start making sense: semantic plane filtering and control for post-5G connectivity

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the traditional spot of a comm engineer

1.2. Three Levels of Communications Problems

Relative to the broad subject of communication, there seem to be problems at three levels. Thus it seems reasonable to ask, serially:

LEVEL A. How accurately can the symbols of communication be transmitted? (The technical problem.)

LEVEL B. How precisely do the transmitted symbols convey the desired meaning? (The semantic problem.)

LEVEL C. How effectively does the received meaning affect conduct in the desired way? (The effectiveness problem.)

The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning;* that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one

Shannon, C. E., and W. Weaver. "The mathematical theory of Communication" University." *University of Illinois Press* (1963).

trends that shake the traditional comm spot

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the comm engineering

this turned into a trap!

trends that shake the traditional comm spot

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the comm engineering

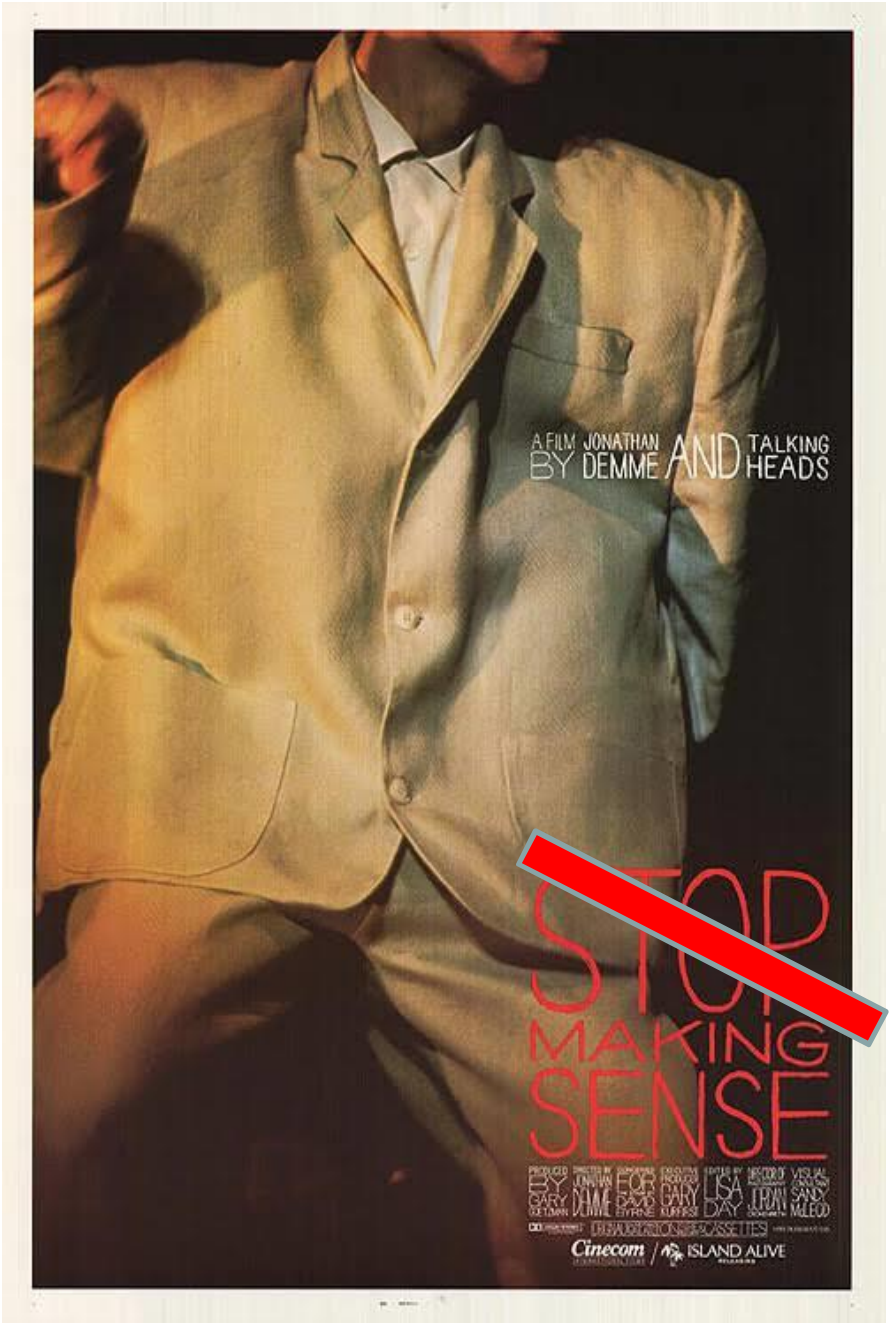
FAANG++

Facebook
Amazon
Apple
Netflix
Google
++

getting data accurately from A to B
perceived as ”easy” and even ”boring”

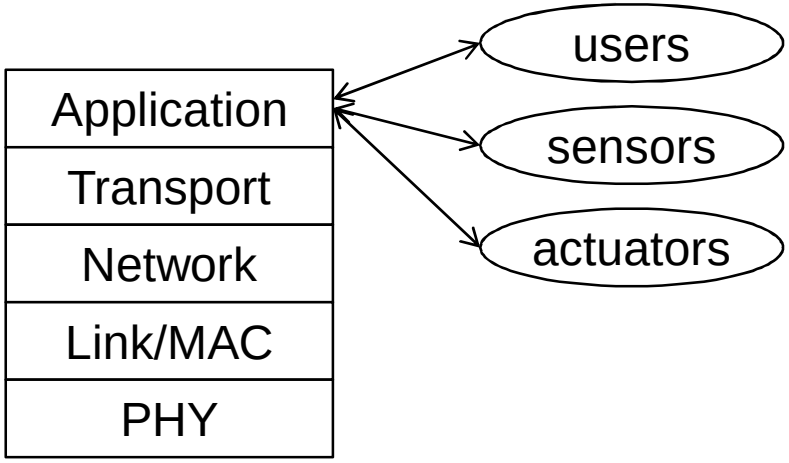
trends that shake the traditional comm spot

- wireless connectivity becomes a commodity,
  more conceptual advances expected in entities that use it.
- ML/AI extract information from a lot of side channels accessible throughout the protocol stack.
- expected explosion in semantic overhead,
  i.e. data ending up not being used.
- increased protocol overhead due to
  security, privacy and trust.



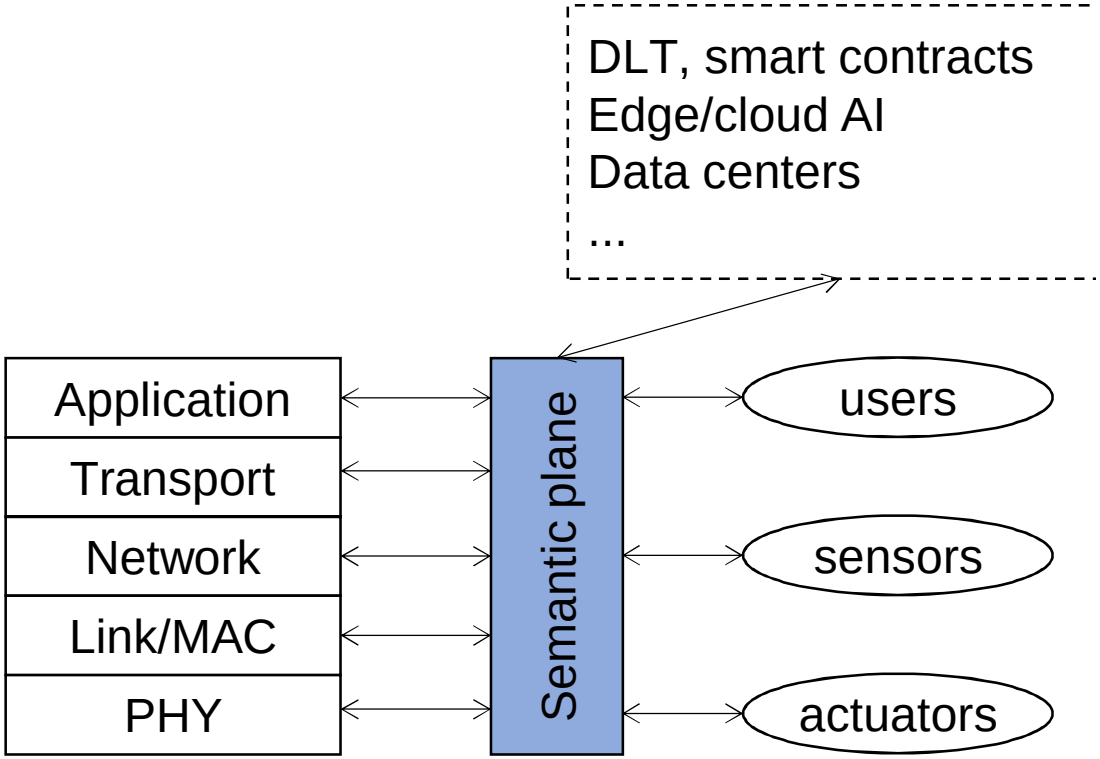
start making sense

proposed architectural evolution

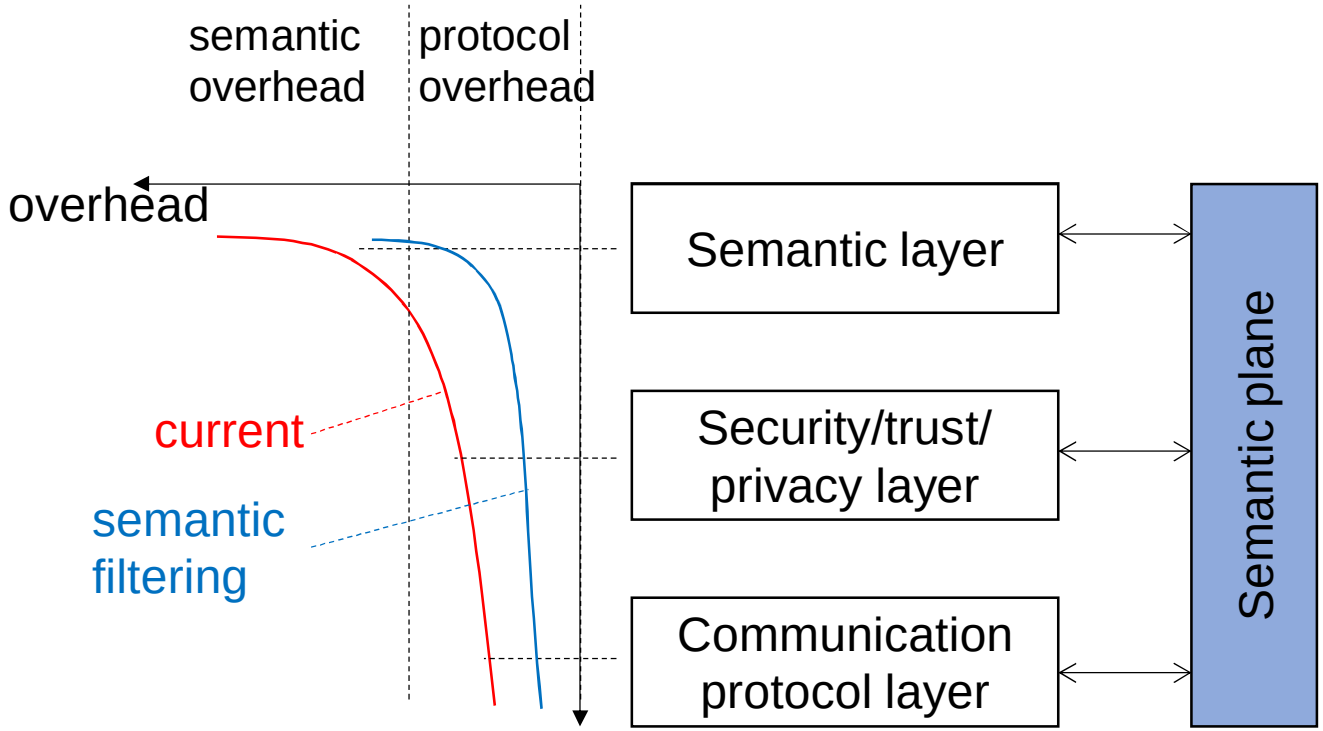


2G-3G-4G-5G

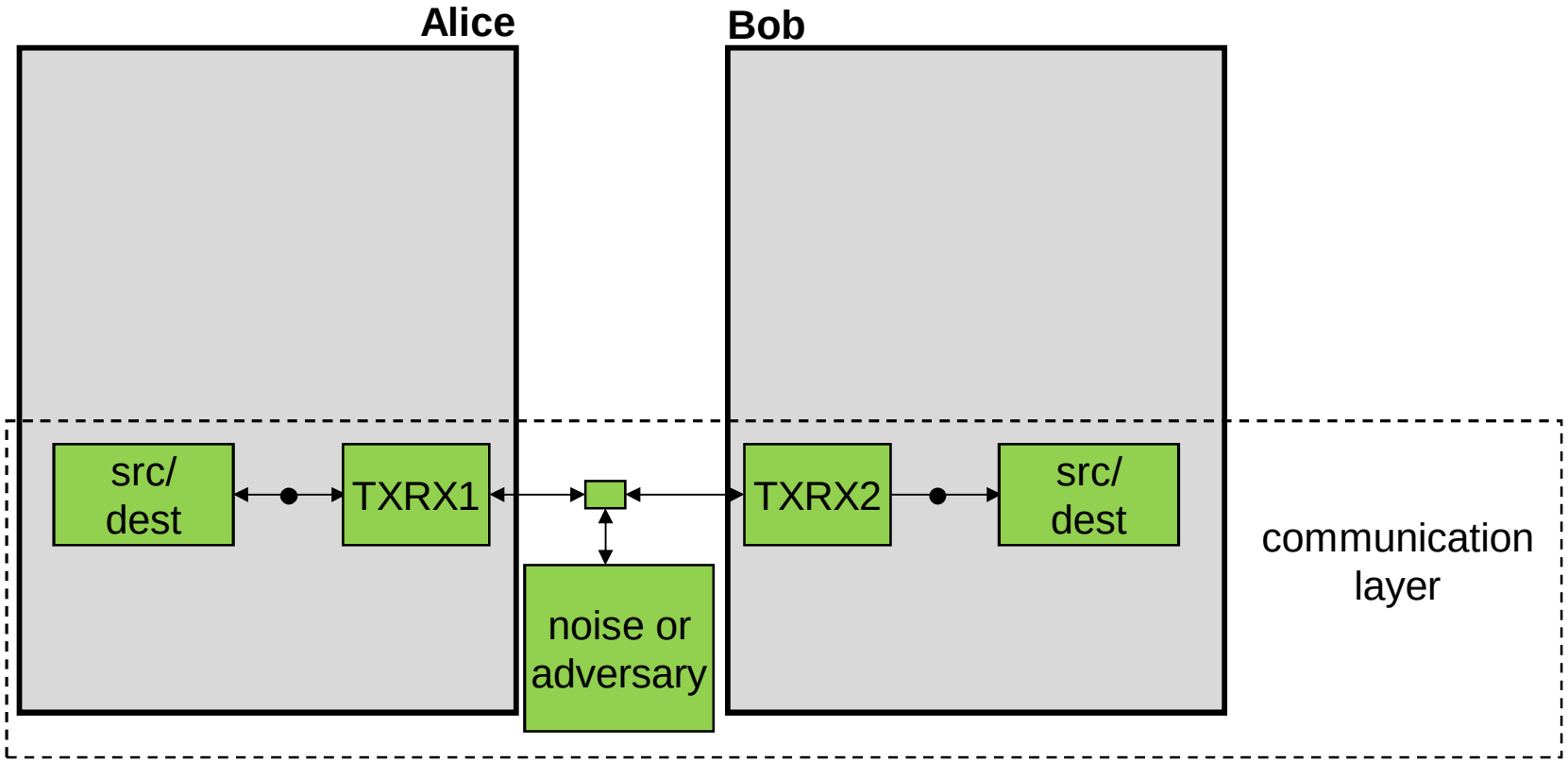
5+G or 6G



the effect of semantic filtering



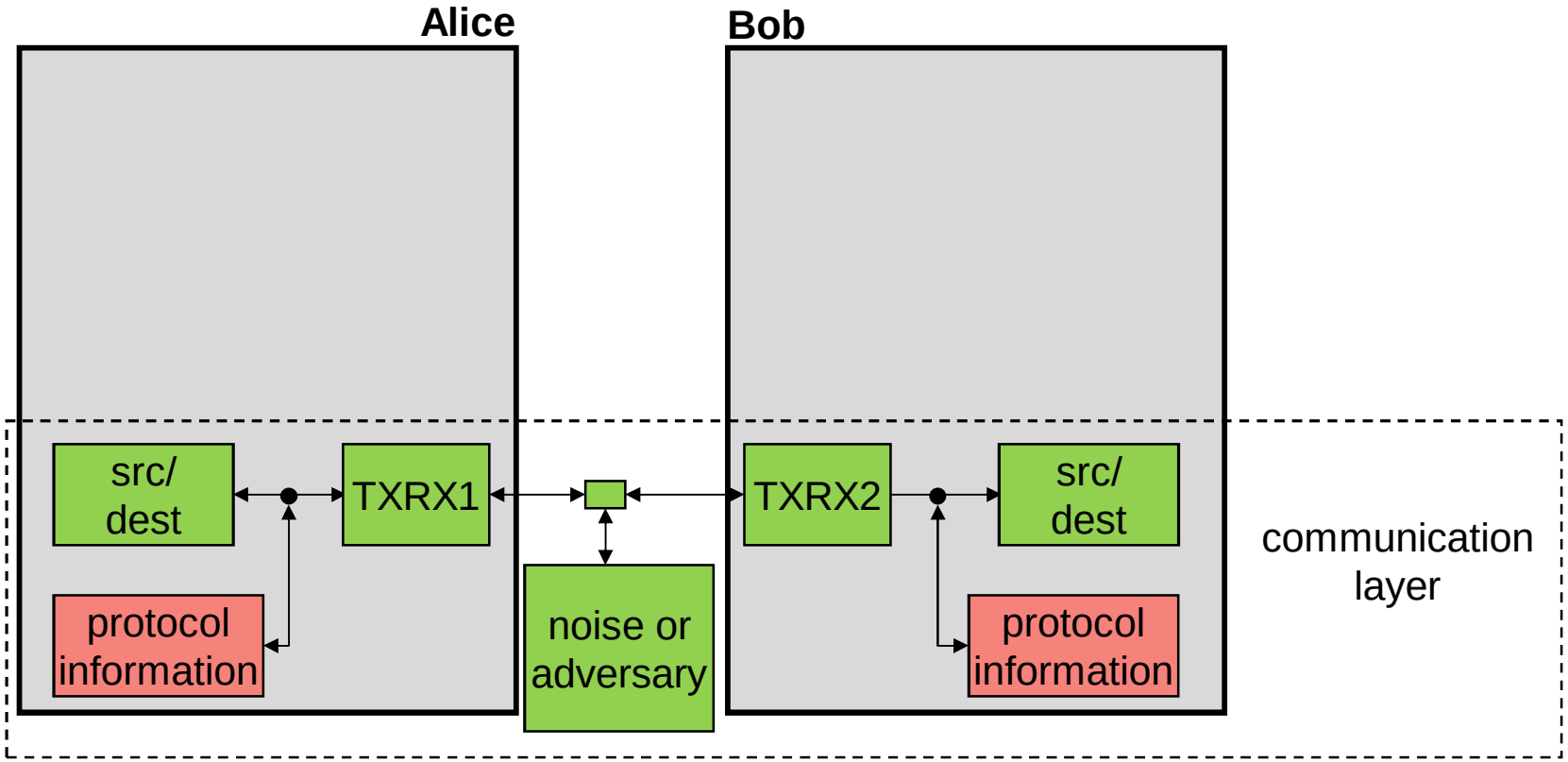
the communication model



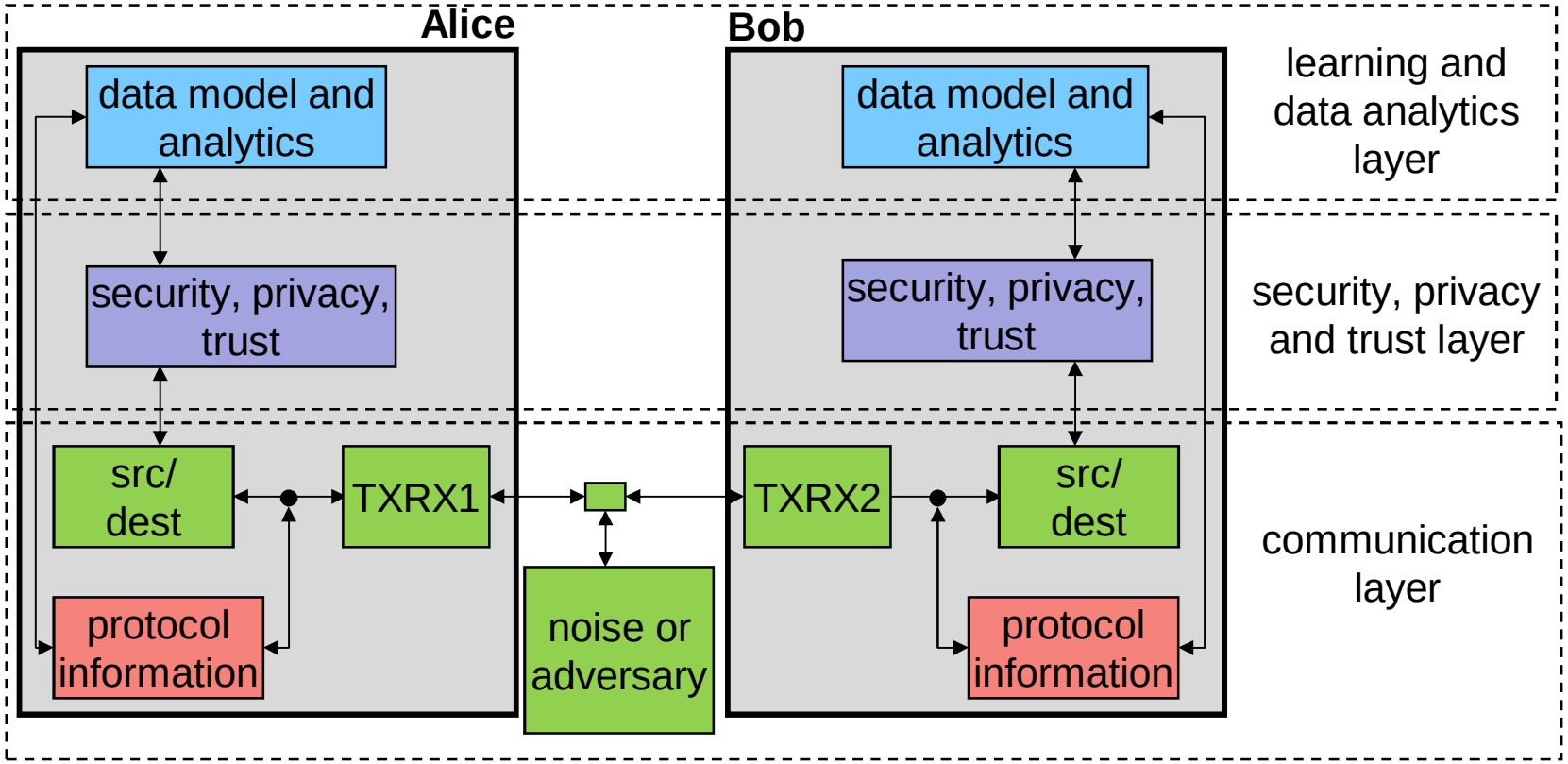
mathematical model of communication (Shannon):

- § digitalization
- § modularization

the 5G model for lean protocols



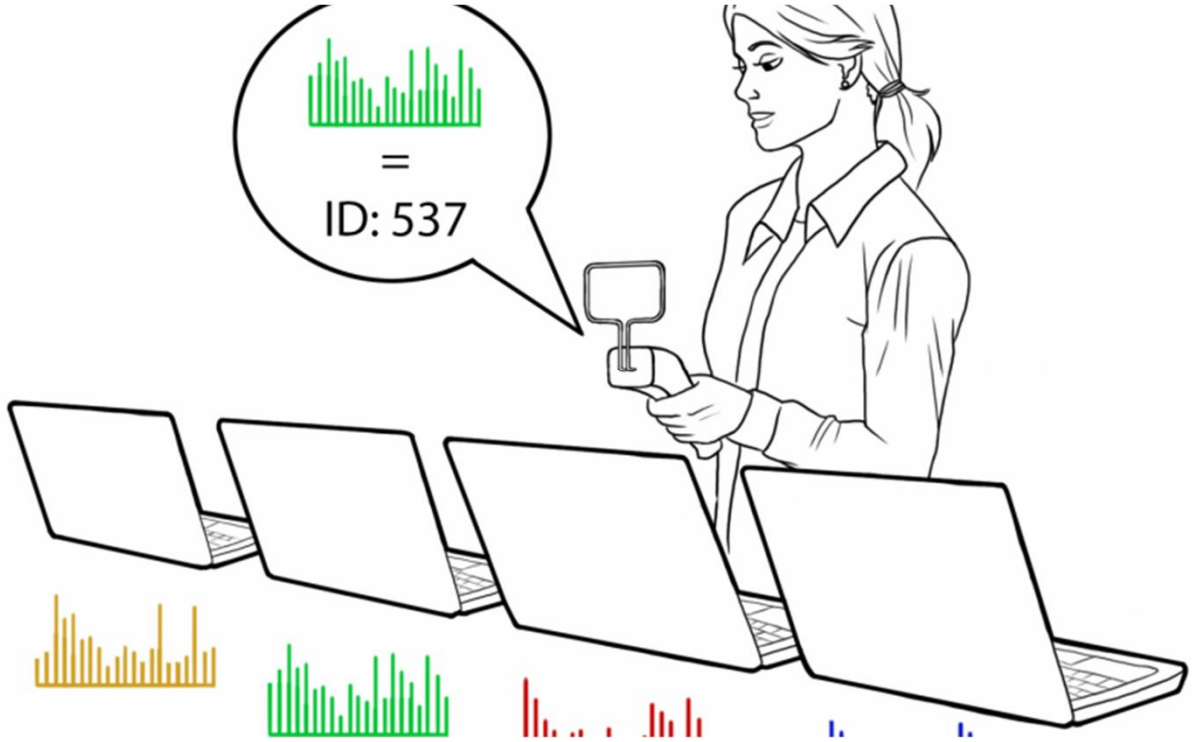
upgrading the model



post-5G model

examples of semantic plane functionality

§ physical layer provenance filtering
separate relevant signals through device fingerprinting



source: phys.org

examples of semantic plane functionality

- mmwave/THz radar and communication
  use the same PHY-interface to integrate them

J. Choi, V. Va, N. Gonzalez-Prelcic, R. Daniels, C. R. Bhat, and R. W. Heath, “Millimeter-wave vehicular communication to support massive automotive sensing,” IEEE Communications Magazine, vol. 54, no. 12, pp. 160–167, 2016.

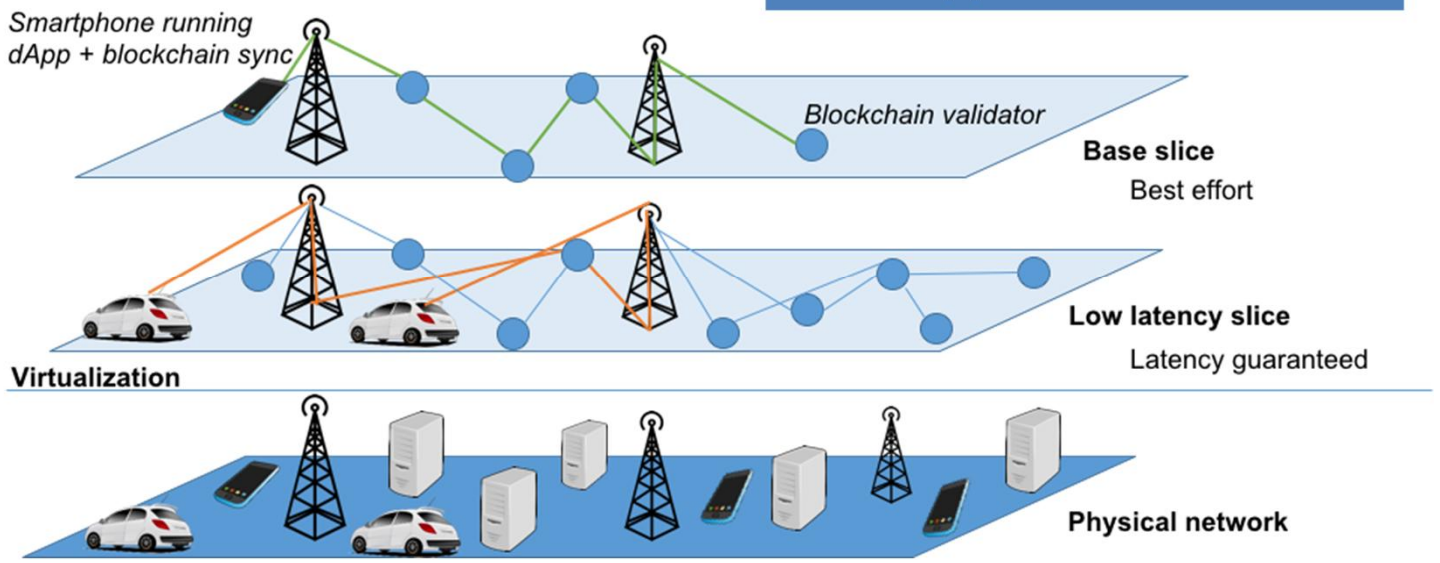
- MAC-layer retransmission control
  resend only the data relevant for the ML/AI

G. Zhu, D. Liu, Y. Du, C. You, J. Zhang, and K. Huang, “Towards an intelligent edge: Wireless communication meets machine learning,” arXiv preprint arXiv:1809.00343, 2018.

examples of semantic plane functionality

§ application-level aggregation for DLT transactions
decrease the verification overhead

at present:
blockchain client is treated as an application



examples of semantic plane functionality

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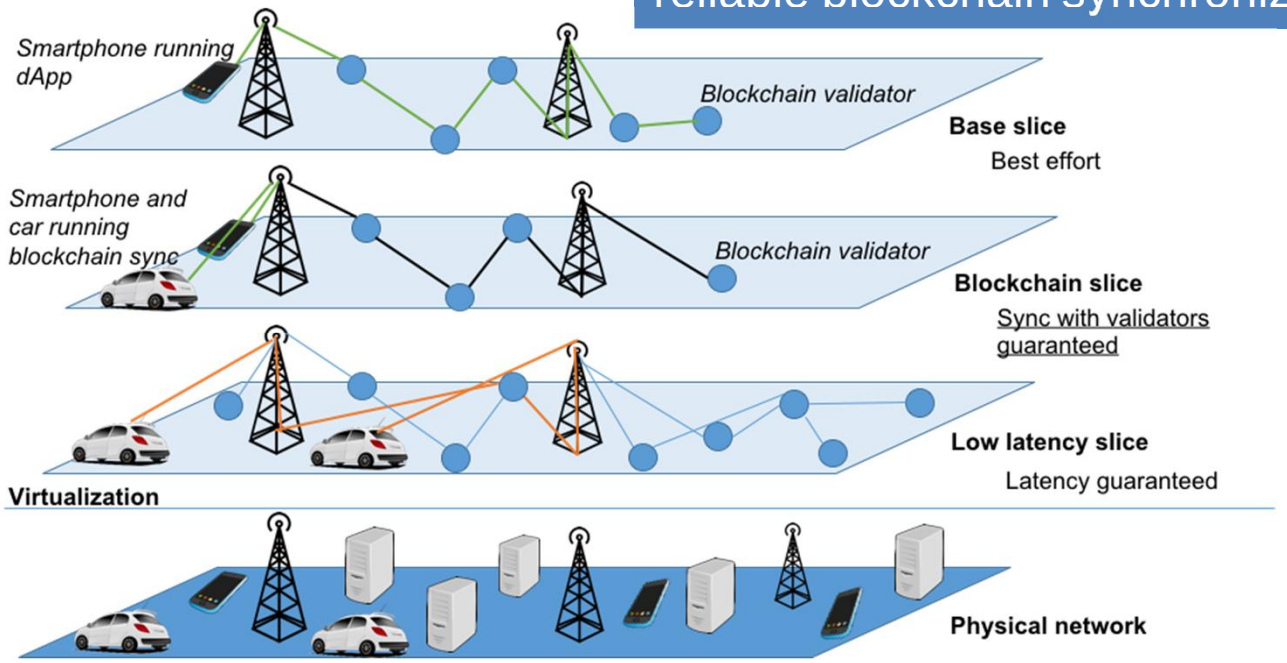
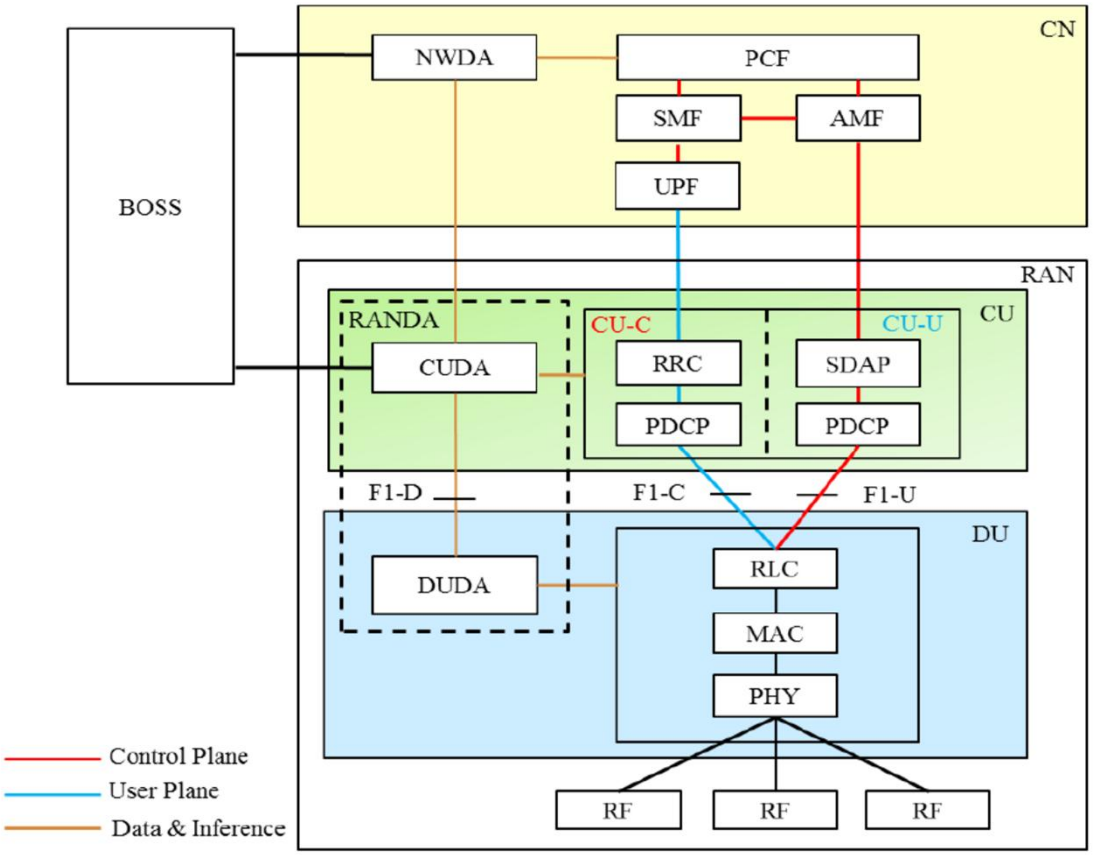
proposal:
reliable blockchain synchronization slice



related efforts: NWDA



§ extension of NWDA to all layers
for semantic filtering and control

outlook

the focus of comm engineers should shift towards engineering tasks that embrace meaning/semantics

initial steps in standardization

§ 3GPP defined Network Data Analytics (NWDA)

could drive the evolution of communication systems towards open source