Computing Technology
Waves of Development

Dubberly Design Office

Technology growth follows an 'S-curve'

Emergence + slow growth

Conceptual foundations
Science fiction
Vision demos
Speculative design

Proofs of concept

Engineering development

Product experiments
Market probes

Early adopters

Rapid growth

Standards emerge
Explosion of competitors
Scaling
Commercialization
Creation of infrastructure

Slow growth + decay

Market consolidation
Maturity

Capability

See also: Joseph Schumpeter
and "creative destruction" —
"... the process of industrial mutation ...
that incessantly revolutionizes the
economic structure from within,
incessantly destroying the old one,
incessantly creating a new one."

Time

"What's suddenly
going wrong?"

"OMG, we're doomed!"

"We're all going
to be rich!"

"New 32 inch screens and
free massages for everybody!"

"Wow, what is
happening??"

"OK it's still early,
but where is the
traction?"

"This thing is not
going anywhere"

"OK, maybe it's
not hopeless"

Inflection point

Development of personal computers

Capability
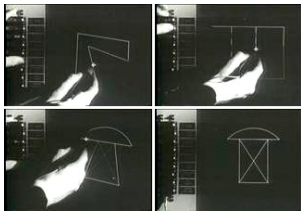
Time

Ivan Sutherland Sketchpad
1963

Doug Engelbart's NLS Demo
1968

Xerox Alto
1973

Apple 1
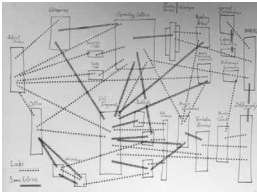1976

Mac 128K
1984

MacBook Pro
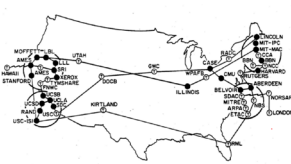2023

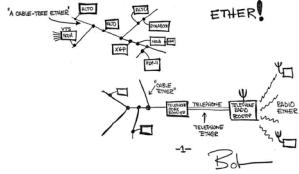# Development of hypertext systems

Capability

Time
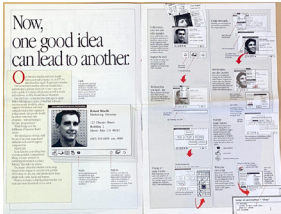
Vannevar Bush's Memex
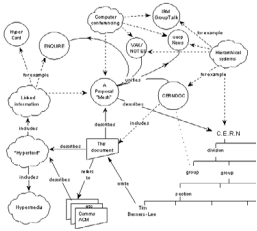1945

Ted Nelson, Xanadu
1965

JCR Licklider, Bob Taylor, ARPANET
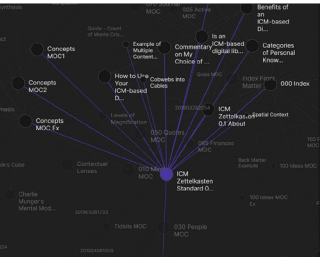1966

Bob Metcalfe, Ethernet
1973

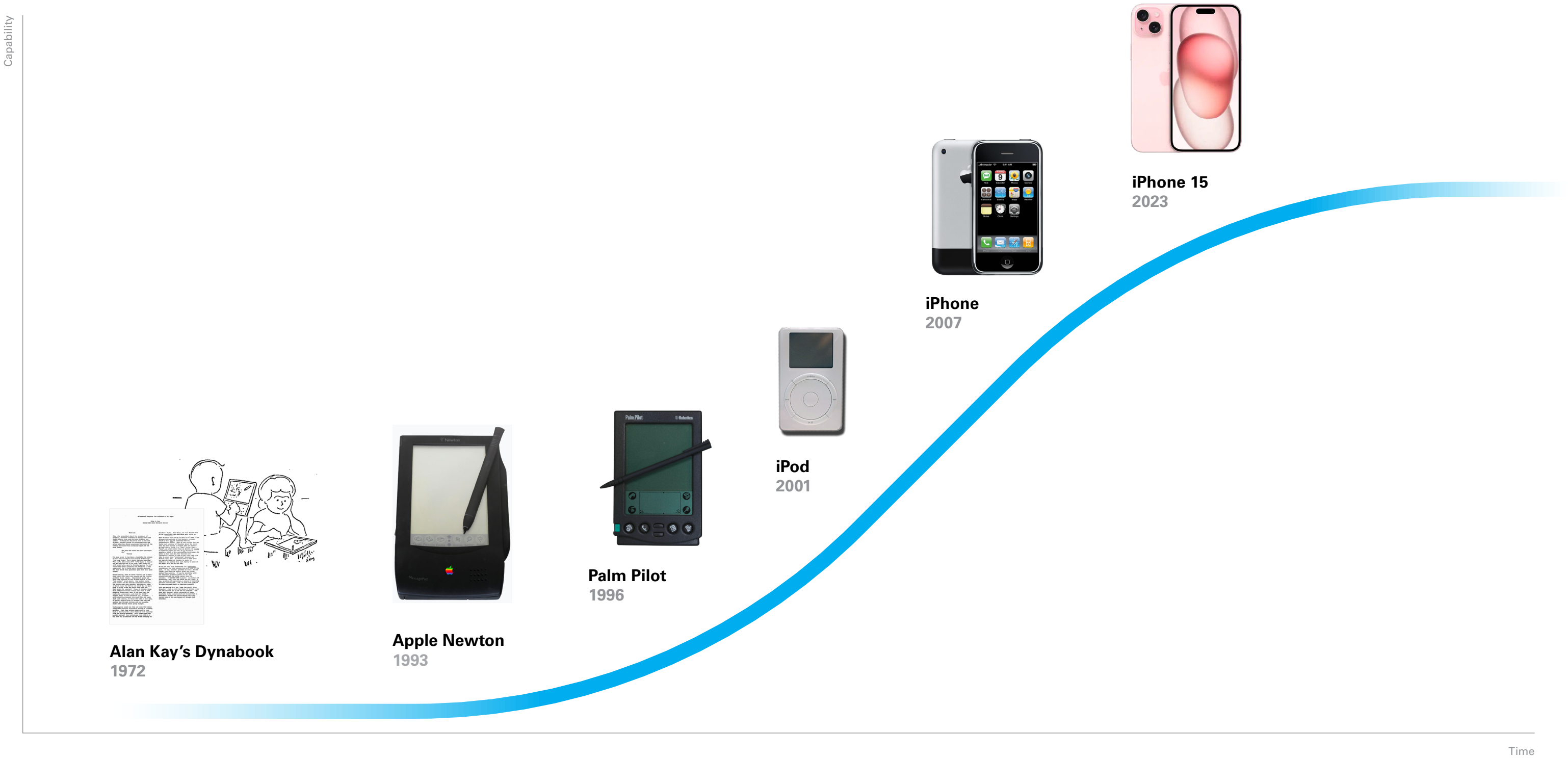**Bill Atkinson, Apple HyperCard**
1987

Tim Berners-Lee World-wide Web
1993

Larry Page, Sergey Brin, Google Search
1998

Shida Li and Erica Xu, Obsidian
2020

Development of mobile devices

Capability

iPhone 15
2023

iPhone
2007

iPod
2001

Palm Pilot
1996

Apple Newton
1993

Alan Kay's Dynabook
1972

Time

Development of smart watches

Capability

Time

**Dick Tracy's
Wrist Radio Comic**
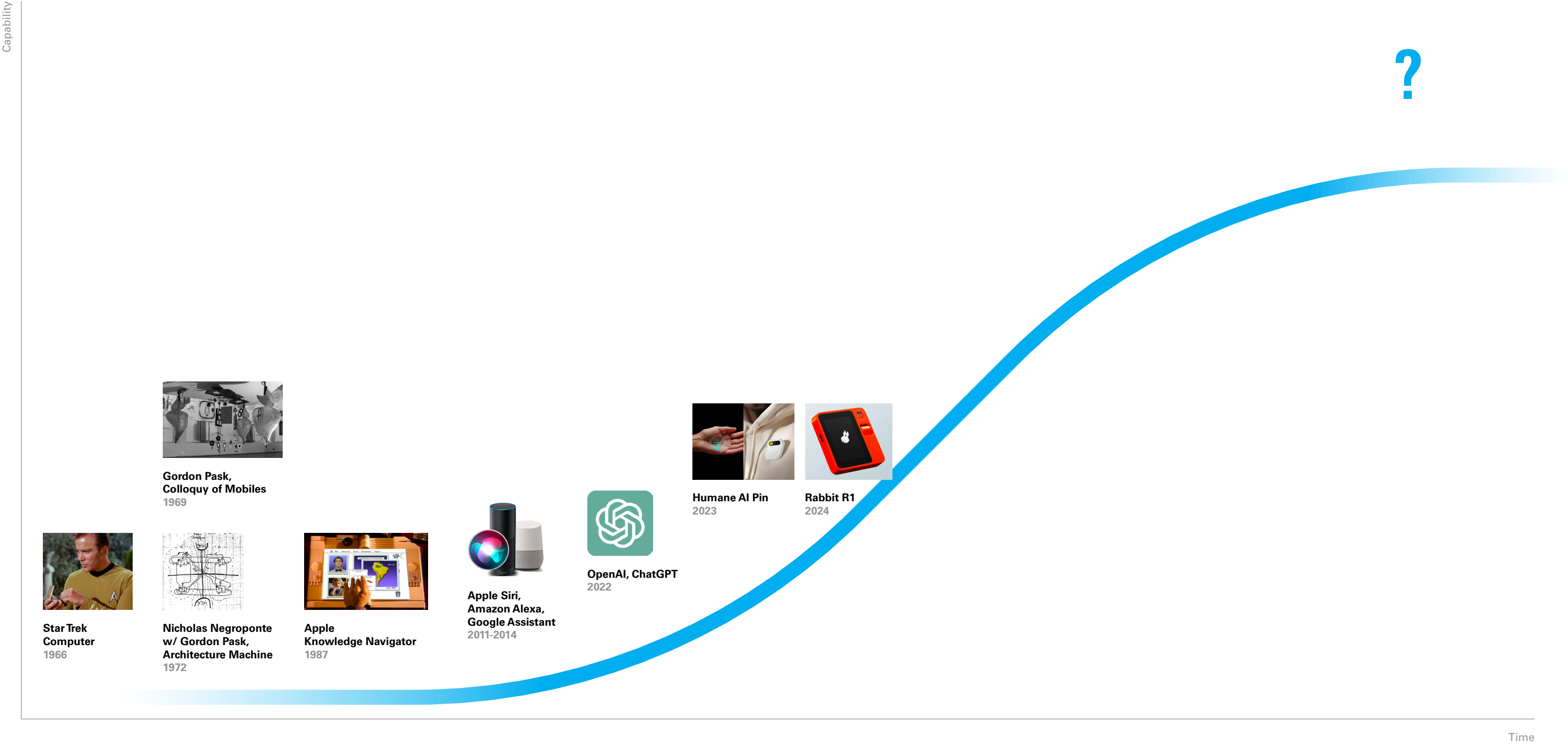1946

Seiko's Ruputer
1998

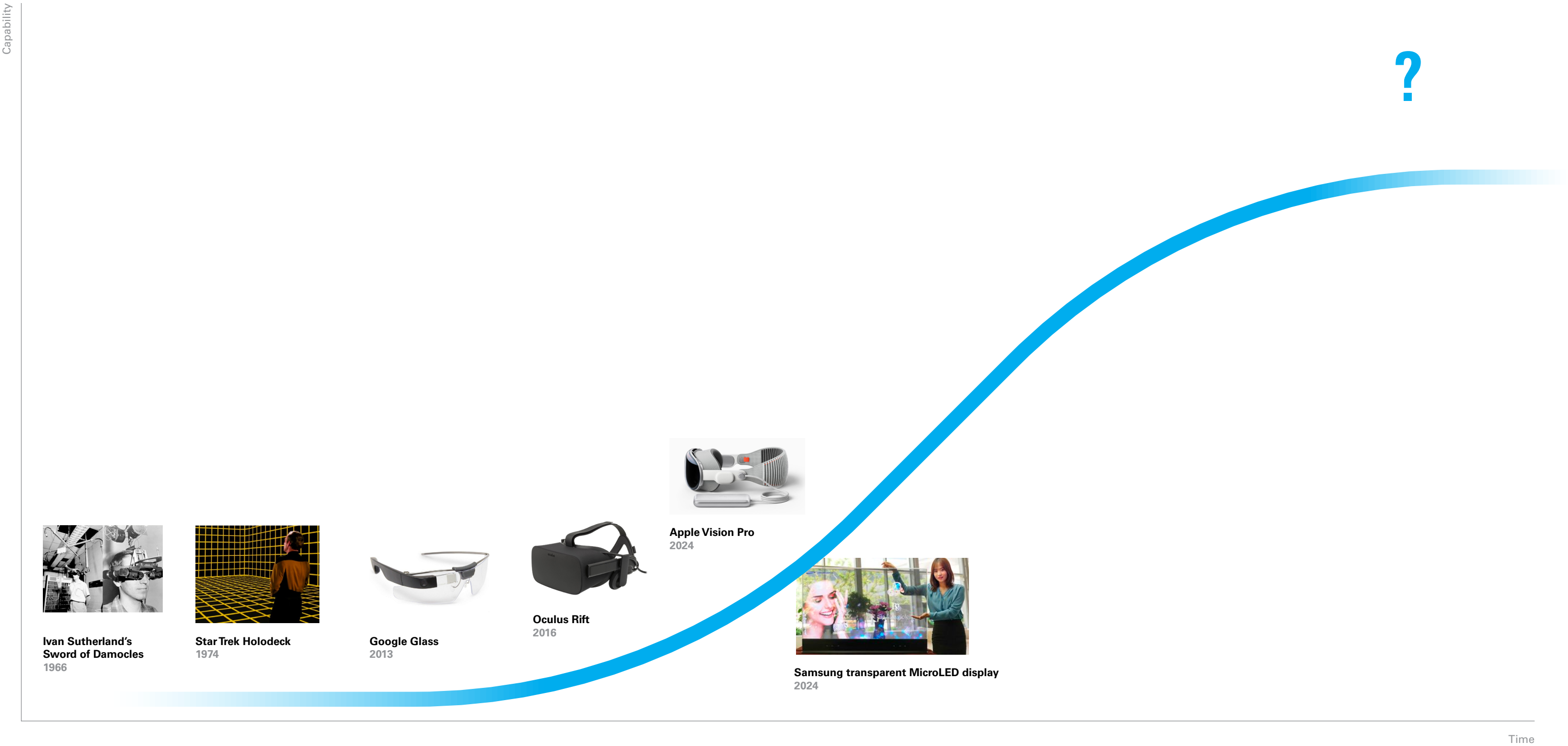**Fitbit Tracker**
2009

Apple Watch
2015

Apple Watch Series 9
2023

Development of intelligent agents

Capability

Time

?

Gordon Pask,
Colloquy of Mobiles
1969

Star Trek
Computer
1966

Nicholas Negroponte
w/ Gordon Pask,
Architecture Machine
1972

Apple
Knowledge Navigator
1987

Apple Siri,
Amazon Alexa,
Google Assistant
2011-2014

OpenAI, ChatGPT
2022

Humane AI Pin
2023

Rabbit R1
2024

Development of virtual reality / augmented reality

Capability

Time

?

**Ivan Sutherland's
Sword of Damocles**
1966

Star Trek Holodeck
1974

Google Glass
2013

Oculus Rift
2016
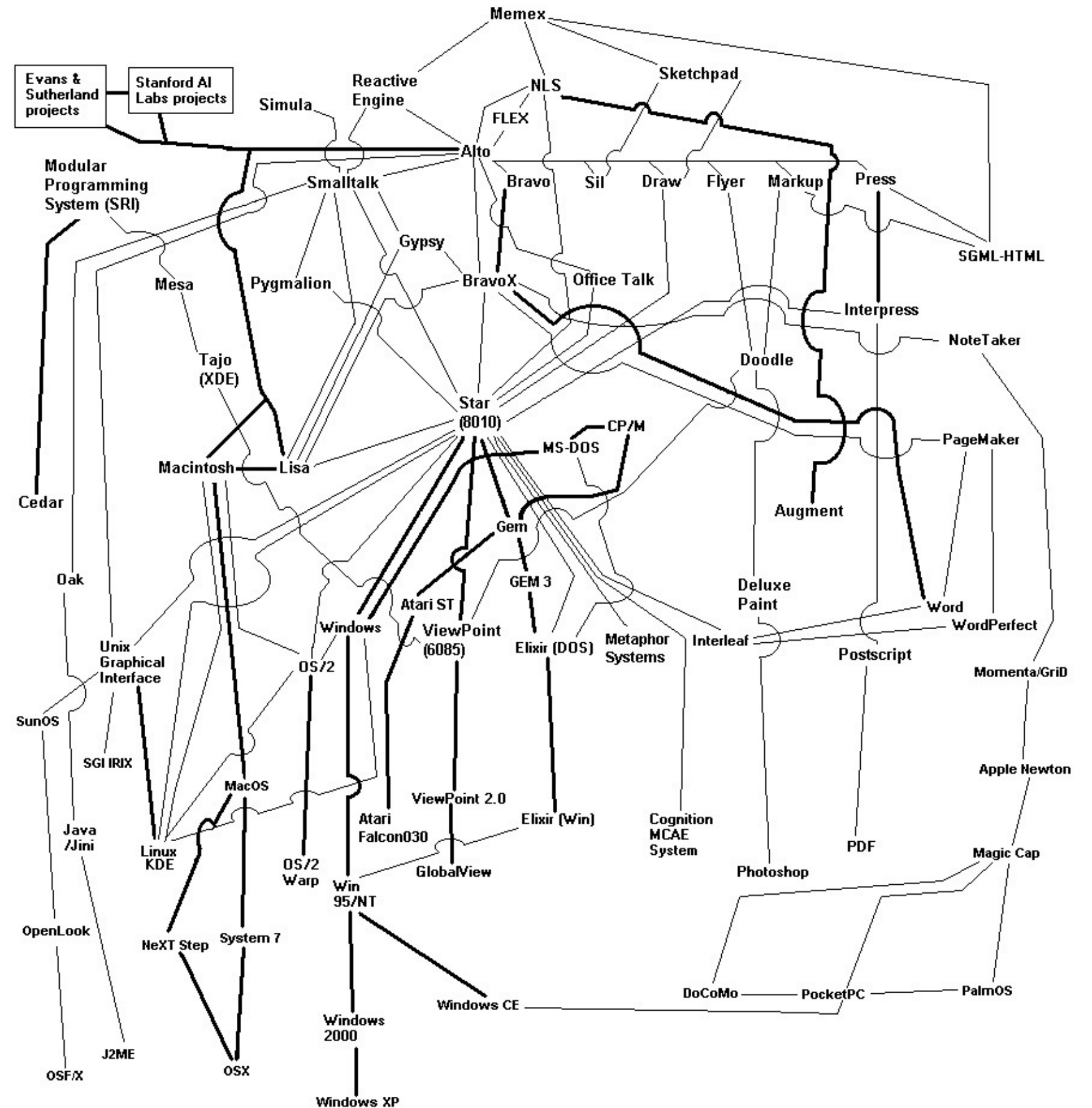

Apple Vision Pro
2024

Samsung transparent MicroLED display
2024
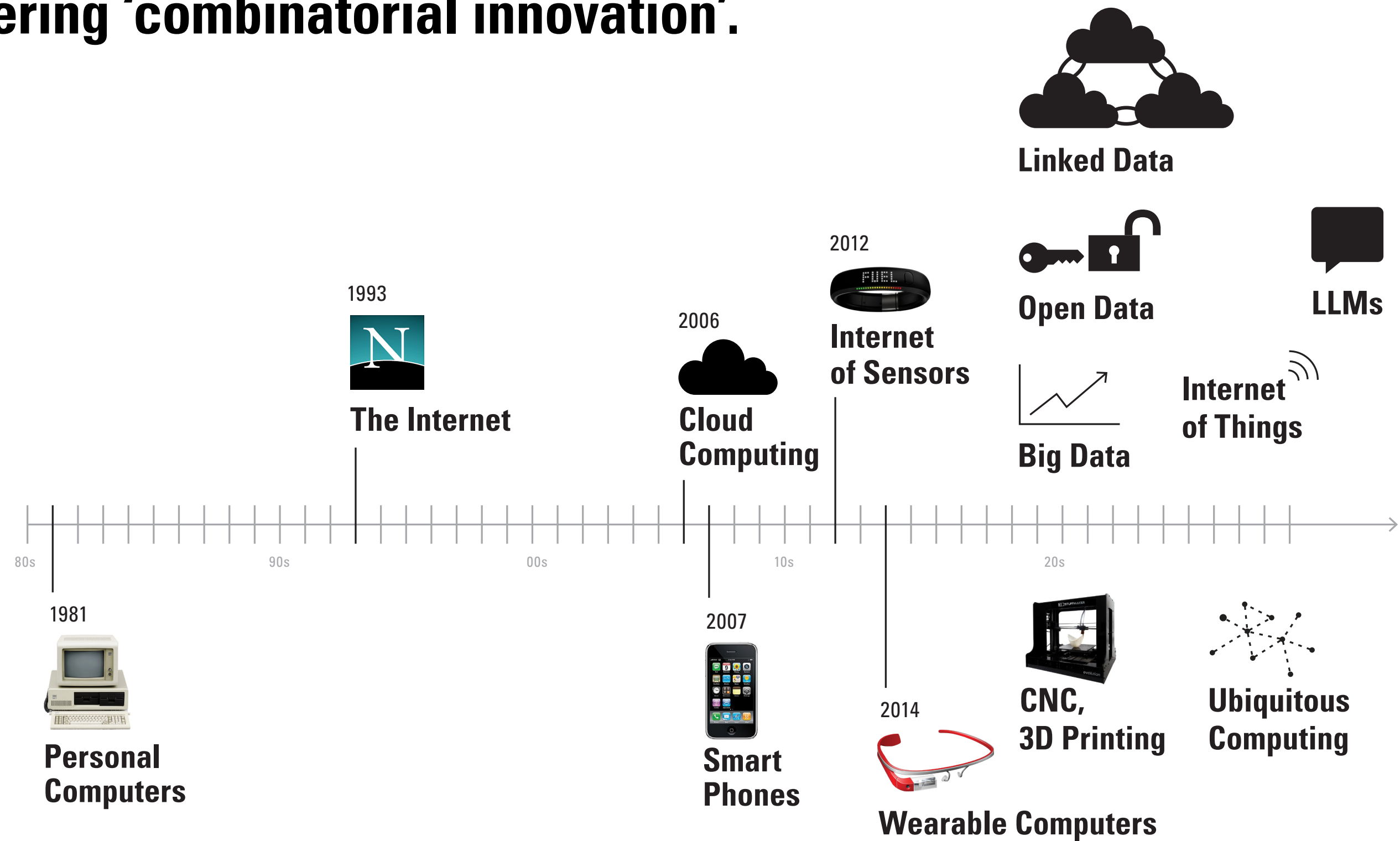
Appendix

History as a network

Waves of development interact with each other, fostering 'combinatorial innovation'.

Linked Data

Open Data

LLMs

1993

The Internet

2006

Cloud Computing

2012

Internet of Sensors

Big Data

Internet of Things

80s   90s   00s   10s   20s

1981

Personal Computers

2007

Smart Phones

2014

Wearable Computers

CNC, 3D Printing

Ubiquitous Computing

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