

Initial Research

Industrial Automation
Transferring Data

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Gothic Architecture
Horology

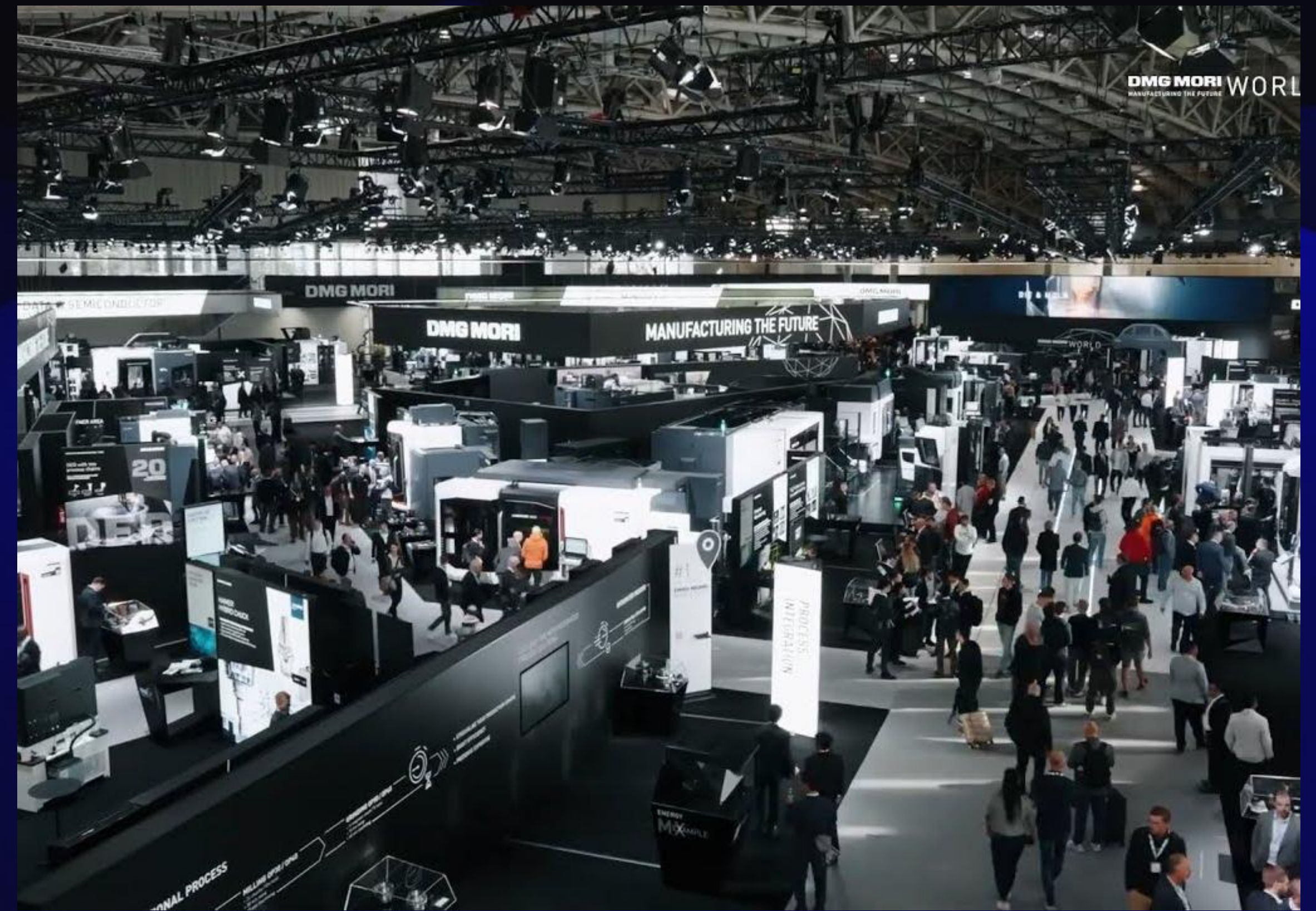
Ryan Gunther-Leece

Industrial Automation

Why?

Industrial automation

- Relevance to my work
- Not something required by my job
- Recent attendance of EMO 2025
- EMO stands for Exposition Mondiale de la Machine Outil, which translates to World Machine Tool Exhibition



DMG Mori at EMO 2025, one of the over 1,600 exhibitors at this years show

Scope

Industrial automation

- Automation of manufacturing
- Relevant to production in all industries
- Research focus on Machined components
- Control systems and design

History

Industrial automation

- The earliest evidence of a lathe dates back to 4th century BC Egypt and is a depiction in the tomb of Petosiris
- Tenuous evidence for a turned artifact as far back as the 13th or 14th century BC
- Though debatable this lathe from 1751 could be thought of as the first proper metal lathe and offered easily an entire order of magnitude more precision than a wood lathe

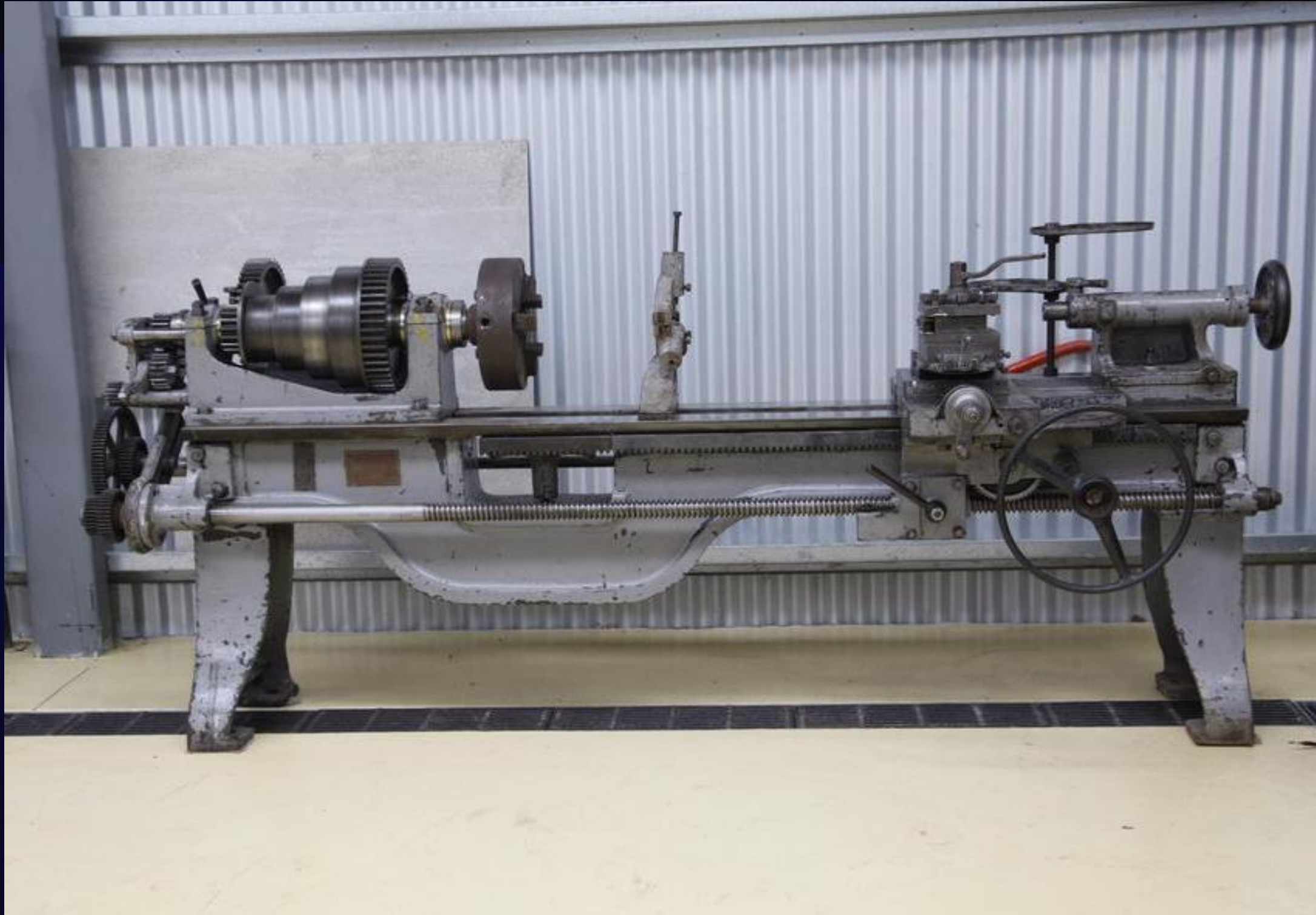


Vaucanson 1751

History

Industrial automation

- Early 1900's



Gap Bed Lathe from the early 1900's



Two Workshops operating on line shafts

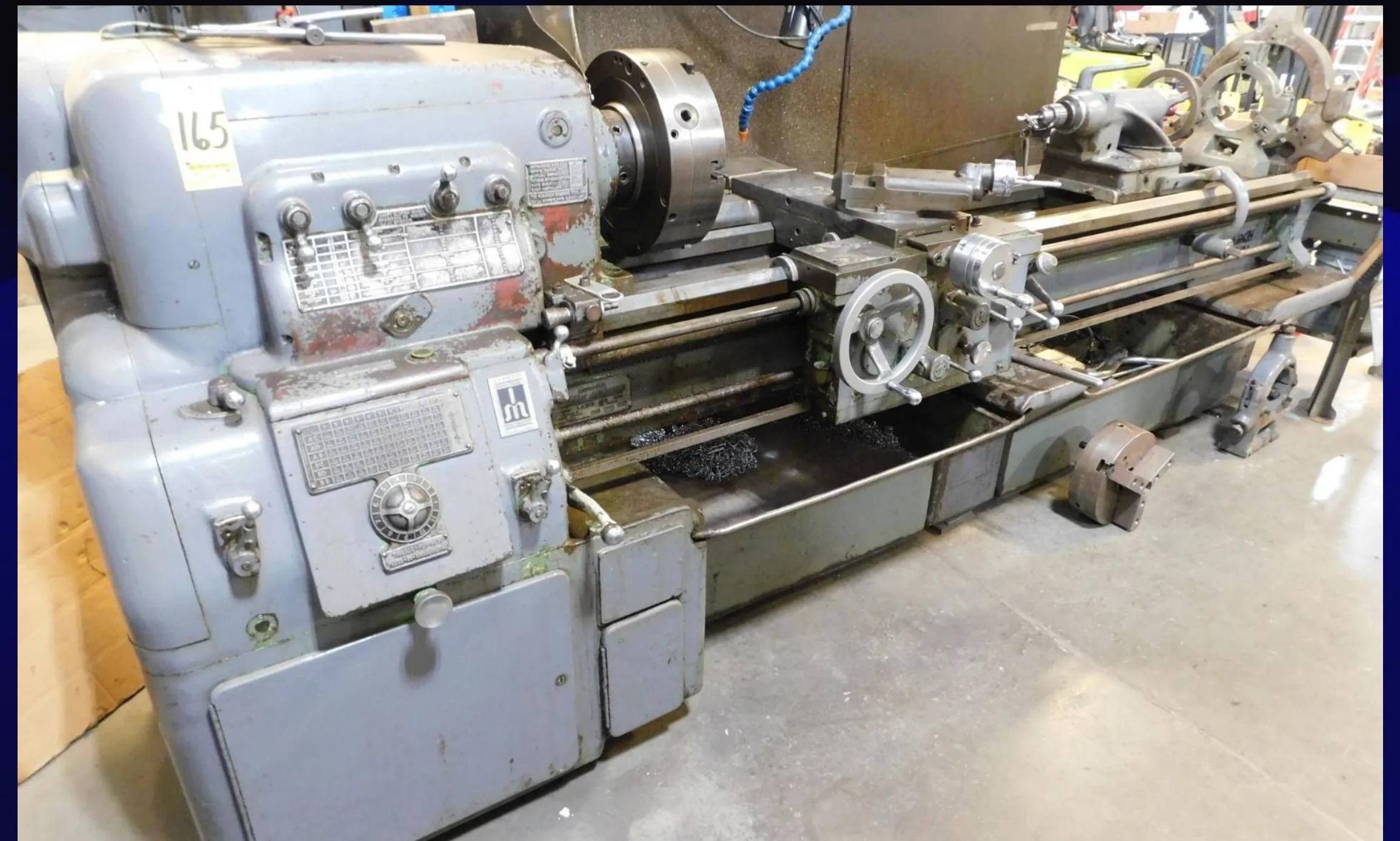
History

Industrial automation

- WWII and post War



Dean Smith & Grace 17x48 Circa.1960



1940's Monarch Lathe

- Swing over bed and Distance between centres

History

Industrial automation

- Modern Manual Machinery



Colchester Triumph 2000



Modern CNC/Toolroom lathe



Southampton university Building 46 Physics Machine Shop

History

Industrial automation

- Production Machinery



Ward 2C Capstan Lathe



A sprint 26 Capstan being run by myself

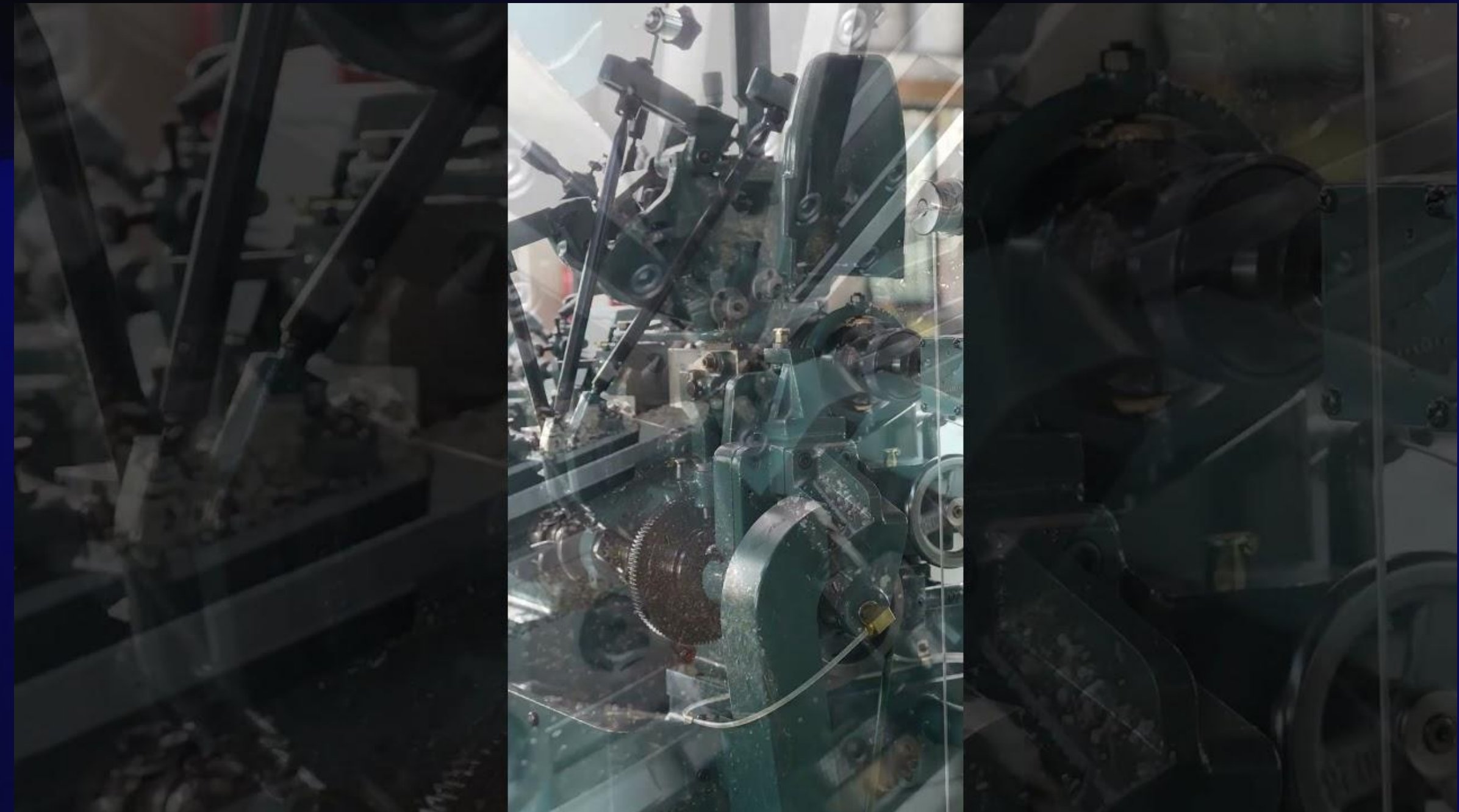
History

Industrial automation

- Production Machinery 2 (Electric Boogaloo)



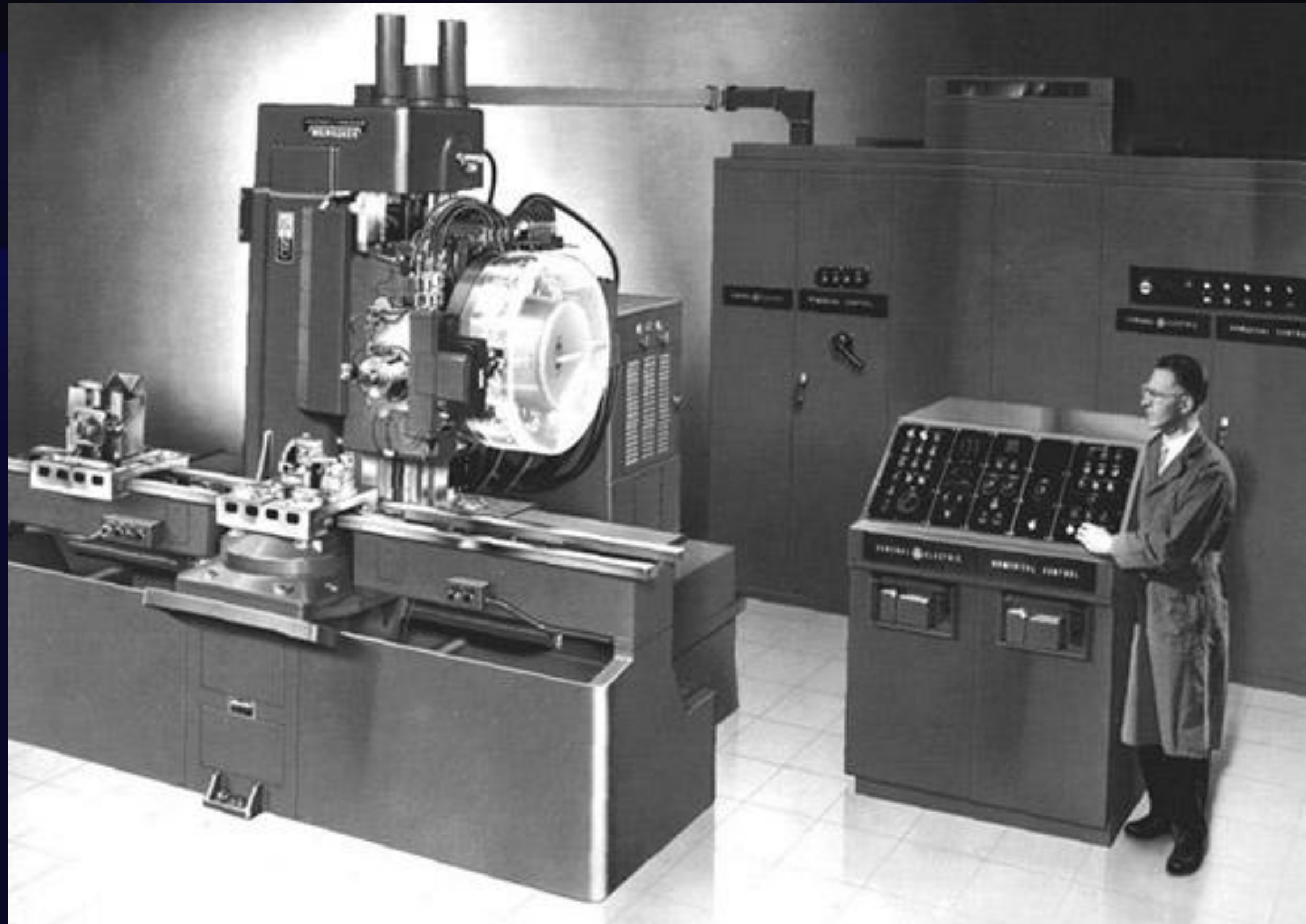
Index B60 Cam driven lathe, fully automatic



History

Industrial automation

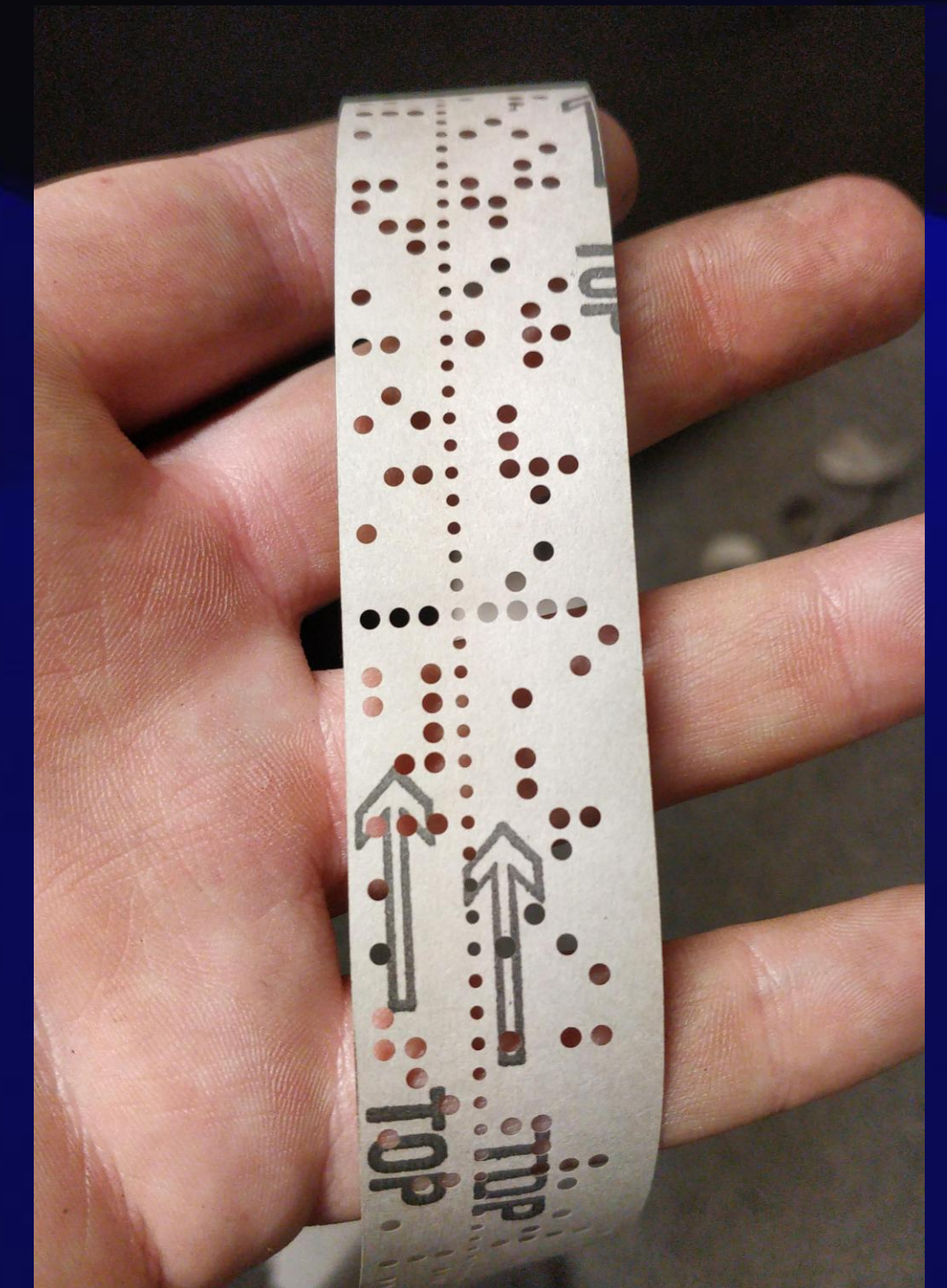
- Early NC



Very Early CNC Mill



External Cassette Tape Drive



Punch Card Memory strip

History

Industrial automation

- The 80's



Mazak Lathe running Mazatrol T-1



Bridgeport interact running Heidenhain TNC151

History

Industrial automation

- Automated loading with Cobot arm



Modern Production

Industrial automation

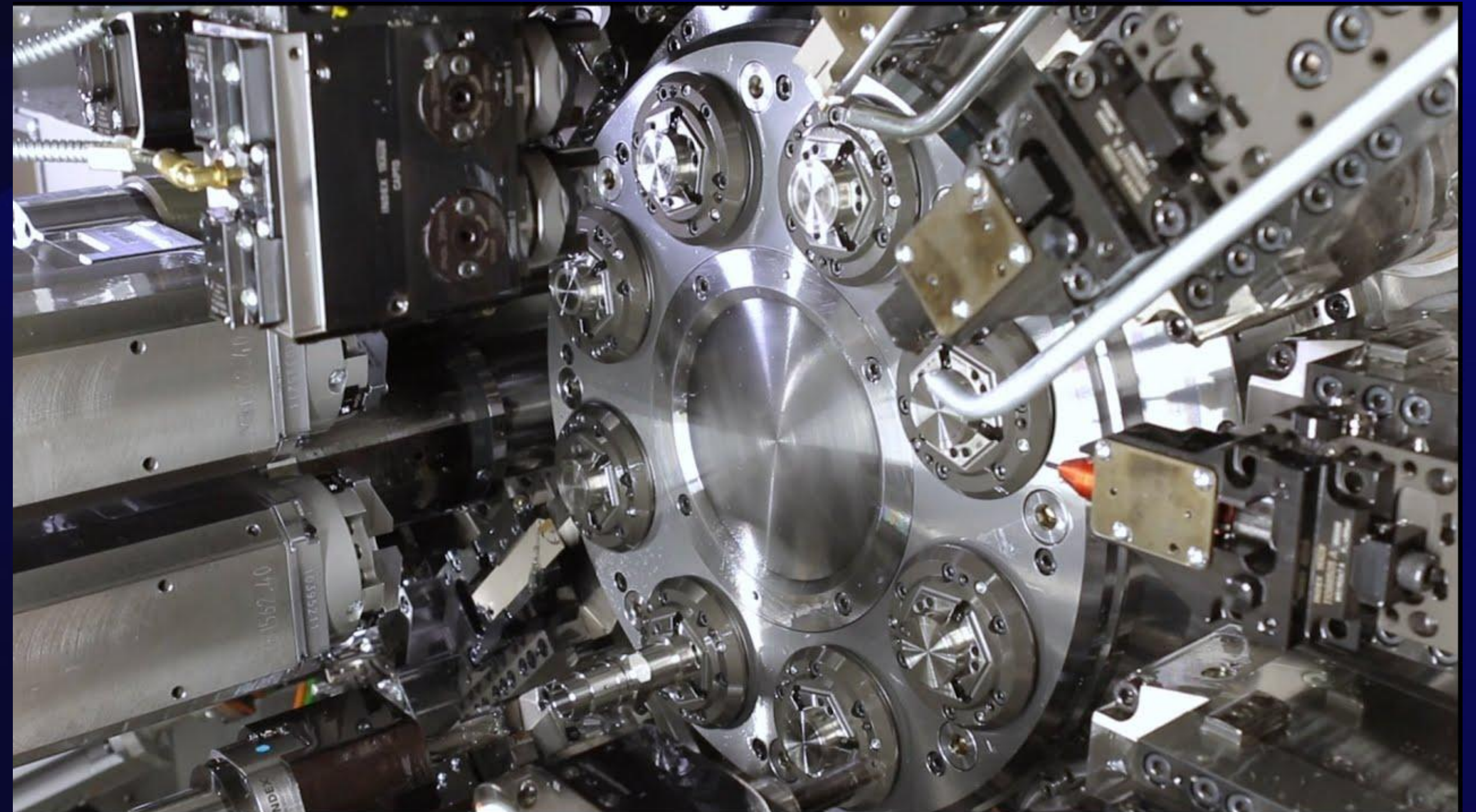
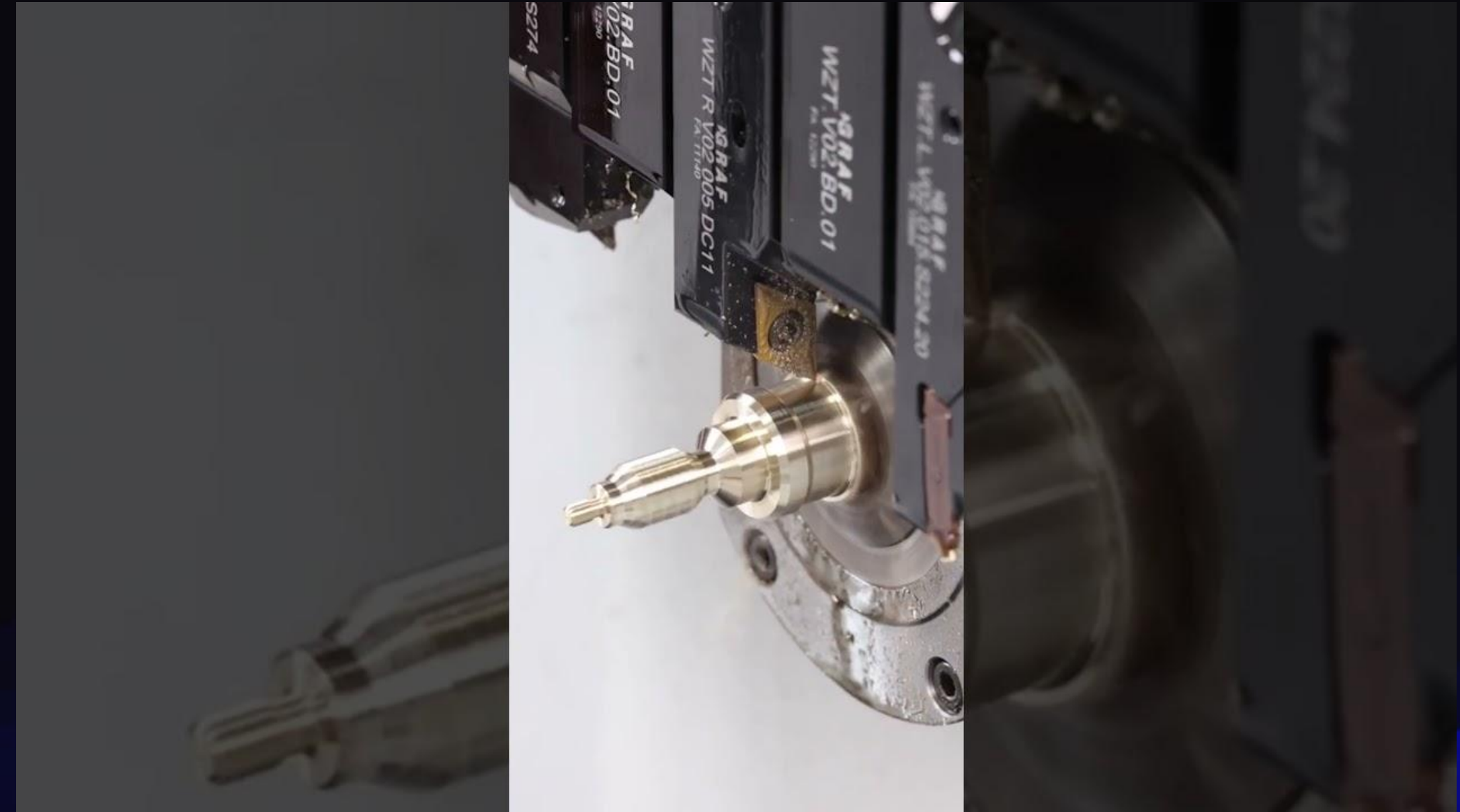
- Dual pallet
- Pallet pools
- Tombstones
- Gantry loading



Modern Production

Industrial automation

- Sliding head lathes
- Multispindle
- Rotary transfer
- Custom built heads



Transferring Data

Why?

Transferring Data

- Relevance to everyday life
- Interest in details of electromechanical tech
- Interest in modern developments and the bleeding edge

History

Transferring Data

- Cave paintings and hieroglyphics
- Tallysticks: Notched sticks of bone or wood were used for numerical record-keeping
- Inca system of knotted strings used for record-keeping.
- Clay tablets used by the Sumerians

History

Transferring Data

- Store Data to physical media
- Transport physical media

History

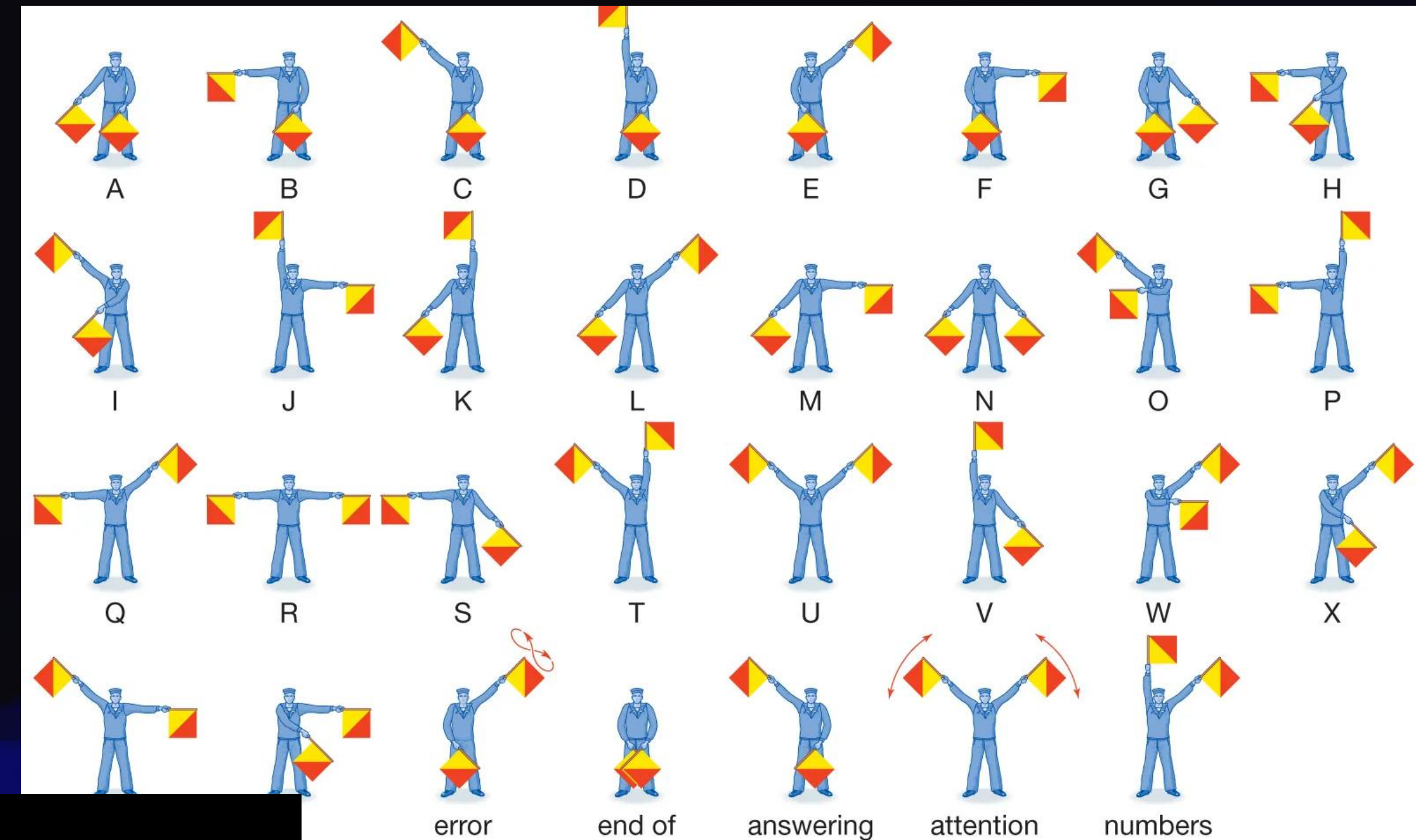
Transferring Data

- Runners - Pheidippides was a 5th-century-BC Athenian running courier who was the central figure in the story that inspired the marathon race.
- Riders - Horseback and Bicycle
- Carrier Pigeon - Note attached to pigeon, leg, back or ties round base of wings, surprising variation in methods used

History

Transferring Data

- The 1800's
- Semaphore, both flags and mechanical
- Benefits of fast two way communication over distance



Flag Semaphore Code



History

Transferring Data

- Morse Code
- Sent as short and long pulses
- Utilising signal lamps for communication over air

A ● -	J ● - - -	S ● ● ●
B - ● ● ●	K - ● -	T -
C - ● - ●	L ● - ● ●	U ● ● -
D - ● ●	M - -	V ● ● ● -
E ●	N - ●	W ● - -
F ● ● - ●	O - - -	X - ● ● -
G - - ●	P ● - - ●	Y - ● - -
H ● ● ● ●	Q - - ● -	Z - - ● ●
I ● ●	R ● - ●	

Morse code alphabet

History

Transferring Data

- Telegraphy
- 1830's
- Telegram via wire
- Multiple methods including multi-conductor
- Eventually converged on morse code

A ●-	J ●---	S ●●●
B -●●●	K -●-	T -
C -●-●	L ●-●●	U ●●-
D -●●	M --	V ●●●-
E ●	N -●	W ●--
F ●●-●	O ---	X -●●-
G --●	P ●--●	Y -●--
H ●●●●	Q --●-	Z --●●
I ●●	R ●-●	

Morse code alphabet

History

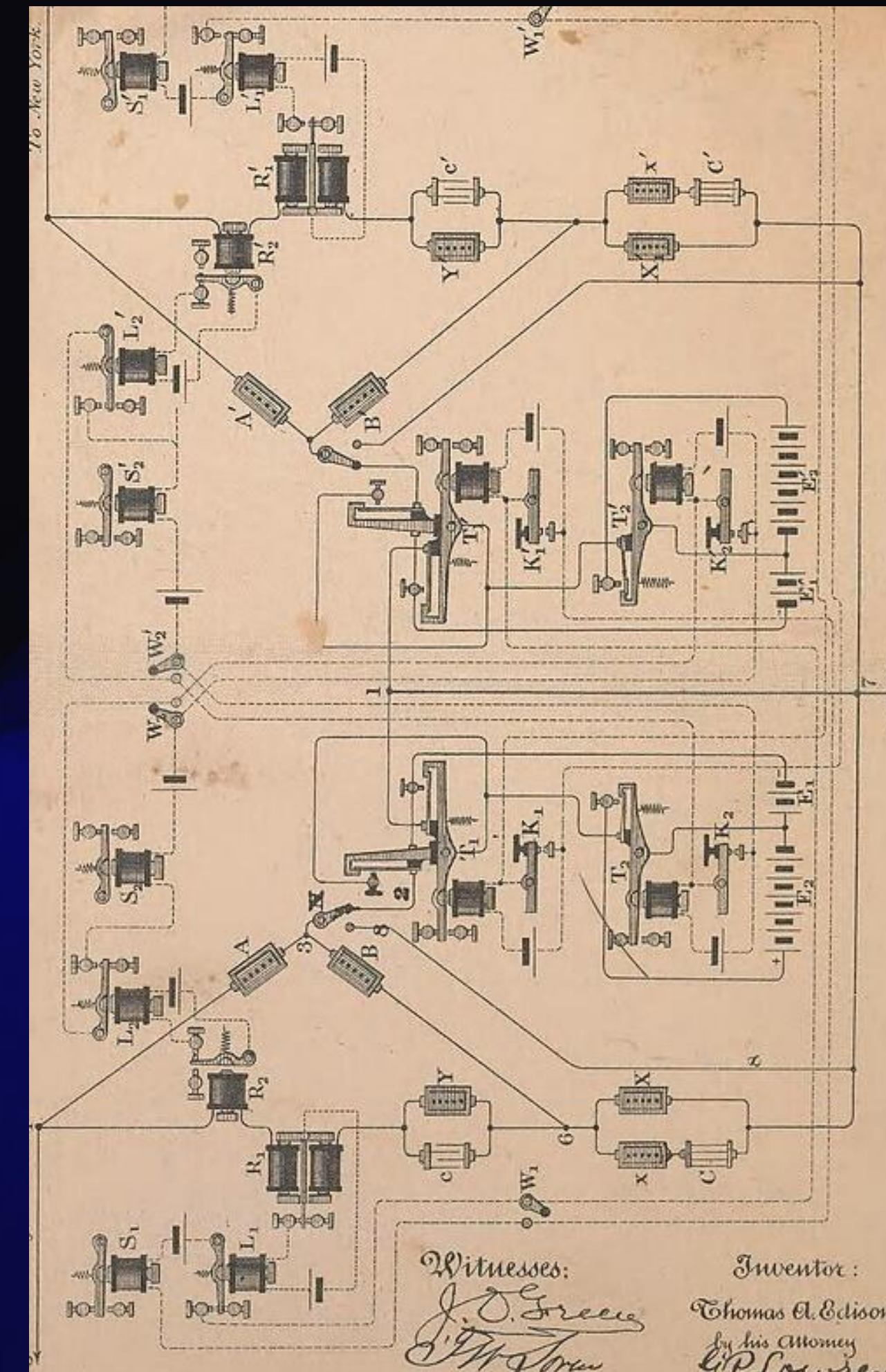
Transferring Data

- Transatlantic
- 1858 first cable laid
- Awfully slow, took over a minute to send a single character, slow relative to expectations due to noise disrupting the signal
- 1865 & 1866 Subsequent cables of improved design
- "Two weeks to two minutes" coined to emphasise the great improvement over ship-borne dispatches
- 1870s, duplex and quadruplex transmission and receiving systems were set up that could relay multiple messages over the cable
- Huge earner, Patent sold for equivalent of 800,000 then later 5,000,000, made over 190,000,000 from the investment (converted to USD 2025)

History

Transferring Data

- Duplex and Quadruplex
- Splitting transmission down a single cable into voltage bands of -3V, -1V, 1V and 3V
- Allows for a 4x in data transfer

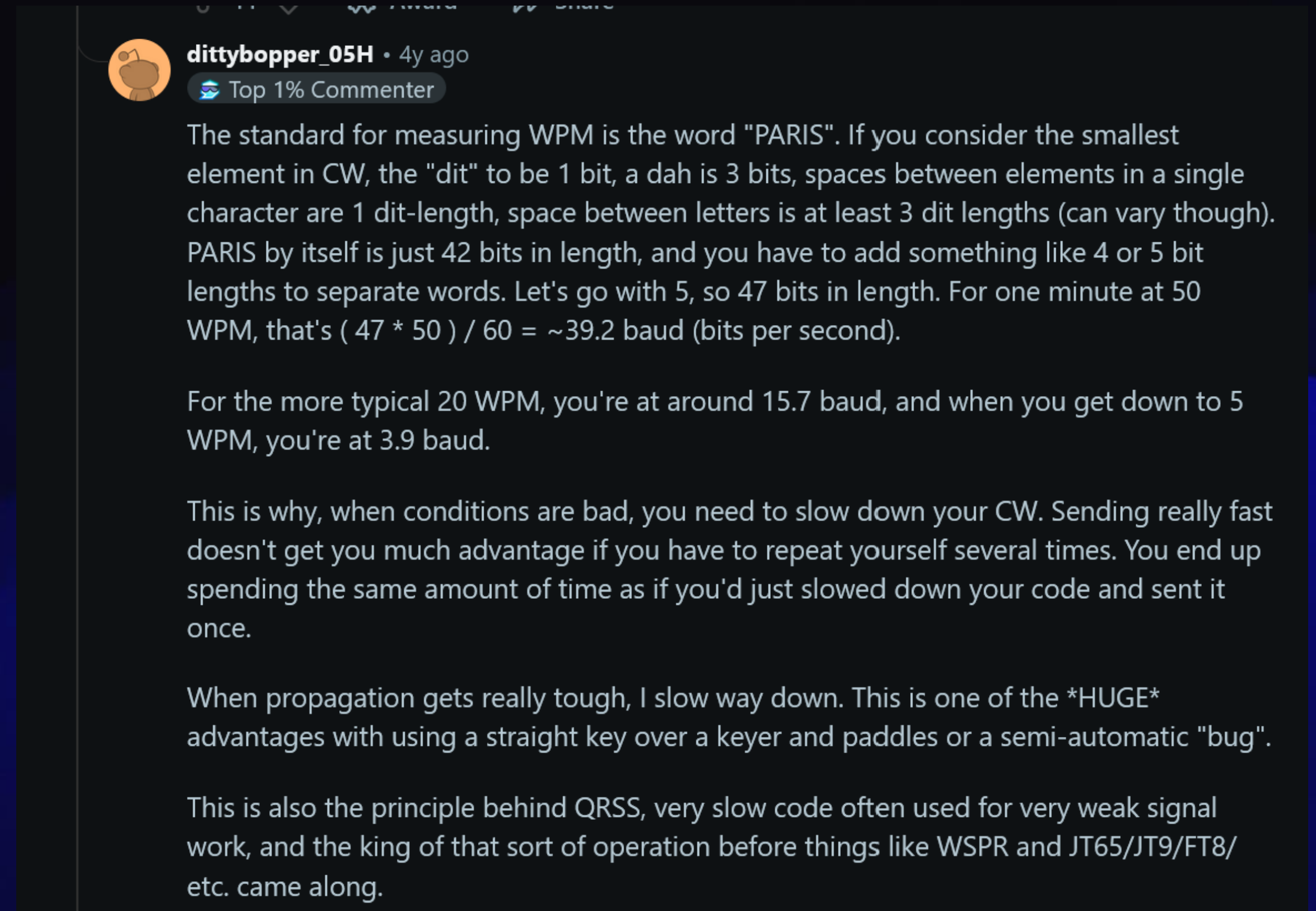


Edison Quadruplex Patent Drawing

History

Transferring Data

- Baud Rate
- Baud is useful as it describes the speed of transmission rather than just the flow of Data itself
- 9600 Baud sent over 8 lines (8 bits per Baud) would net you 76.8Kbps
- To send the same data in the same time over a single cable you would need to 8x the BaudRate i.e. 76.8k, in this instance Bitrate = Baud Rate



Reddit Comment Laying out a method of calculating in the Baud rate for telegram via Morse code, Also explains quite a good analogue for why communication speed between devices may need to be limited to avoid losses due to interference

History

Transferring Data

- Transatlantic Baud rate 15.7
- Bit rate 62.8
- 100 years later, RS232
- Slowest possible Baud rate allowed: 110
- Common use for transferring data between devices

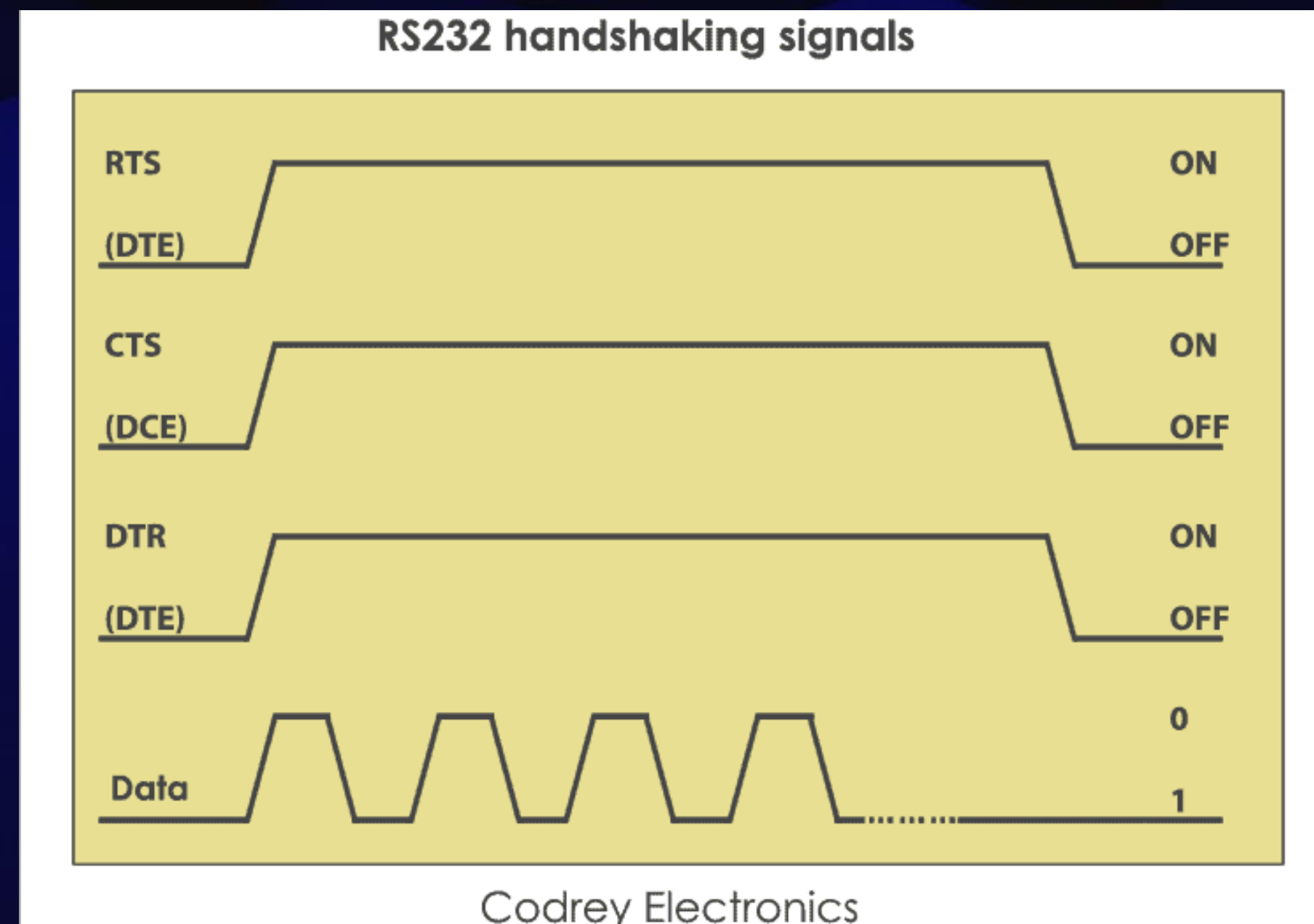


DB9 Serial Cable

History

Transferring Data

- Handshaking
- Agreement between devices on protocol/transfer speed/when to transfer
- RS232 is limited and the Baud rate is set manually rather than by communication between devices

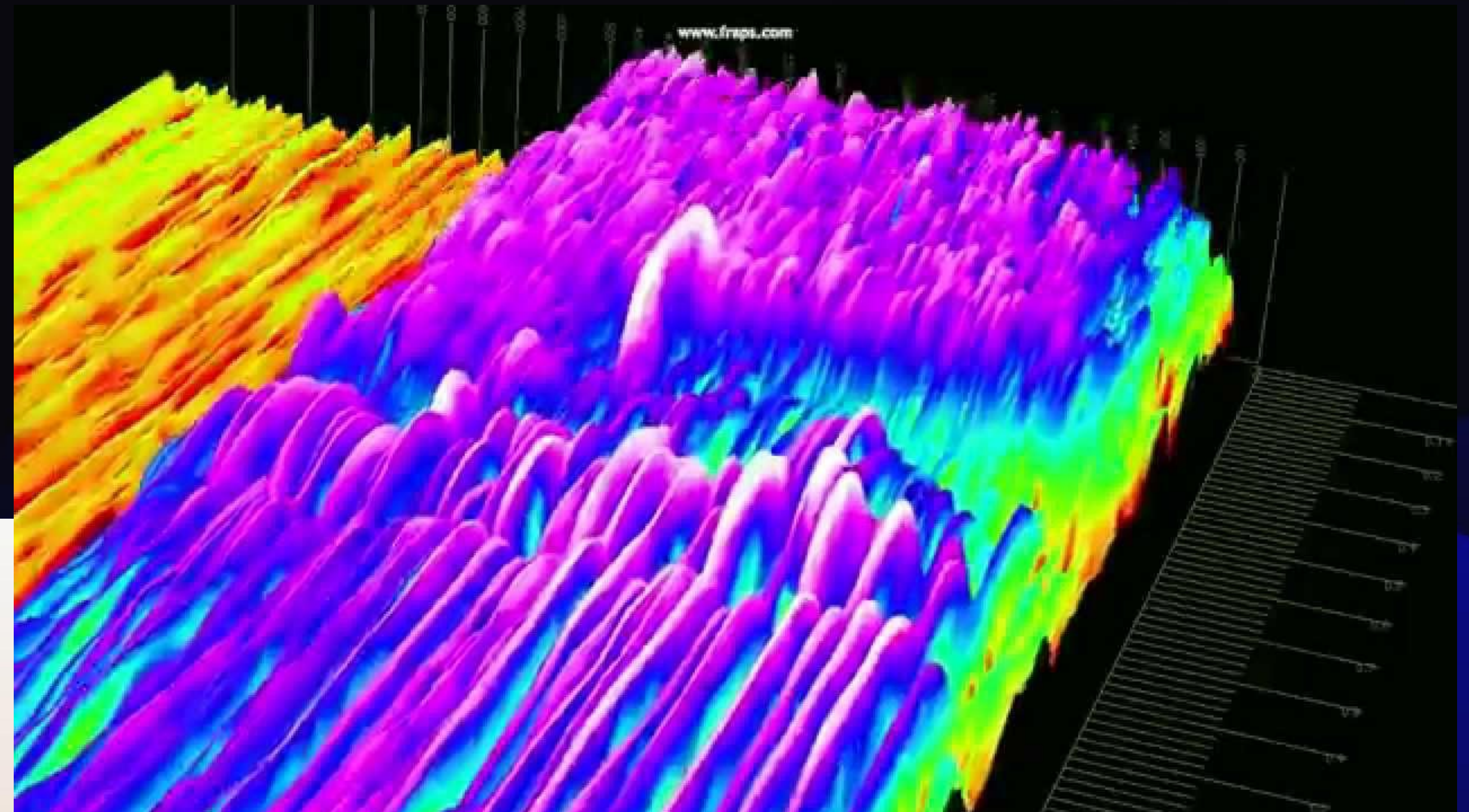


Handshaking Signals for RS232

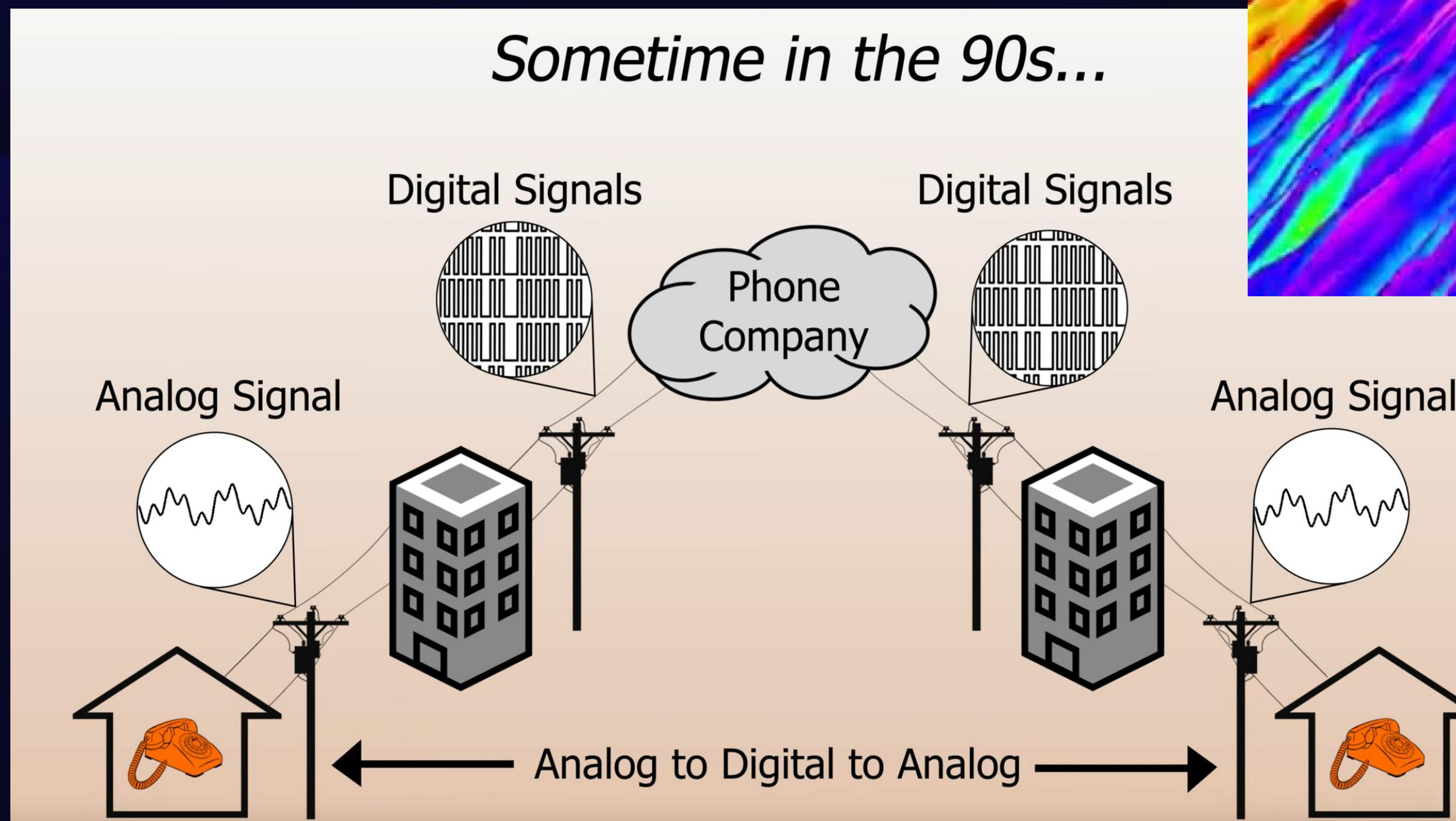
History

Transferring Data

- 56k Modem Handshaking
- Dial up Internet



Sometime in the 90s...



How information is shared between two computers with a dialup connection

History

Transferring Data

- DTMF
- Dual-tone multi-frequency
- Dialup max speed 56Kbps
- RS232 max speed 115kbps... over 8.5ft



Casio Watch with phonebook/dialer

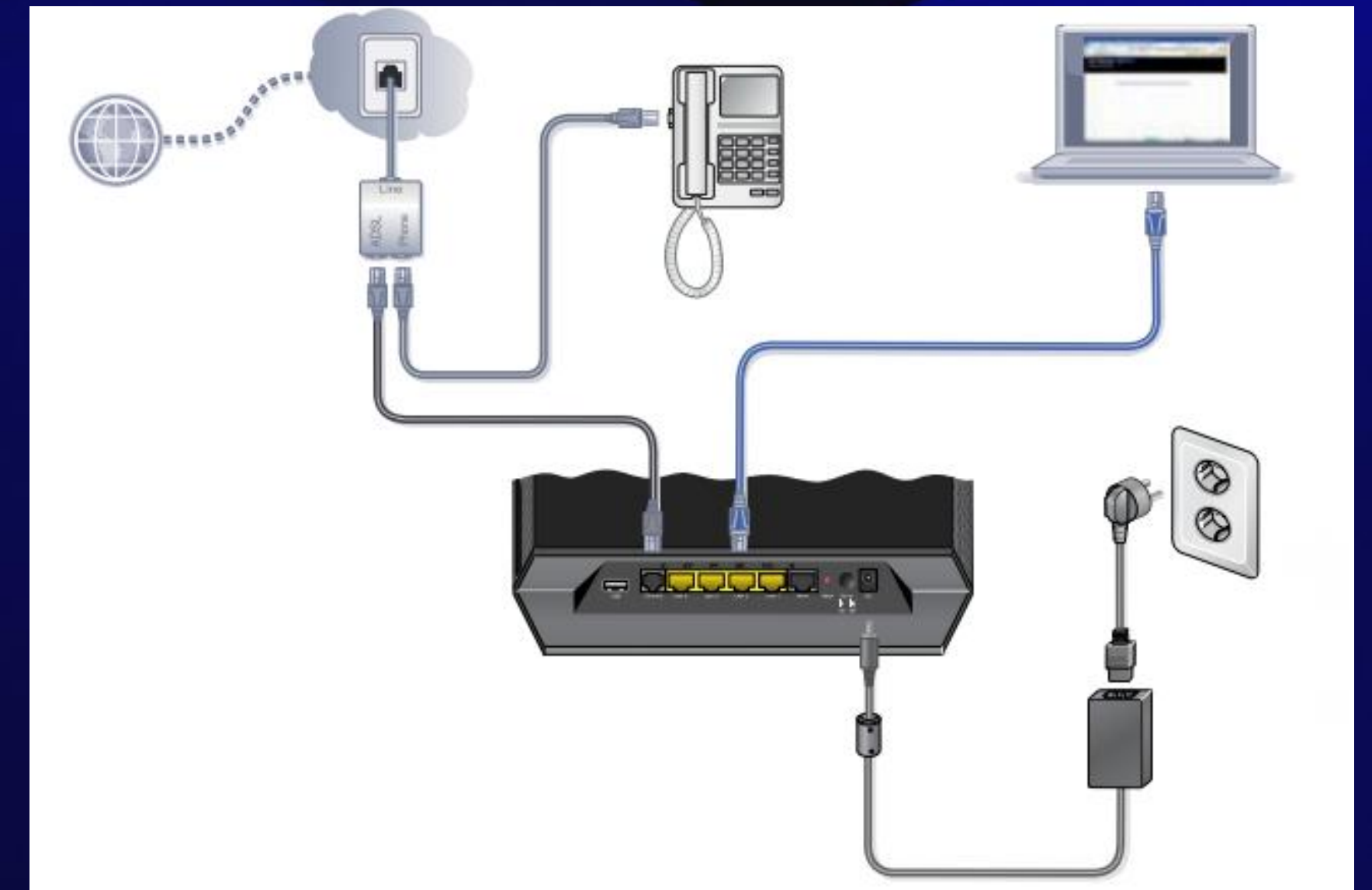
History (very Soon)

Transferring Data

- ADSL
- Asymmetric digital subscriber line
- works by using spectrum above the band used by voice telephone calls
- Max Speed of 24Mbps
- Over 400x Dialup



ADSL Filter/Splitter



ADSL Router Setup

Present Day

Transferring Data

- High speed internet
- Fibre to Cabinet
- Fibre to Premises
- Copper vs Glass

Office/Campus Setup

Transferring Data

- End clients e.g. PC
- RJ45 switch
- FSP and QFSP
- Transceivers



office pc



Fibre Transceiver



Gigabit Switch

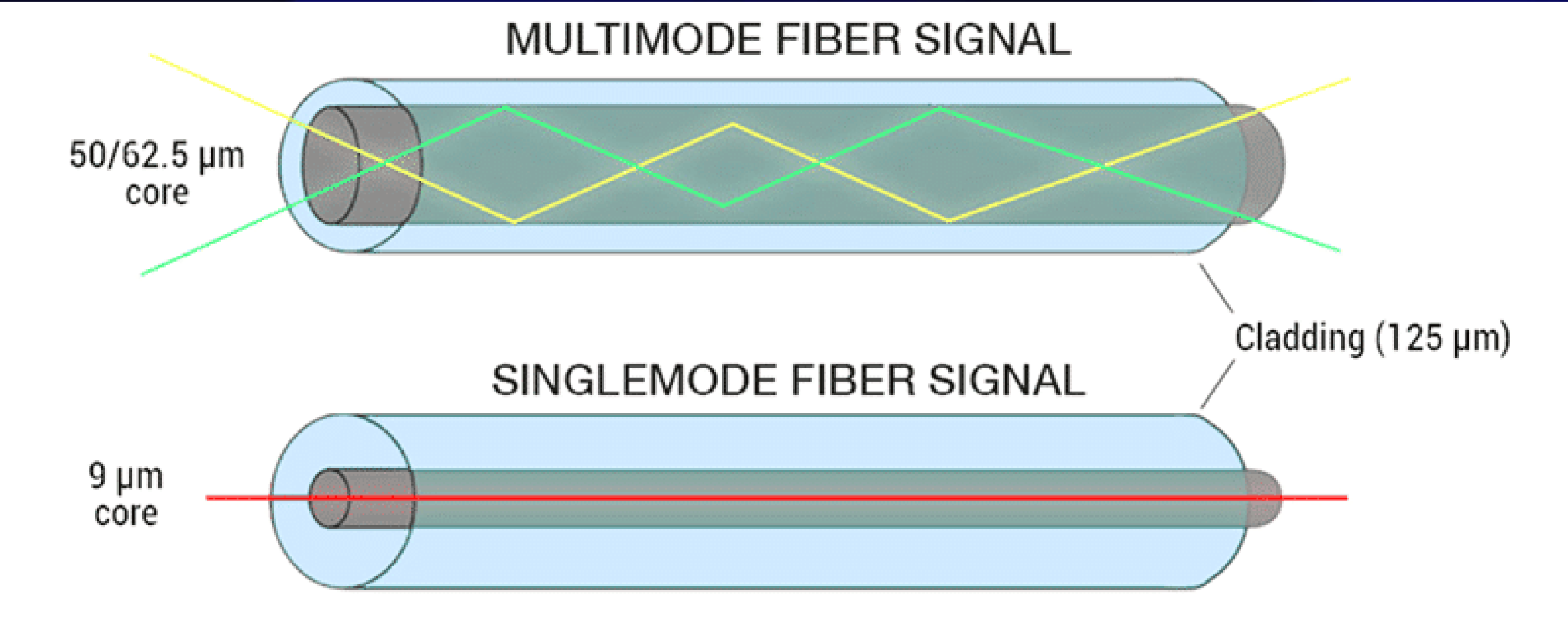


High Speed Switch

Office/Campus Setup

Transferring Data

- Singlemode distance
- Multimode Speed but expense



Single vs Multimode Fibre

Product picture		
Product name:	40Gbps 850nm 100M QSFP+ optical module	40Gbps CWDM 10KM QSFP+ optical module
encapsulated type	QSFP+	QSFP+
wave length	850nm	CWDM
CWDM	MPO	LC duplex
Fiber Type	MMF multimode fiber	MMF multimode fiber
Max transmission distance	150m (OM4 multimode fiber)	10km
Laser type	VCSEL	DFB

Transceivers

Internet

Transferring Data

- Remember Multiplexing?
- Allows huge increase in data transfer down single path
- Uses optics instead of electronics
- Can be set up and utilised later without great expense

What is WDM?

WDM = Wavelength Division Multiplexing

Refraction through a prism

White light

Multiplexing De-Multiplexing

Single strand of fiber

DWDM

40 virtual high-speed channels per physical fiber
Expanding capacity of an OC-48 ring from 2.5 to 100 Gbps

WDM is used on fiber optics to increase the capacity of a single fiber

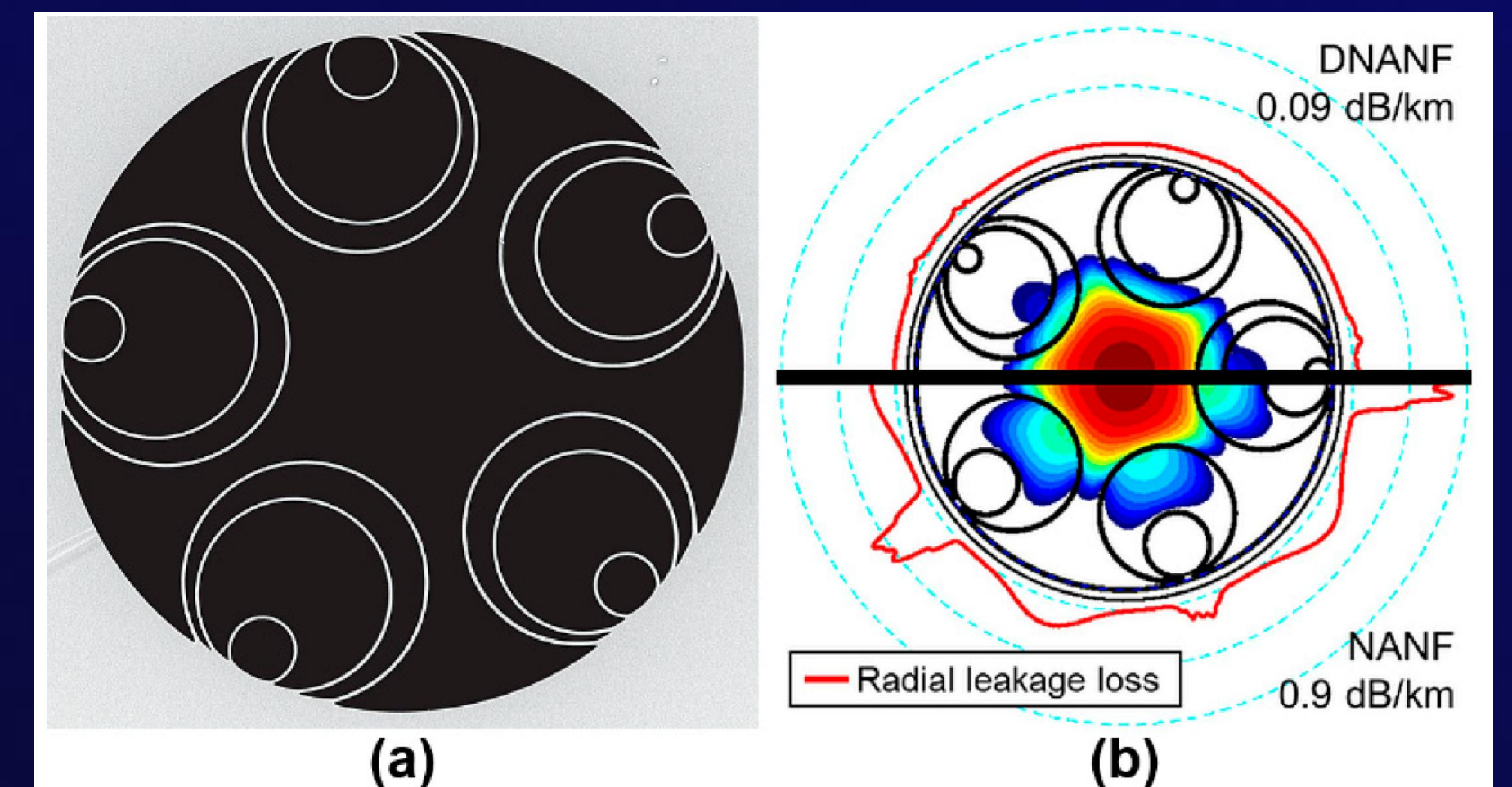
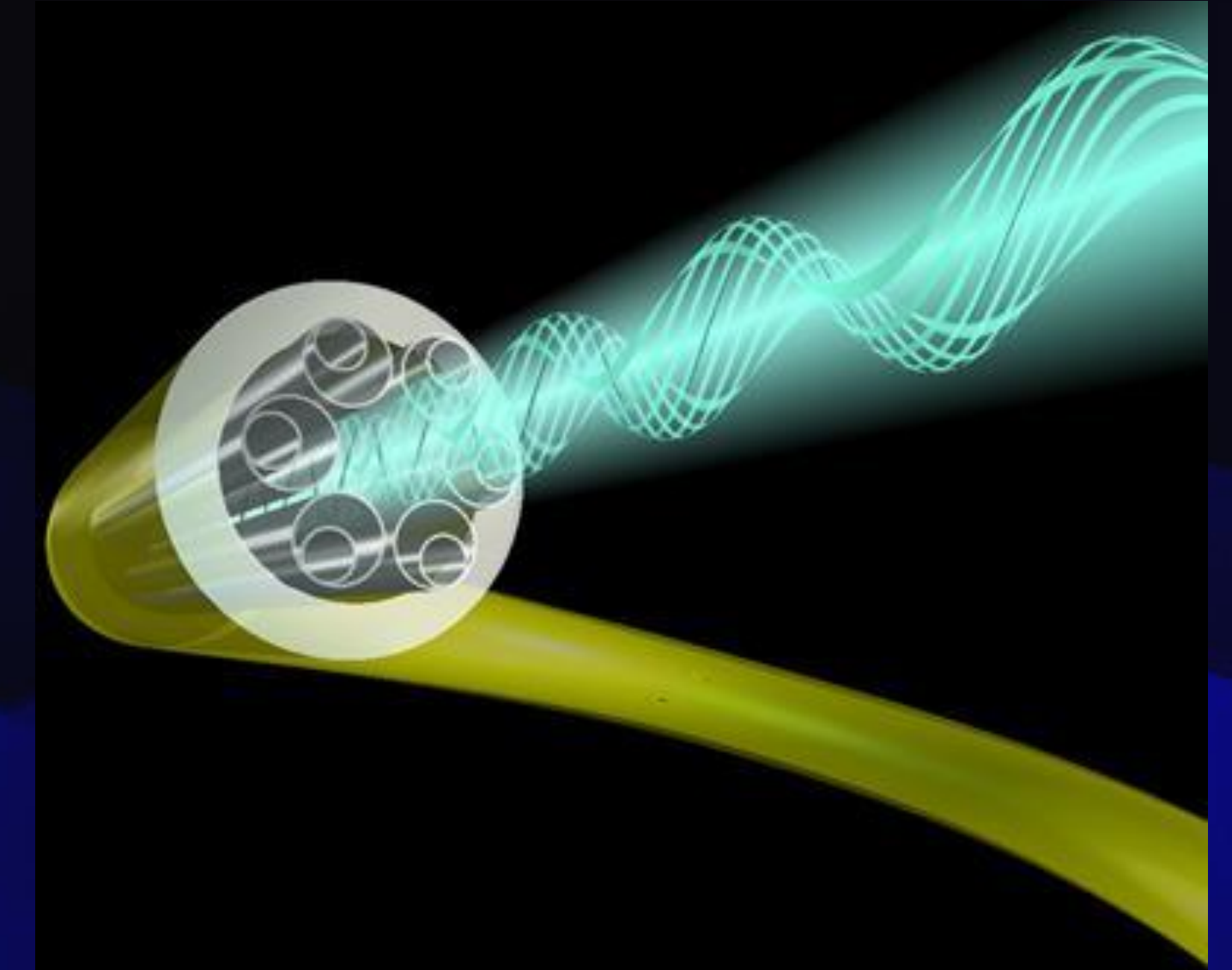
Fiber Optics For Sale C
COMPLETE SUPPLY SOLUTION

Caption

Future

Transferring Data

- But what if 186,000 miles per second is a bit.... slow.
- Fibre optics bounce light
- Refractive index of glass is around 1.5
- $3 \times 10^8 \text{ ms}^{-1}$ (subscript wont work)
- Use air instead
- Extremely low attenuation



light travels through the air inside the fibre, not the glass