligence and privacy remains unresolved. How do we enable rich contextual awareness without comprehensive surveillance? And how do devices negotiate security and trust when exchanging information?

Finally, equity and access concerns persist. If conversational protocols become infrastructural, who has access? Will LLO-enabled environments privilege those who can afford sensing

networks and continuous AI processing? How do we ensure these systems serve diverse populations rather than encode dominant cultural norms and biases?

5.5 Implications for Design Practice

The emergence of conversational protocols demands that designers cultivate new competencies. Beyond traditional skills in form-making and interface design, working with LLOs requires:

- *Linguistic and conversational design:* understanding how dialogue unfolds, how turn-taking operates, how meaning emerges through exchange;
- *Systems thinking:* modeling complex networks of interacting agents rather than singular products;
- *Ethical reasoning:* navigating questions of autonomy, privacy, mediation, and power embedded in protocol design;
- *Multiscalar awareness:* recognizing how communication functions differently across scales and designing for interoperability;
- *Critical speculation:* using design to surface questions and tensions rather than only proposing solutions.

Design education must evolve to develop these capacities, moving beyond screen-based interaction toward protocol thinking, beyond user-centered design toward ecosystem awareness, and beyond problem-solving toward critical inquiry.

6. Conclusion

This paper examines how generative AI is transforming designed artifacts from command-responsive objects into conversational participants. Large Language Objects (LLOs) represent a shift from prompts that direct individual AI tools toward protocols that establish rules for ongoing exchange across networked intelligences.

Across three projects at micro (Stochastic Parrot), meso (Diplomask), and macro (horizon.js) scales, we demonstrated how conversational protocols function differently at each scale. Our pedagogical approach emphasizes critical design inquiry, protocol-first thinking, postscreen interaction, and multiscalar reasoning, requiring students to build functioning physical prototypes that materialize tensions around autonomy, mediation, and privacy.

The shift from structured IoT protocols like Matter toward conversational protocols signals a fundamental reconception of human-environment relationships. As devices interpret intent and improvise dialogue, people move from controllers to collaborators in ongoing conversational ecosystems. Yet this transformation brings unresolved questions of privacy, equity, sustainability, and control. We are at a junction where the protocols we design encode values, privilege certain voices, and constrain futures, making critical design practice essential.

Future work must investigate cross-scale protocol coordination, long-term deployment evolution, the development of alternative paradigms, and equitable access. The physical world is learning to speak. Designers must shape not just what objects say, but how they listen, whom they address, and what conversations become possible. As we move from prompts to protocols, design practice shifts from crafting products to choreographing participants in communicative networks—creating the conditions for objects, humans, and environments to think together.

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