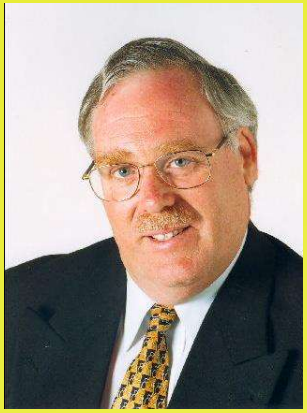


Milner Consulting Limited

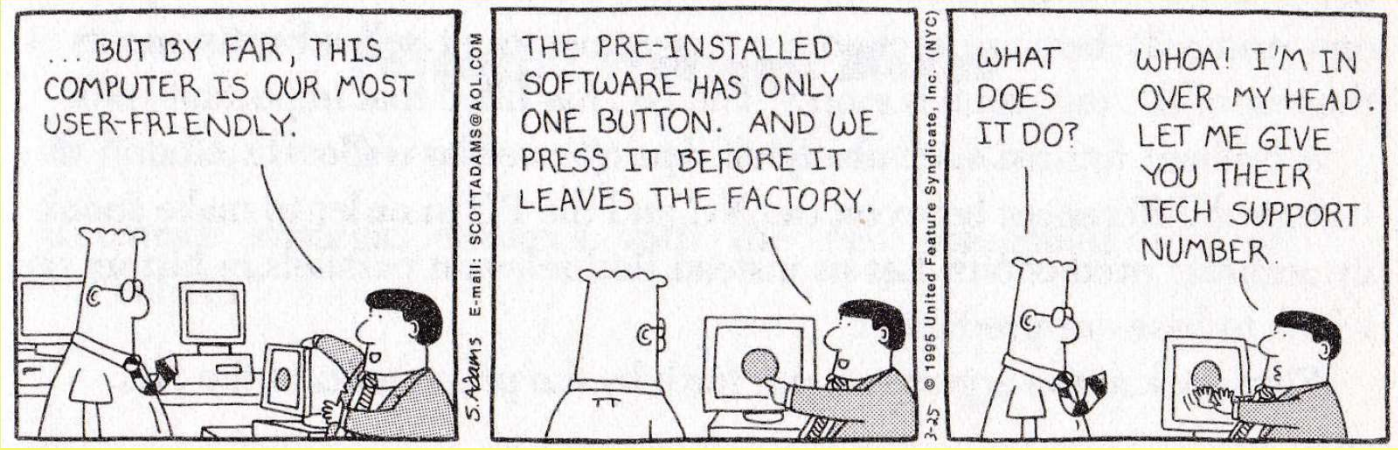
IEEE DAY 2017
LEVERAGING TECHNOLOGY FOR A BETTER TOMORROW

A Snapshot of Information and Communication Technology in New Zealand over the last 50 years

Presented by
Dr Murray Milner
3 October 2017

Overview

- Introduction
- The Technology
- Some Major Milestones
- The Companies
- Notable Personalities
- Successes and failures
- Conclusions

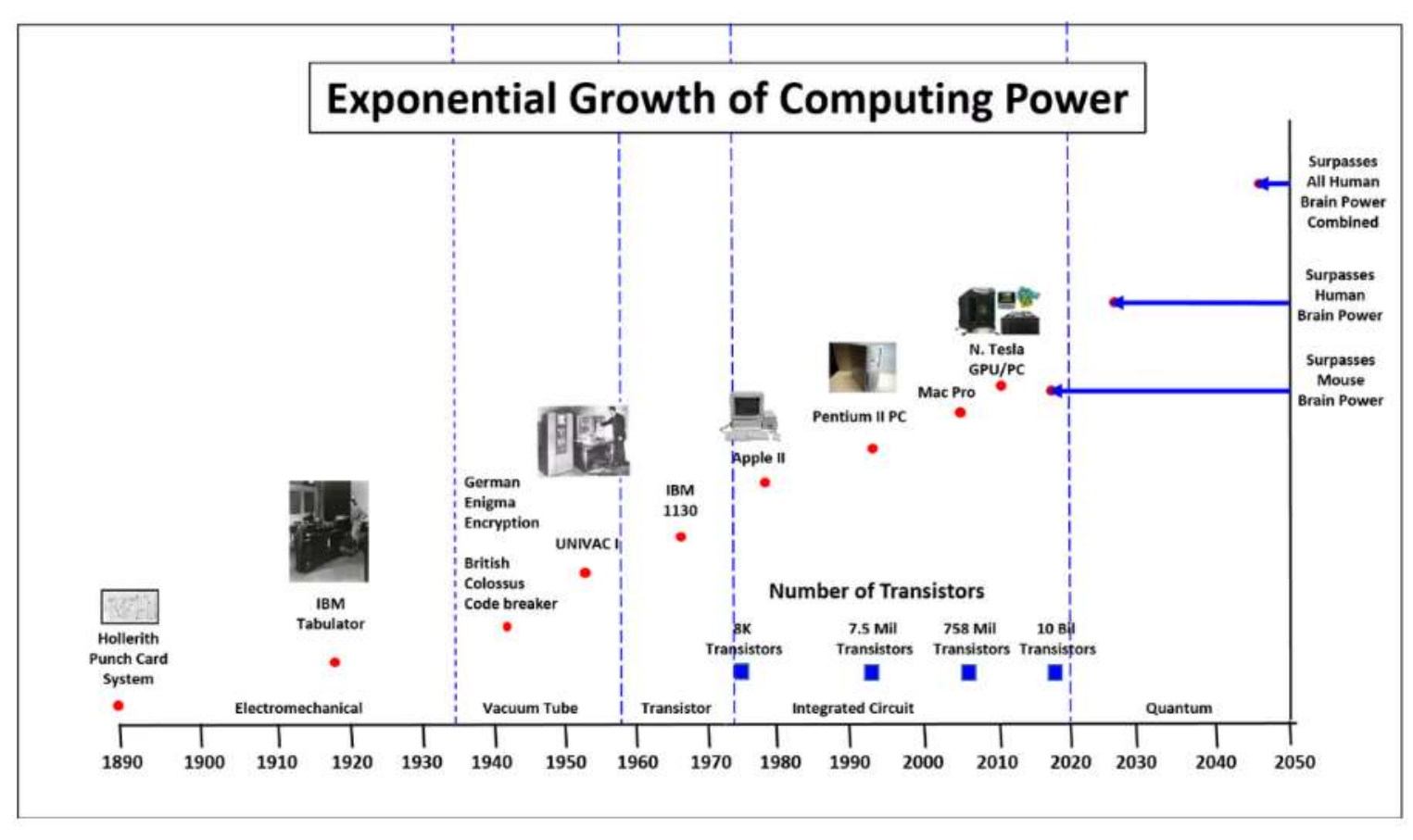


Acknowledgements

- The content for this lecture has been gathered from many sources including from many of my colleagues who have lived through the evolution of the ICT industry in New Zealand over the past five decades
- I would like to particularly recognise the contributions from:
  - Peter Williams,
  - Neal Miranda,
  - Kim Moleta
  - Mark Bothaway

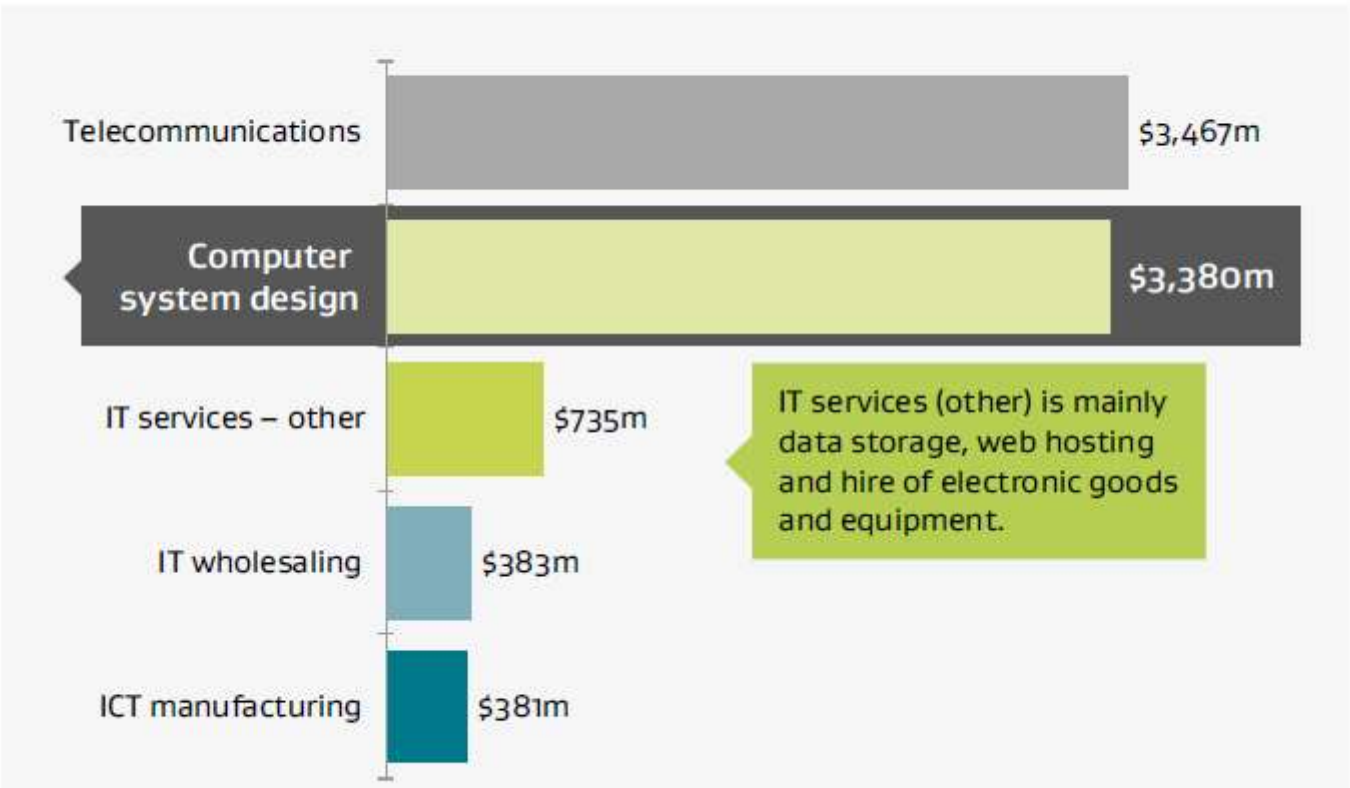
Introduction

Snapshot only: Too much has happened!



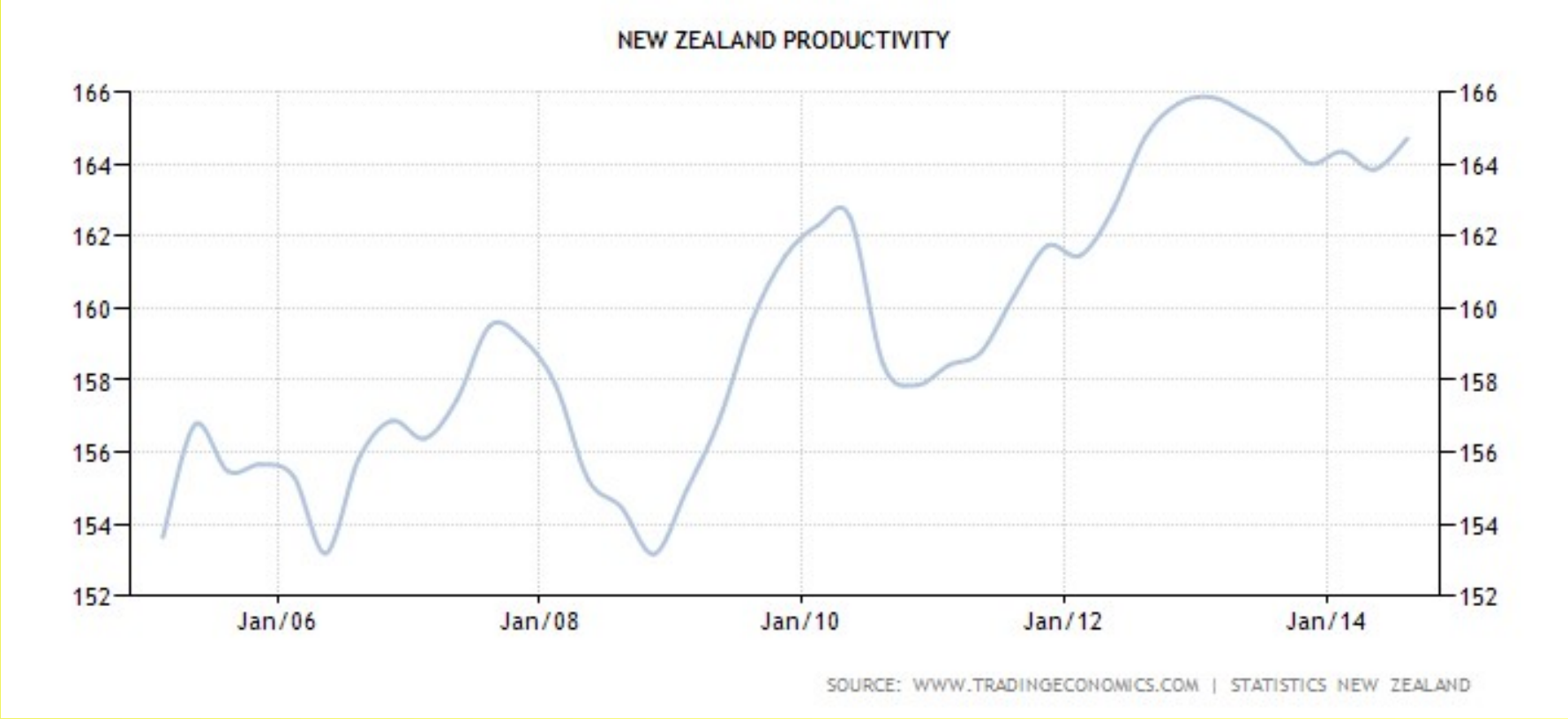
Source: Dr Jeffrey Reilly, Over the Horizon: The Multi-domain Operational Strategist (MDOS)

Value of ICT in New Zealand



- 1967< NZD1B, Approaching NZD10B today

ICT as a Driver of Productivity Improvement and Economic Growth



- Not a simple relationship, but observed by many commentators through **Digital Transformation**

Pre 1960s: When Telephony Density Mattered

The bakelite phone

For obvious reasons, the LM Ericsson product best known to the general public has always been the telephone. From 1931 on, this was made in black bakelite, a thermo-setting resin named after the chemist L.H. Baekeland, a Belgian working in the US. The design and styling were the result of work at LME's Norwegian subsidiary, Elektrisk Bureau. Not only was the styling new, the circuitry was based on extensive new calculations and measurements in the laboratories. The transmitter included a new anti-sidetone transformer for the first time.

The new telephone was fully on a level with the best foreign designs, and with its practical construction and advanced external form it set a standard in the industry for many years to come. It was adopted by Televerket and the British Post Office, among other administrations.

The desk set was the instrument most commonly in use, but a full range of different types for different uses was soon available: a wall-set, a 2-line set, a set with built-in amplifier, a house exchange telephone, and so on.

TABLE 11. TELEPHONE DENSITY
Selected countries and world total.

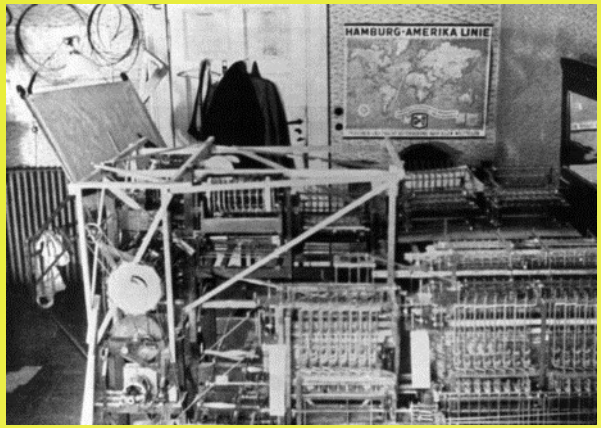
Number of telephones per 100 population.

	1930	1950	1970
USA	16	27	56
Sweden	8	23	54
Switzerland	7	18	45
New Zealand	10	18	44
Canada	14	20	44
Denmark	10	16	32
Australia	8	13	30
Norway	7	13	28
Great Britain	4	10	25
World total	**2**	**3**	**7**

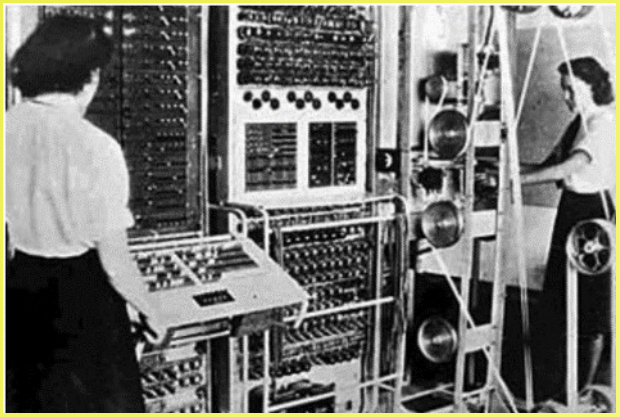
By including figures for 1970, we get a picture of the dramatic extension of the telephone networks that eventually took place.

Selected data from 'LM Ericsson 100 years', vol. II.

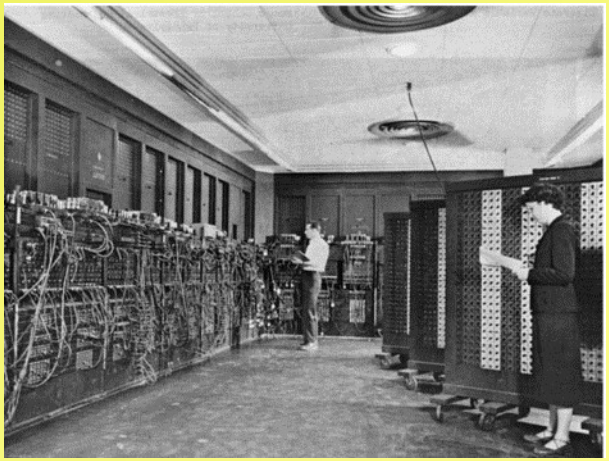
The Earliest Computers



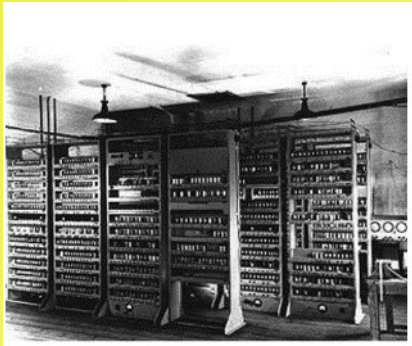
Z1 by Kanrad Zuse, 1936-38

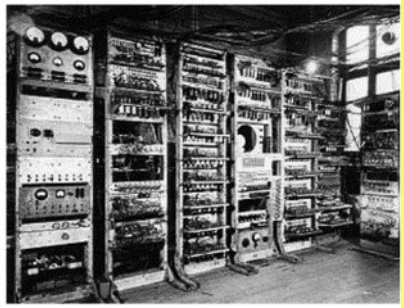


Colossus, Tommy Flowers, 1943

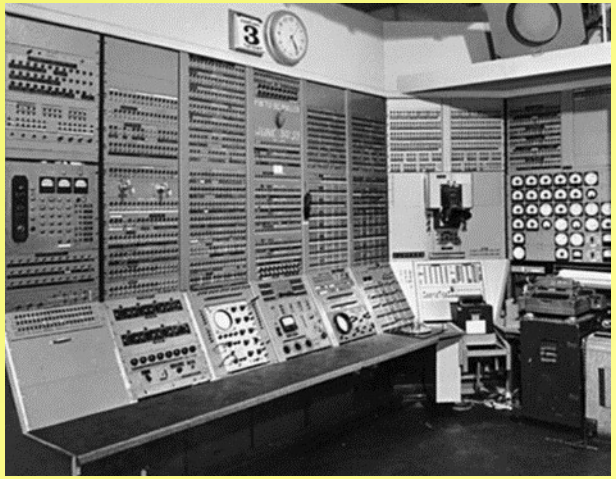


ENIAC, J. Presper Eckert and John Mauchly, 1943-46





EDSAC, first stored program electronic computer, 1949.



Whirlwind machine, 1955, first digital computer with magnetic core RAM

Source: Computer Hope, When was the first computer invented? 27 June 2017

Mainframes: "IBM and the Seven Dwarfs"

1962: NCR 315 Data Processing System

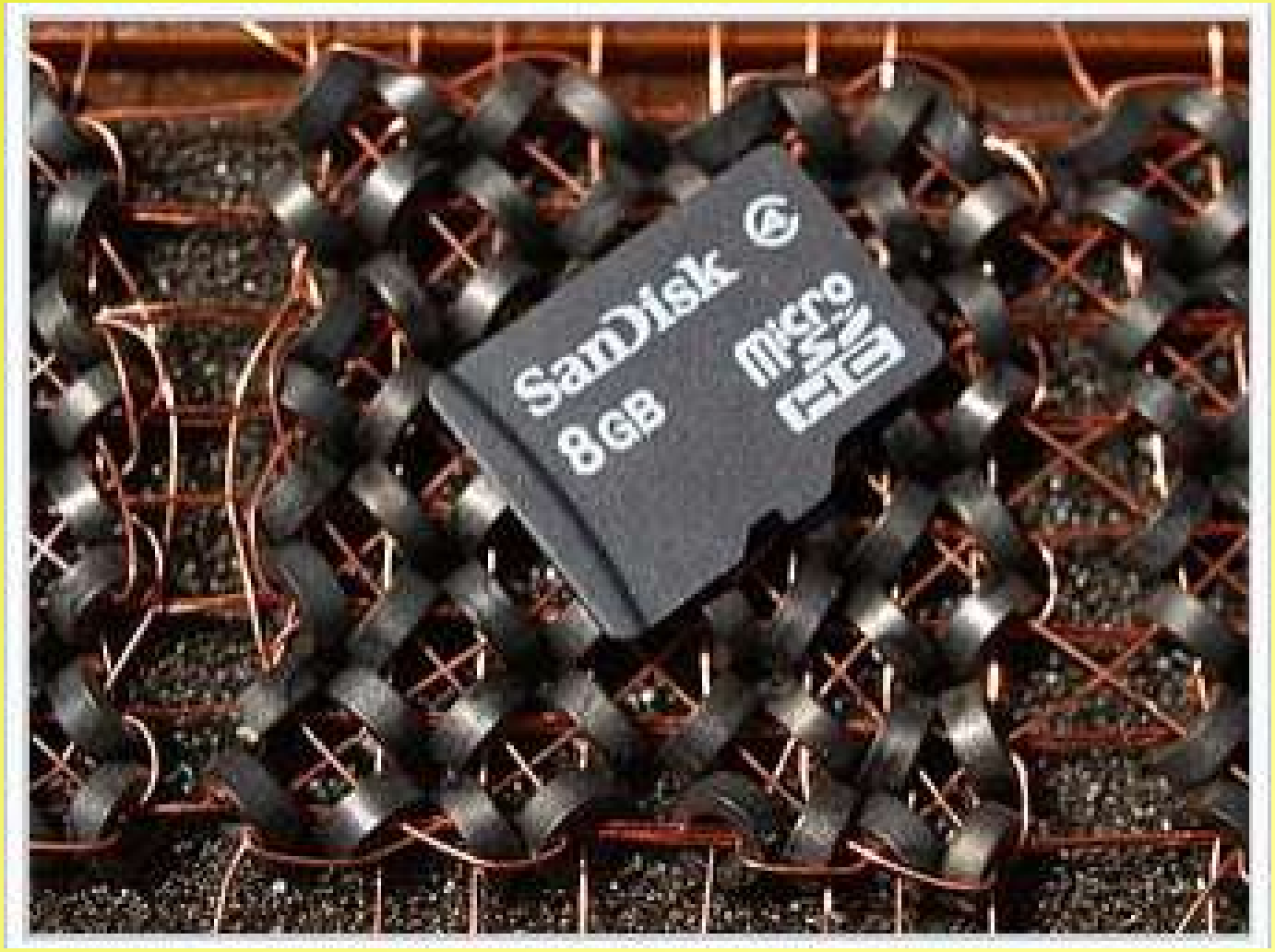
Burroughs
UNIVAC
NCR
Control Data
Honeywell
General Electric
RCA

1964: IBM 704 mainframe

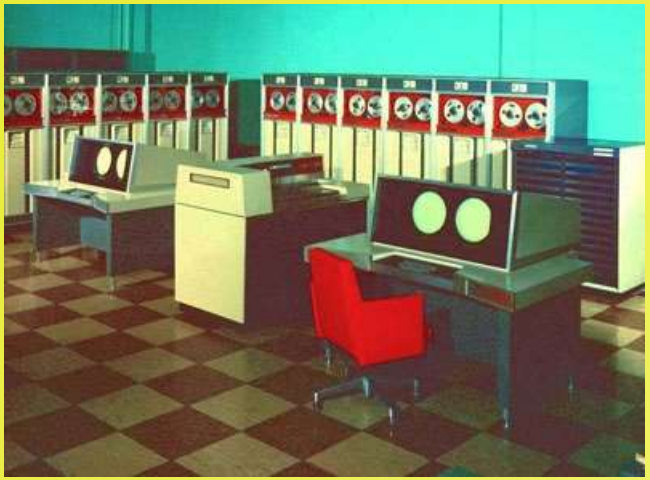
1971: Burroughs B6700 mainframe

1972: Honeywell Bull DPS 8/47 mainframe

Core Memory with a Modern Flash SD Card on Top



Supercomputers



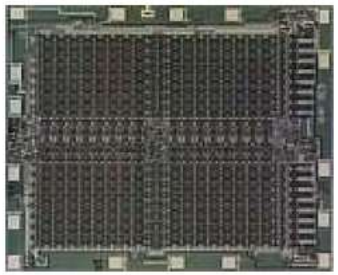
160 MegaFlops in **1976**
to 500 Petaflops in **2017**

1964: The CDC 6600, designed by Seymour Cray, was the first "super computer"

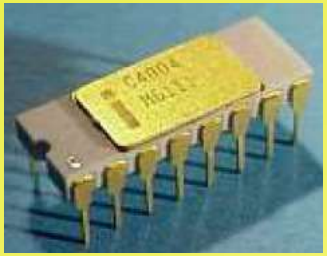
1975: The **Cray-1** was a supercomputer marketed by Cray Research Source: British Museum

2017: The **Cray XC50** supercomputer purchased by NeSI - 72nd on Top 500 rankings Source: Rob O'Neil, Reseller News, 12 June 2017

The Evolution of The Microprocessor



1970: Intel 1103 Dynamic Random Access Memory DRAM chip

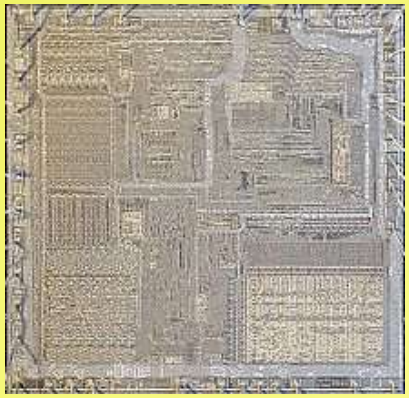


1971: Intel 4004, the first microprocessor chip

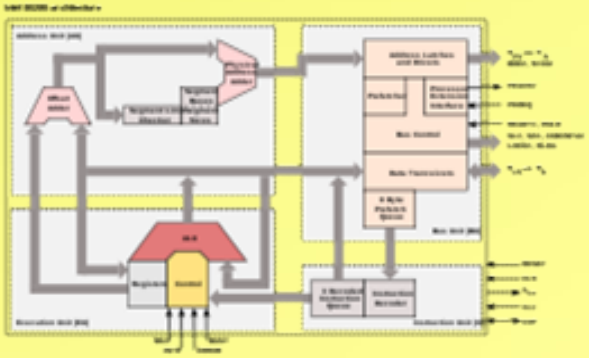
An Intel 8008

1972: Intel 8008, Intel's second microprocessor chip

1973: The IBM Winchester Disk Model 3040



1978: Intel 8086 CPU die image



1982: Intel 80286 16 bit CPU simplified microarchitecture

Source: Computing History Displays, University of Auckland and Wikipeadia.

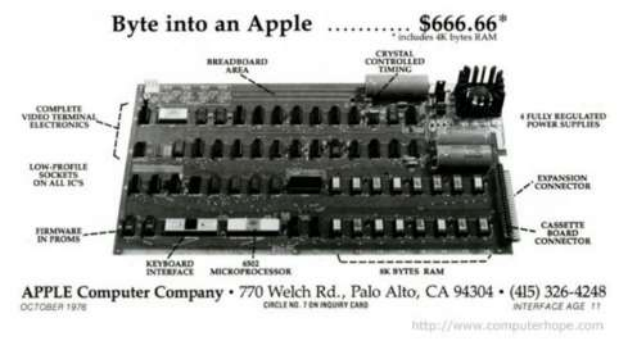
The Evolution of the PC

1975: The Altair 8800 Computer

Source: Display in the British Museum of Science and Technology

1982: Commodore 64: “The best selling computer in history”

Apple vs IBM



1976:
Apple 1

1980:
Apple III

1987:
Macintosh SE

2008:
MacBook Air

1975:
IBM 5100

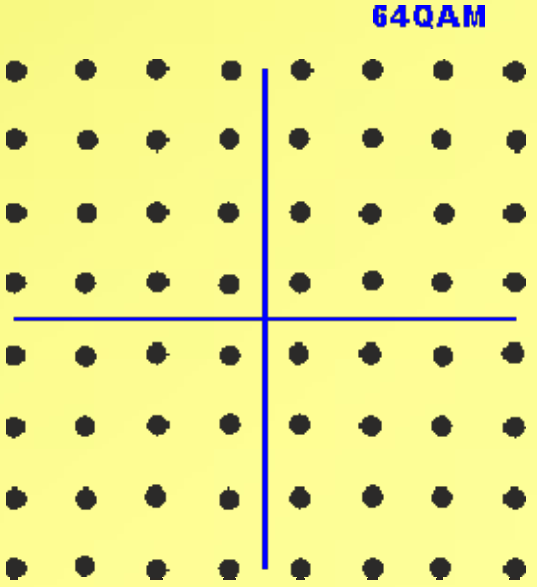
1981:
IBM PC

1995: IBM
Thinkpad 701c

2017: Lenovo
Legend Y520

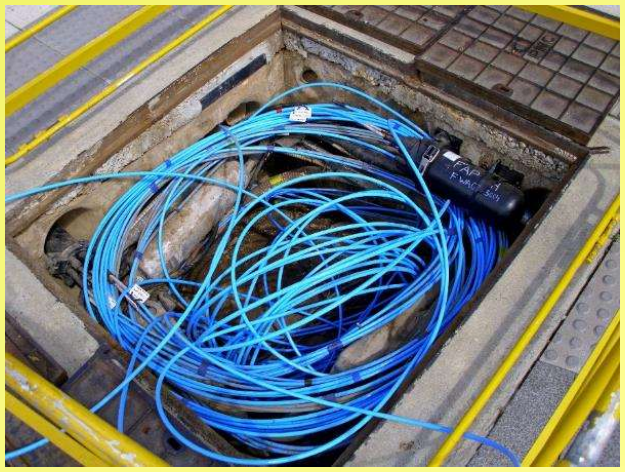
Microwave Radio

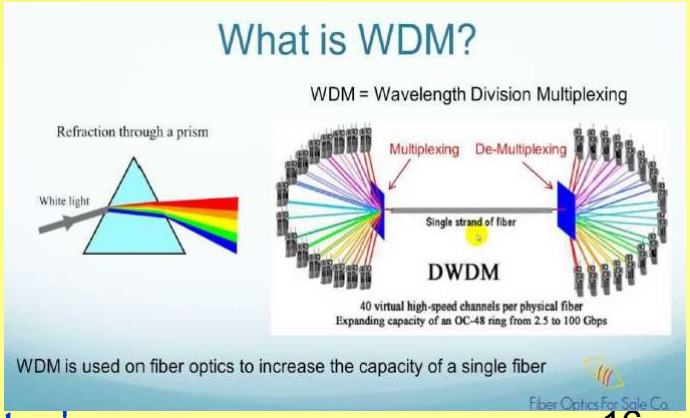
- **1959:** Wellington-Auckland AMR system commissioned, carrying 600 simultaneous voice calls
- **1976:** Substantial upgrade of Analogue microwave routes throughout New Zealand
- **1979:** Nelson-Greymouth AMR System
- **1984:** The first Wellington-Auckland DMR system commissioned, using 140Mbps per carrier
- **1986:** By YE 541 Digital TX/RX systems had been deployed
- **2000:** All AMR and most DMR long haul systems decommissioned



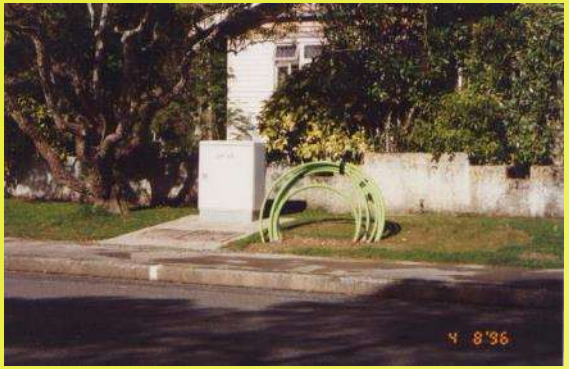
Fibre Optic Transmission

- **1983:** First fibre optic cable system installed
- **1985:** 620Mbps fibre optic cable systems in widespread use
- **1988**: Telecom installs large capacity fibre optic systems in CBDs
- **1996:** Telecom installs First Media Fibre to the Premise
- **2004:** 10Gbps DWDM systems deployed
- **2007:** Telecom deploys Fibre to the Node
- **2011:** UFB deployment commences
- **2014:** 100Gbps DWDM OTN



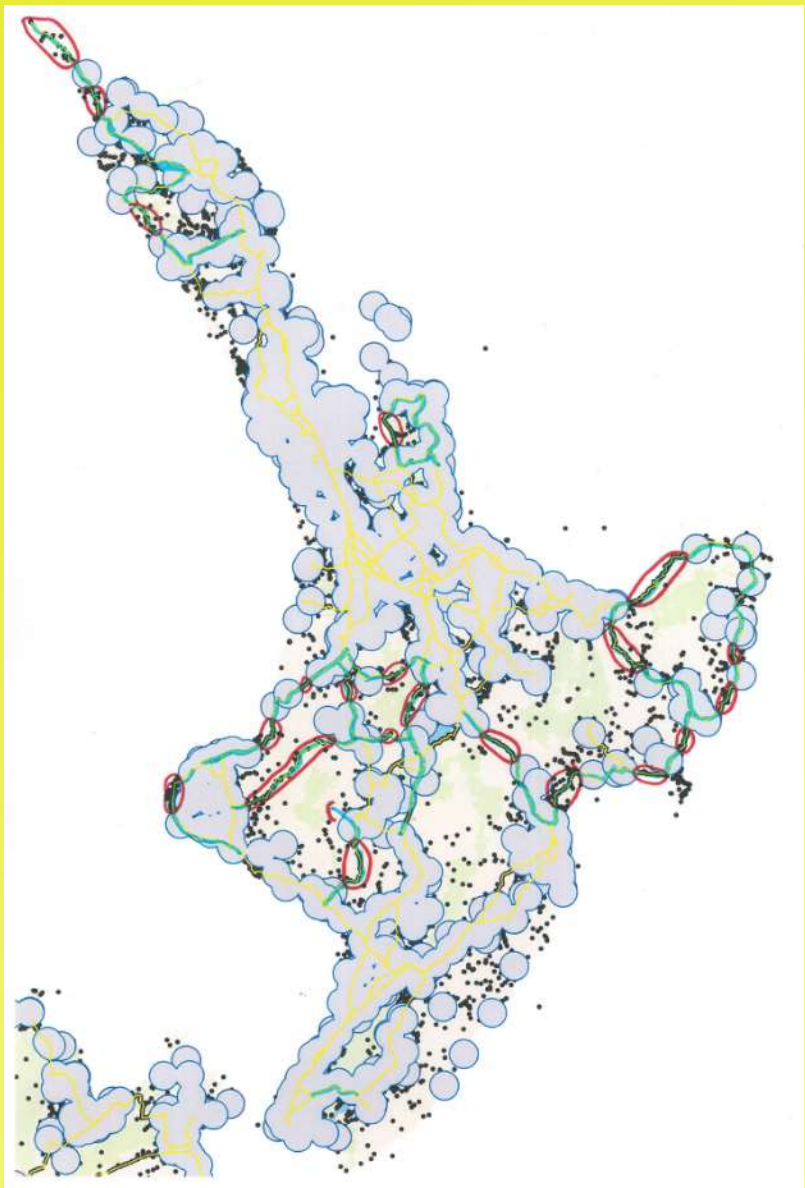


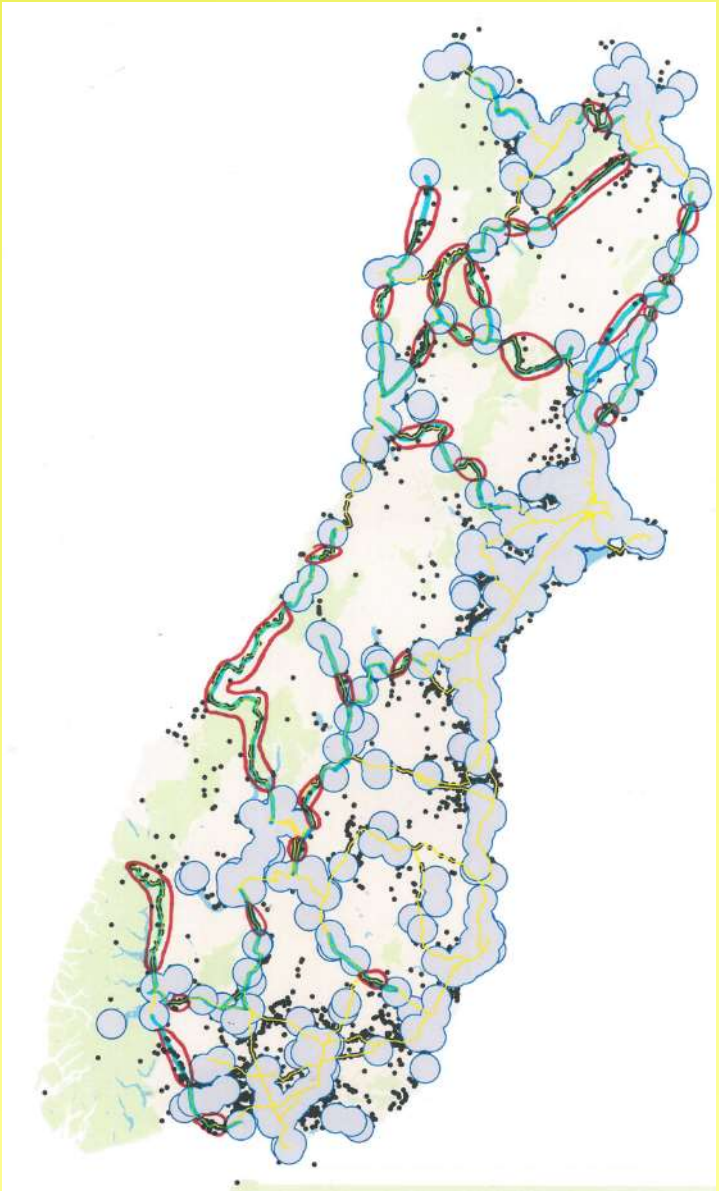
Fibre to the Premise



Ultrafast Broadband: 87% FTTP by 2022

Rural Broadband and Mobile Black Spots



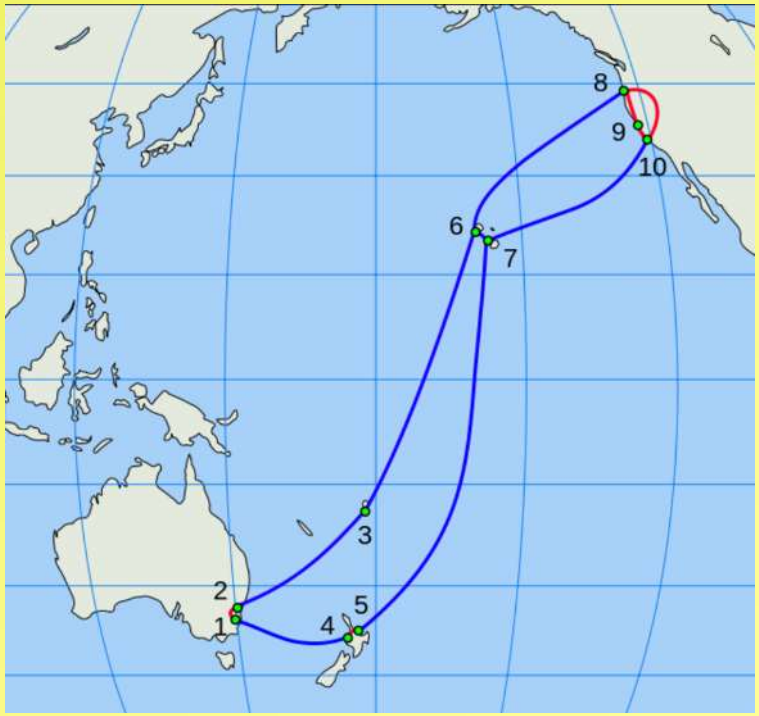


Submarine Cables Connecting NZ to the World

Sydney Morning Herald December **1963:** COMPAQ Submarine cable is commissioned (76 telephone circuits)

ANZCAN submarine cable system commissioned in **1984** (1380 telephone circuits)Source: History of the Atlantic Cable and Undersea Communications

In **1976** the Tasman 1 cable was commissioned



Southern Cross Cable System commissioned in **2000** - Capacity 12Tbps.

Warkworth Satellite Earth Station

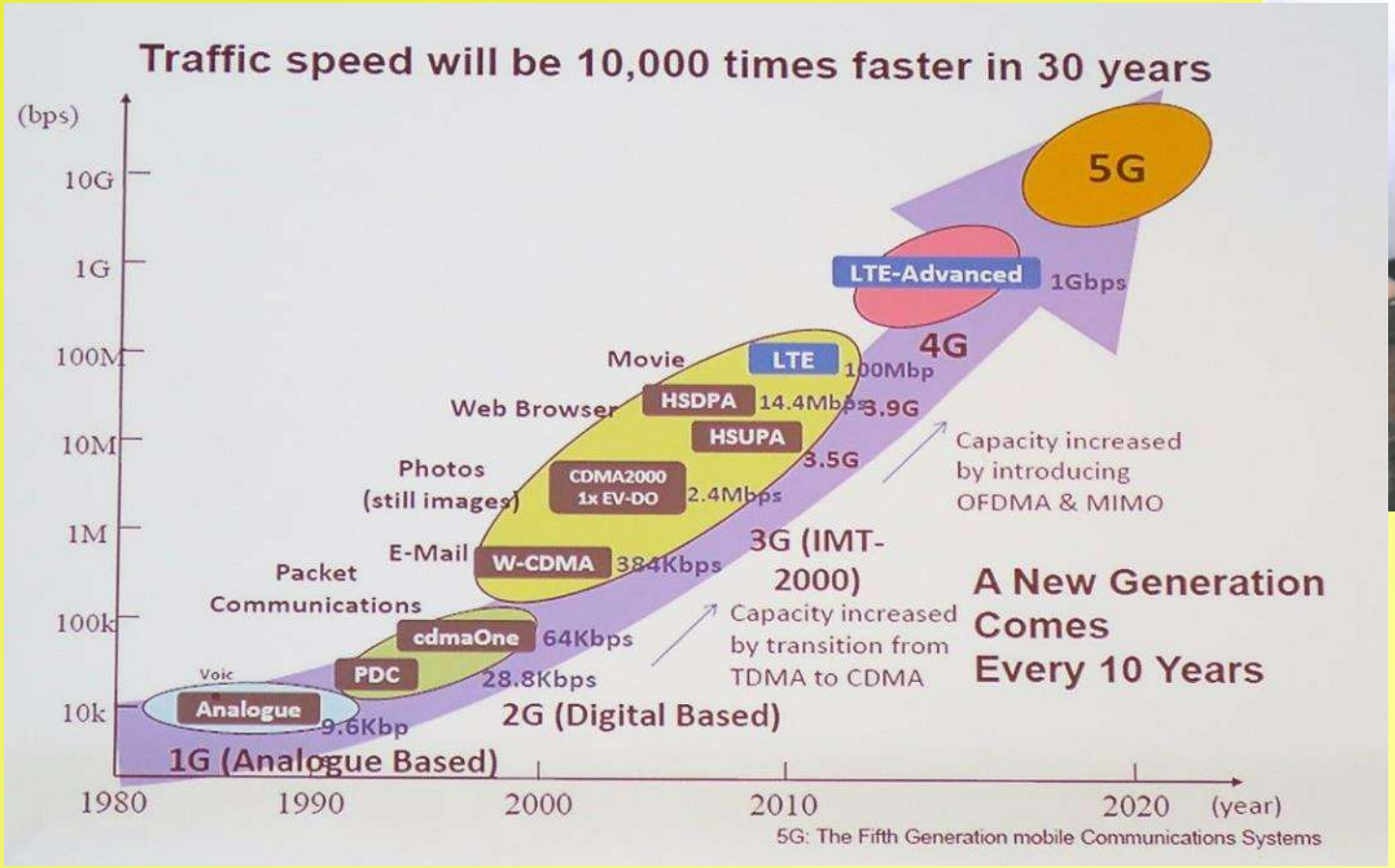
Commissioned in **1971**

1982:
Warkworth 1 Antenna and Control Console

Warkworth SES in **1990** and **2016**

1986: “Satellite Man off to the USA”

Cellular Mobile Technology



Evolution of the Mobile Phone

1984: Dyna TAC 8000X

1999: Ericsson T28

1999: Nokia 9110

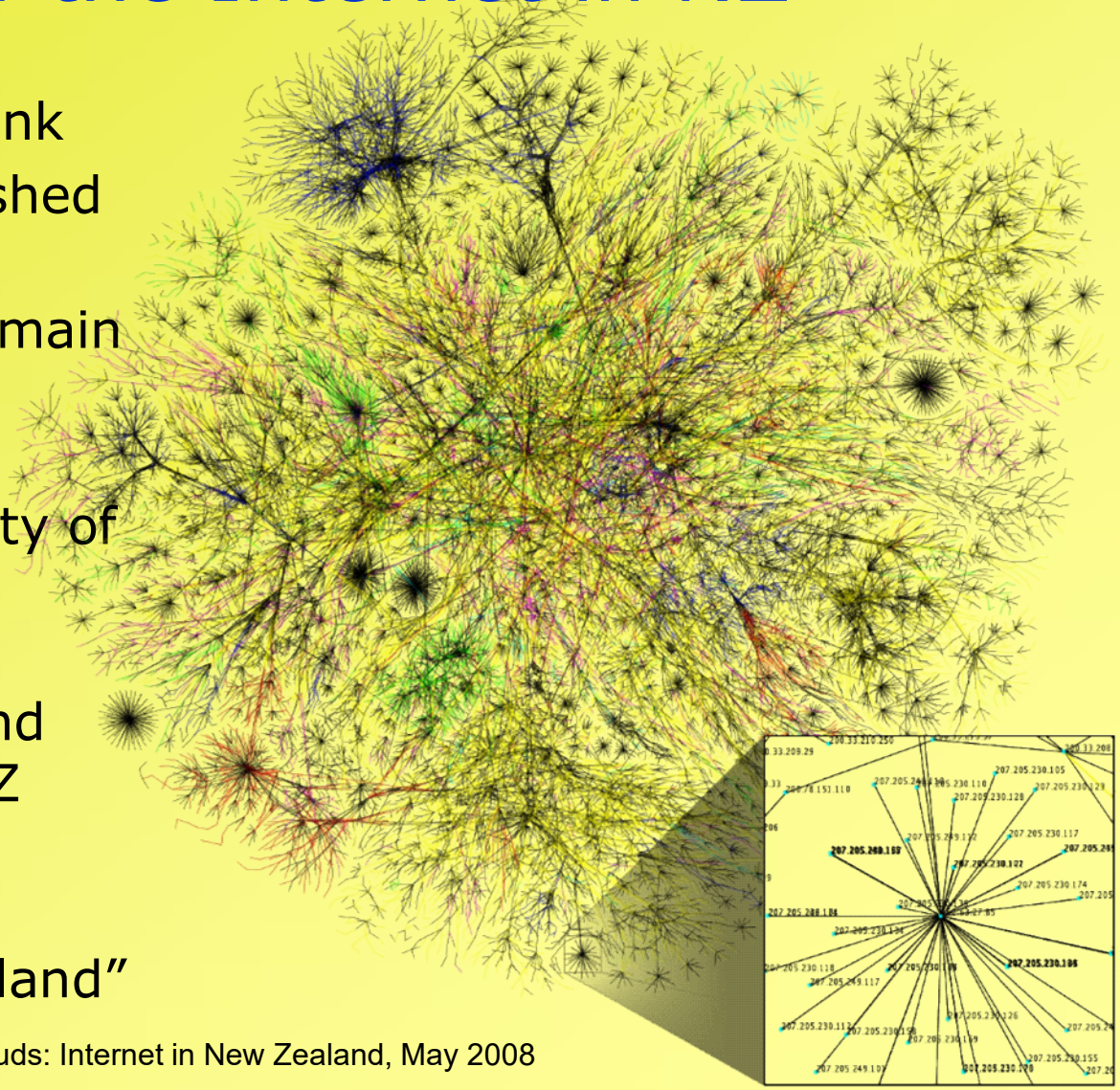
2007: Apple iPhone 1

2000: Ericsson R380 WAP Phone

2017: Samsung S8

Genesis of the Internet in NZ

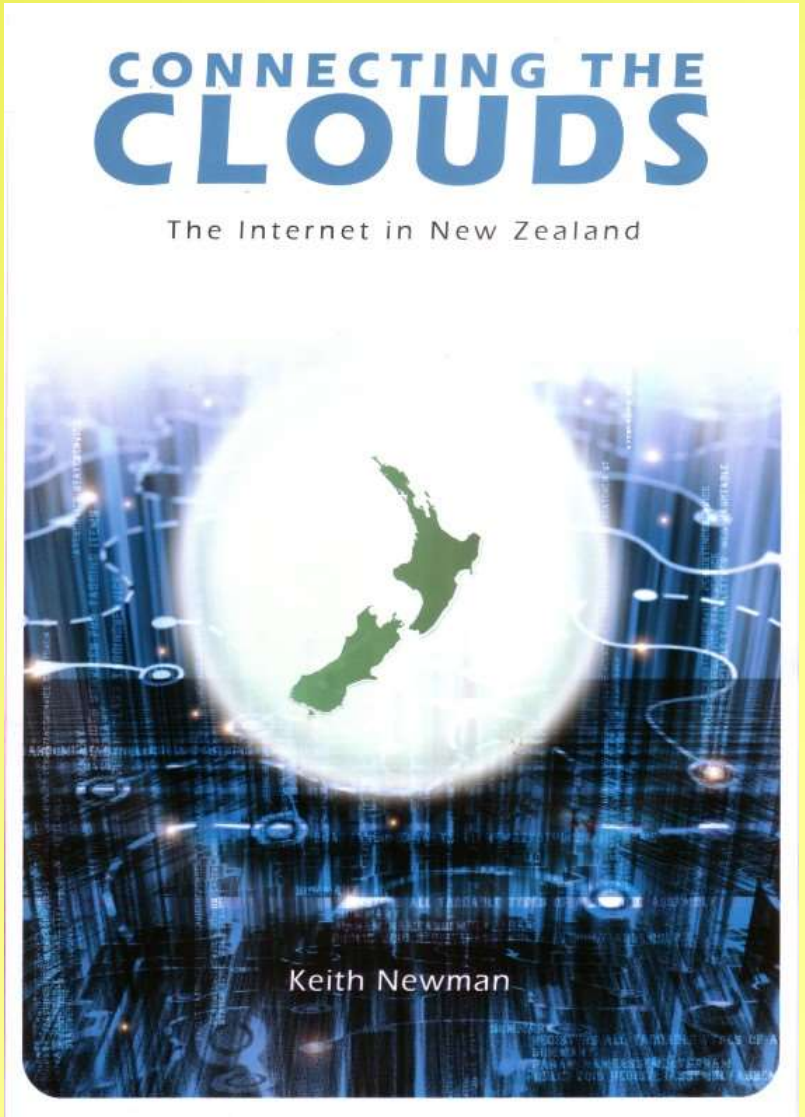
- **1975:** First KiwiNet link
- **1976:** VicNet established
- **1985:** John Houlker established dot.nz domain
- **1986:** Gateway - US Computer Science Network and University of Waikato
- **1986:** Battle of the protocols OSI X.25 and TCP/IP emerged in NZ
- **1987:** John Hine published "Research Networks in New Zealand"



Source: Keith Newman, Connecting the Clouds: Internet in New Zealand, May 2008

The Internet Emerges in NZ

- **1987**: Murray Milner led the Advanced Technology Group from Stanford University
- **1989**: First permanent circuit via ANZCAN
- **1990**: 14.4kbps satellite link established between Waikato and San Francisco
- **1994**: ihug was launched by brothers Nick Wood and Tim Wood
- **1996:** Telecom launches Xtra Internet access service
- **2017:** More than 95% of NZers connected



Early Government Computing

- **1961:** NZ Treasury IBM 650 and DSIR Elliot 503
- **1961:** Ministry of Defence Sperry Univac 1100/62
- **1969:** Nine government agencies
- **1970:** Government Computer Centre in DIA
- **1972:** Computer Services Division (CSD) of SSC
- **1975:** CSD running 5 large computer centres
- **1976:** DSIR network of PDP-11 mini computers
- **1978:** ICL 2980 mainframe
- **1982:** Wanganui Computer Centre bombing
- **1982:** IBM 3081 Computer in Cumberland Data Centre

ICT in Healthcare

1985:
MRI

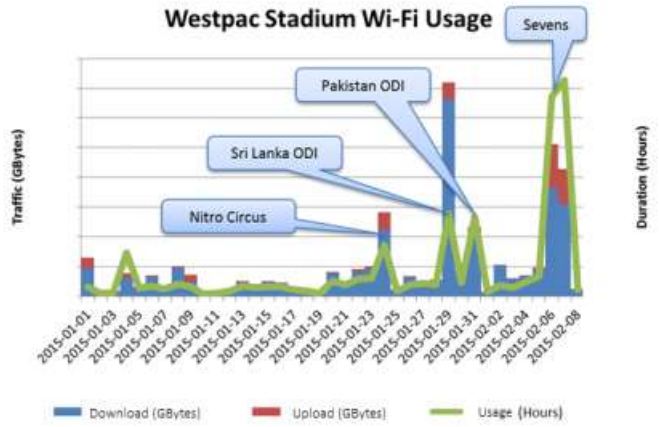
2015:
Hospital Room

2015:
Remote Diagnostics

Dialysis
Dermatology

Local Government Initiatives

- **1986:** Richard Naylor established CityNet for WCC
- **1990:** Wellington metropolitan area fibre network known as CityLink was launched using Ethernet
- **1991:** CityNet was opened to public access
- **1995:** CityNet had over 3000 users
- **1997:** CityLink established as a private company
- **2009:** CityLink Acquired by TeamTalk



Early Academic Computing

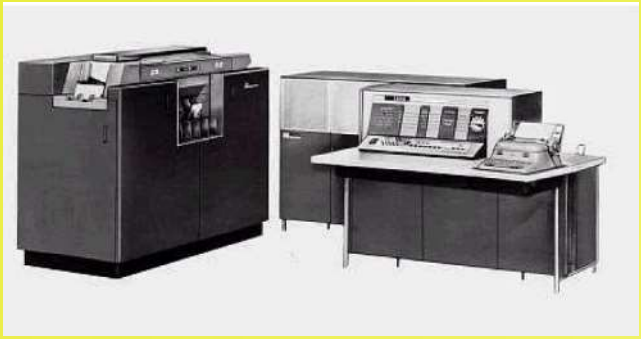
- **1962:** University of Canterbury IBM 1620
- **1963:** IBM 360 series computers in Universities
- **1971:** Vice Chancellor's Committee purchases of five Burroughs B6700 mainframes
- **1980:** Approx. 100 computers in secondary schools
- **1981:** Wellington Polytech develops Amber Pegasus
- **1984:** 1282 microcomputers purchased by schools
- **1985:** 95% of secondary schools had at least one microcomputer

Early Business Computing

- **1961:** IBM 650 at Griffins Biscuit factory
- **1969:** Databank computer centre
- **1972:** Largest IBM System 3 installation in NZ at Waikato Savings Bank
- **1972:** 200 business computers in operation
- **1982:** First twin floppy IBM PCs supplied to AirNZ
- **1982:** New World installed first IBM 3680 Point of Sales system
- **1983:** IBM Personal Computers launched for business
- **1983:** AMP's System 360 is de-commissioned

60 years of IBM in NZ

The Good, the Bad and the Ugly



1962: IBM1620

1964: IBM 360

IBM — Celebrating 50 years in NZ 2005

IBM New Zealand Est.1955

1955
IBM NZ becomes direct branch of IBM World Trade Corporation. Harold Franke appointed NZ managing director. AMP first customer with installation of 421 unit record. General Motors second customer with installation of 421 unit record.

1956
First electronic computers announced (701 and 650). Computers ordered by General Motors, AMP, Railways, Treasury. IBM NZ's revenue £31,000; 14 employees.

1957
Card plant opened in Pharazyn Street — produces 5 million cards annually. IBM Service Bureau (data centre) opened in Wellington. Payroll system installed at NZ Railways.

1958
Jack Wills (former head of Treasury) appointed NZ managing director. First system sale of 650 tape system (leased at US$12,000 per month) to Treasury.

1959
Christchurch branch office opened. Auckland branch makes first unit record sale to Bond & Bond.

1960
Auckland data centre opened by Mayor of Auckland Sir Dove Myer Robinson. IBM NZ's revenue £586,000; 92 employees.

1961
Social security benefit cheques produced on IBM cards (manufactured at IBM card plant, Naenae). Launch of golfball typewriter.

1964
Christchurch data centre opened. System 360 launched in NZ (first country in world) — 8-bit machine with 4K of memory at a cost of US$300,000. System 360 sold to National Insurance and Otago University. AMP installs 1401 to run NZ branch applications.

1965
First System 36 installed at Treasury. IBM NZ's revenue £3.4million; 218 employees.

1966
Card plant production now at 180 million cards per annum. First cheque processing machine installed at Databank.

1968
Thomas J Watson Jnr, chairman and CEO of IBM World Trade Corporation, visits New Zealand. IBM's partnership with Air NZ (then NAC) begins. First online order entry system sold to Gough, Gough and Hamer.

1969
ASB installs teller terminals online system. Magnetic card typewriters introduced, enabling documents to be stored for reuse. System 3 announced offering affordability, more storage, programming — aimed at small-medium businesses.

1970
IBM NZ starts annual briefings to media. Fred Hall becomes acting NZ managing director.

1971
IBM Centre on the Terrace in Wellington opened by Prime Minister Keith Holyoake. IBM becomes NZ registered company. First System 3 installed in the South Island at Canterbury Electric Power Board. System 370 with silicon chip technology launched. David Greatorex appointed NZ managing director.

1972
Largest System 3 in NZ installed at Waikato Savings Bank. CICs and DL/1 database announced, marking beginning of online era. 171 dictating unit, 172 transcribing unit and System 370 virtual storage announced.

1973
IBM Copier III, self-correcting typewriters and System Network Architecture announced.

1974
Bas Logan becomes NZ managing director.

1975
IBM NZ employees now 500.

1976
Government doubles sales tax on computers from 20% to 40%. IBM fund for community service established. 4340/4360 introduced, offering 4x price-performance (a ballot is run for first customer shipment).

1977
IBM NZ revenue $29.8 million.

1978
BNZ installs 3600 in NZ branches.

1980
Vogel Computing Centre re-opens after upgrade to largest single computer in NZ (investment of $3.6 million). IBM 3279 colour screens announced.

1981
More than 500 3279 colour screens on order or installed in NZ.

1982
New World opens 53rd supermarket, in Auckland, with IBM 3680 point of sale system. First IBM 3081 computer in NZ installed at Government's Cumberland Computing Centre.

1983
IBM Personal Computer launched into businesses (not homes). Unilever first in NZ to purchase a PC. AMP's System 360 (last in Wellington) decommissioned. Databank places IBM NZ's largest order to date.

1984
First National Personal Computer Dealer Conference held in Auckland.

1985
3.1 hectares of land purchased for IBM's Petone complex. Air charter service begins for express parts delivery.

1986
New Zealand awarded 'best overall performer' in IBM. IBM NZ's revenue $250 million; 800 employees.

1987
IBM's Petone complex opens 23 November. OS/2 announced. Herb Hunt appointed NZ managing director.

1988
AS/400 announced. Wheelwriter II series of electronic typewriters announced. Personal System 2 Model 30 announced.

1989
Telecom ICMS development commences with first pilot in Kapiti. Four-year partnership agreement signed with Databank.

1990
Smoking banned in IBM buildings. IBM Australia/New Zealand formed. System 390 announced (new range of 18 processors, IBM Enterprise/9000 family). IBM NZ revenue is $262 million. Graham Murray appointed NZ managing director.

1991
Gowan Pickering appointed NZ managing director.

1993
Wellington Area Health Board installs New Zealand's 200th RS/6000. Foodstuffs (South Island) installs first 3995 optical disk in NZ.

1994
ICMS installed in Cable and Wireless UK. IBM and NZ Police sign INCIS contract. Noel Leeming becomes first user of IBM's new 4694 point of sale terminals. P&O purchase first rack-mounted RS6000 in Wellington. IBM NZ's revenue $224.7 million.

1995
IBM acquires Lotus Development Corp.

1996
Formation of IBM Global Services announced in New Zealand. IBM acquires Tivoli Systems Inc.

1997
VisualAge 2000 announced to help companies make applications Y2K-ready.

1999
IBM Australia and New Zealand integrated for second time. IBM acquires Sequent. IBM enterprise storage server, codenamed 'Shark', launched. Ken Symington appointed NZ managing director.

2000
Nick Lambert appointed NZ managing director. Westpac outsourcing contract signed. IBM and NZ Police agree on closure of INCIS contract. IBM e-server introduced. IBM NZ's revenue $307 million.

2001
IBM acquires Informix software.

2002
IBM acquires PWC Consulting. Air NZ extends partnership with IBM. Weta Digital purchases xSeries servers. BNZ purchases new teller system. Vodafone and Auckland University engage services of IBM Business Consulting Services. IBM eServer Blade system introduced.

2003
IBM's graduate program resumes in New Zealand. ICMS sold to US company CSG. IBM acquires Rational Software. Fonterra engages IBM's Business Consulting Services.

2004
IBM acquires Logical Networks Limited. Katrina Troughton appointed NZ managing director.IBM NZ's revenue $390 million; 730 employees; 240 contractors. IBM starts donating the KidSmart early learning programme to New Zealand kindergartens.

2005
IBM's PC business is sold to Lenovo.

ibm.com/nz

The Birth, Life and Death of Digital Equipment Corporation

1962: DEC PDP-1

1957: Founded in California
1998: Became Compaq
2002: Purchased by Hewlett Packard

DIGITAL EQUIPMENT CORPORATION (NEW ZEALAND) LIMITED
1971: Incorporated
1999: Dissolved

1965: The first DEC PDP-8

1969: PDP-11

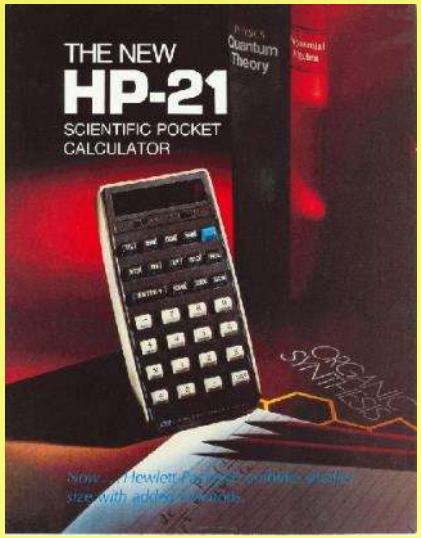
Hewlett Packard Ltd

1966: First HP2116
1969: First HP 2116 at UoA

1968: HP9100A

1972: HP3000

1977: HP9845A



1972: HP-35
1975: HP-21

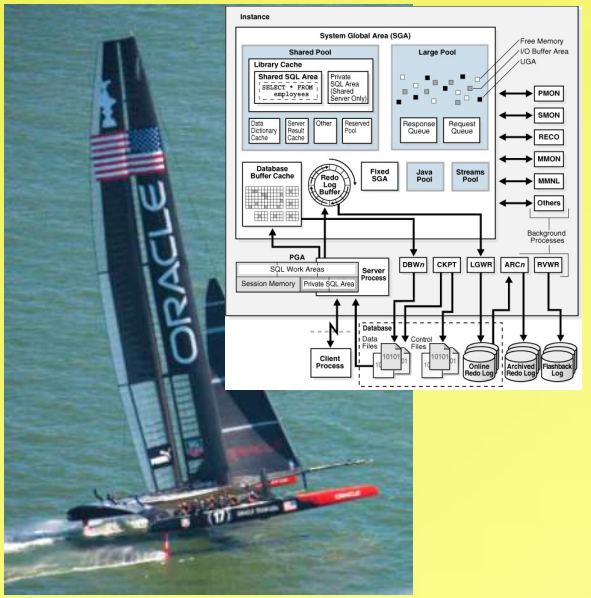
1980: HP-85

1984: Fujitsu NZ
2017: 55 years of Fujitsu in NZ

And Many More

UNISYS

1971: Burroughs in NZ
1986: Merger of Burroughs and Sperry



1977: Established
1983: NZ Dairy Company
1995: Prominence in NZ

1974: Tandem Computers
1983: Non-stop system
1991: Telecom IN
1997: Acquired by Compaq

1976: Wang NZ Ltd
1987: Telecom DAS
1997: Delisted

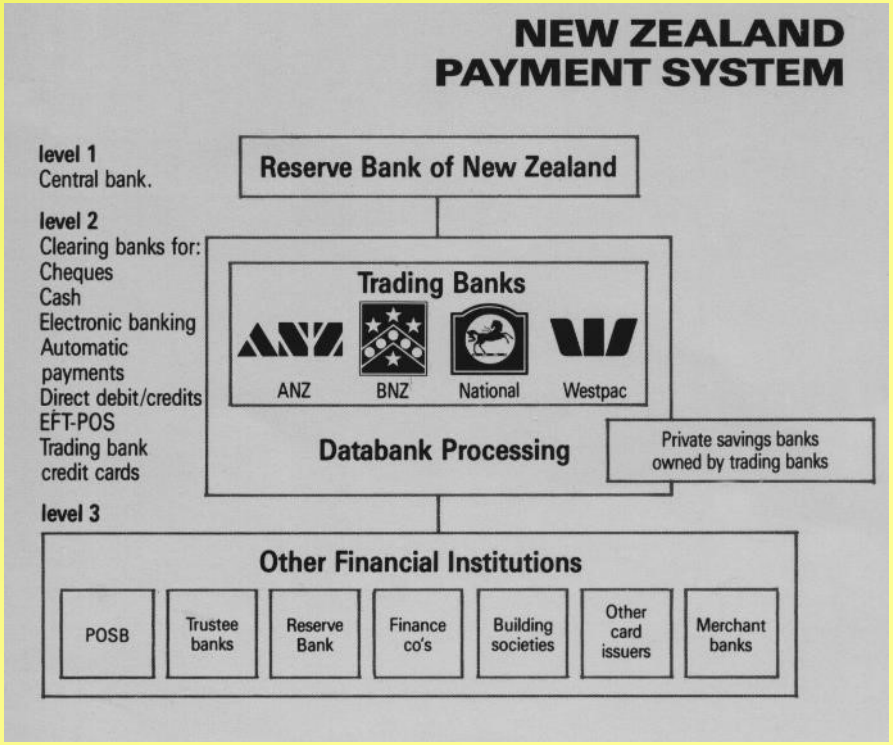
1972: Established
1977: NZ Office
1995: Telecom

Datacom

- **1965:** Computer Bureau Ltd (CBL) founded by Bernard Battersby and Paul Hargreaves in Christchurch using ICL 1902 mainframe
- **1970:** Acquisition of Fletcher Computer Bureau
- **1984:** Changed name to Datacom
- **1989:** CBL Merger with CCL
- **1992:** Merger with IT department of NZ Post
- **2011:** Datacom launches VMware Cloud
- **2013:** Hamilton data centre at Kapua opens
- **2013:** The company acquires IP and assets from XciteLogic
- **2016:** NZD1B revenue year

Databank Systems Ltd

- **1967:** Established by a consortium of banks led by Gordon Hogg
- **1969:**Money Transfer Services (MTS) introduced
- **1974:** Chequing accounts introduced
- **1979:** Databank servicing more than 1,200 banking offices
- **1980s:** Rapid introduction of ATMs and EFTPOS
- **1984:**Banking deregulation
- **1989:** Inter-company transactions must carry GST
- **1994:** Databank sold to EDS



Telecom New Zealand

- **1987:** Telecom Corporation of New Zealand
- **1987:** District Accounting System (DAS)
- **1989:** Telecom ICMS development commences
- **1989:** AMPS analogue cellular system introduced
- **1990:** Telecom New Zealand privatized
- **1991:** DAS capability was consolidated to Hamilton
- **1996:** Telecom launches Xtra ISP
- **1999:** Jetstream ADSL launched
- **1999:** Outsourcing agreement signed with EDS
- **2000:** Southern Cross Cable project completed
- **2000:** CDMA cellular network launched
- **2005:** Major upgrade of billing systems
- **2006:** Operational Separation
- **2011:** Structural Separation into Chorus and Spark

Spark
New Zealand

Vodafone NZ Ltd

- **1998:** Acquired Bellsouth's 65% stake in BellSouth New Zealand
- **1999:** Purchased the remaining 35% stake owned by Singapore Technologies Telemedia.
- **2000:** Owner of radio spectrum management rights in the 900, 1800 MHz ranges, the 1.9, and 2.1 GHz ranges
- **2012:** Purchased TelstraClear, making it NZ's second largest ISP
- **2013:** Launched their LTE network which is currently available in 54 centres
- **2016:** Completed RBI1 rollout

Many Other Telcos

Wireless Internet Service Providers

Retail Service Providers

Wholesale Service Providers

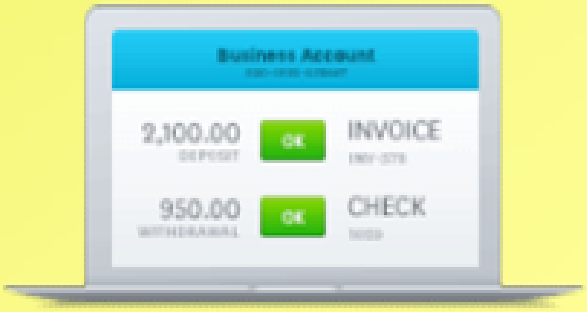
NZs Own Social Media Giant

- **1999** Trade Me established by Sam Morgan
- **2000** Success fees introduced
- **2003** Trade Me Motors launched
- **2004** NZ's fastest-growing company in 'Deloitte Fast 50'
- **2005** Trade Me Property launched
- **2006** Trade Me Jobs launched
- **2006** Sale to Fairfax for NZ$700 million
- **2008** 1 million concurrent listings achieved
- **2010** iPhone app launched
- **2011** 1 million members logging in each month
- **2012** Trade Me listed as a public company - onto the NZX 50 Index
- **2014** 50% of all Trade Me sessions are via a mobile device
- **2015** 1 billionth listing goes live
- **2017** Launched Buyer Protection

Source: https://www.trademe.co.nz/about-trade-me/our-story

Xero Highlights

- **1986:** Xero Limited was officially formed in Wellington
  - By Rod Drury and his personal accountant
- **2007:** IPO on NZX for NZD150m
- **2008:** Entered Australian and UK markets
- **2009:** Raised NZD23M private funding from Craig Winkler
- **2011:** Entered the United States market
- **2012:** Public Listing on ASX
- **2013:** Raised > NZD230M from private investors
- **2014:** Chris Liddell announced new Chairman
- **2015:** Best accounting software in the Cloudswave Awards
- **2016:** Announced a partnering agreement with PayPal



Some More Large NZ ICT Companies

1969: Trevor and Corallie Eagle founded Eagle Technology
2017: World leading systems integration and information Management company

1993: Solnet Technologies
2003: Solnet Solutions
2017: Digital transformation specialists

1978: Jade Software Corporation Limited founded by Gill Simpson in Christchurch - Based on LINC adopted by Burroughs
2017: Designs, builds, and markets software products and services for businesses worldwide

1993: Orion Health founded by Ian McCrae
2017: Integrated healthcare and precision medicine solutions

Many Other Innovative NZ ICT Companies

And all the Usual Multinationals

NOKIA

SONY

NEC

\Orchestrating a brighter world

DELL

HUAWEI

intel

ASUS
IN SEARCH OF INCREDIBLE

SAMSUNG

Microsoft

Panasonic

TOSHIBA

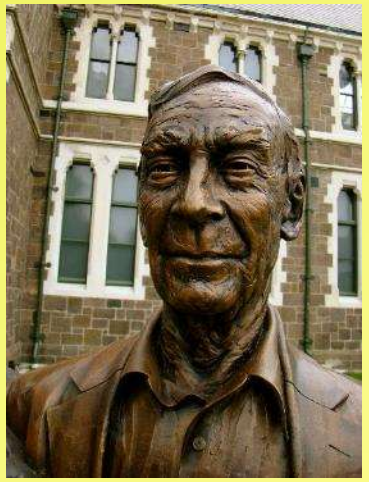
facebook

Some Notable Personalities

Gordon Hogg and Databank

Malcolm Dick and CallPlus

Sir Neville Jordan and Marine Air Systems



Sir Angus Tait and Tait Electronics

Trevor Eagle and Eagle Technologies

Peter Troughton and Telecom NZ

Dame Margaret Bazley and Public Service

Sir Gilmore Simpson and Jade

Many Successes and a Few failures

NZ Herald - 30 June 2000
$1.4m bill to bury Incis project

New Zealand Herald - 18/12/2013
Taxpayers' Union Uncovers Massive IT Screw Up Within DOC
The National Property and Land Information System (NaPALIS) initiated two years ago … $5.6 million project was completed several months late and failed to function

Dominion Post - 21 April 2015
The Ministry of Justice has been left red-faced after a software programme aimed at modernising courts was scrapped at a cost of almost $7 million to the taxpayer.

2011: About 200,000 newspaper subscribers in four New Zealand cities missed out on their morning papers after a computer glitch stopped the presses

2015: Novapay
NZD225m to date

Why Large ICT Projects Fail?

- Lack of good governance, poor leadership
- Lack of expertise, skill, experience
- Poor standards compliance
- Poorly defined objectives
- Unrealistic timeframes and costings
- Too long in define and design (no early outcomes)
- Proprietary technology (less so now?)
- Rapidly changing tech. and trying to stay current
- Changing business priorities and marketplace

Best Practice Supported by IEEE

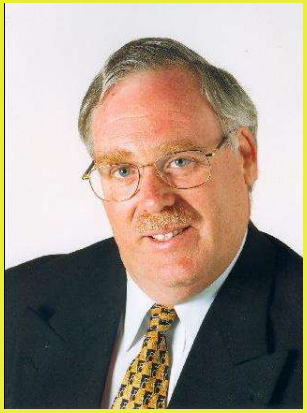
- Institute of Electrical and Electronic Engineers for more than 150 years
- Region 10 (Asia-Pacific) for 50 years
- Since 1999 in the Central Region
- Collaboration with Engineering New Zealand and Institute of Engineering and Technology
- Working with Academics and Industry

Most Visible Through Standards

- Developing standards for ICT for over 40 years
  - IEEE-260-1978: Standard Letter Symbols for Units of Measurement (now 260.1-2004)
  - IEEE-488-1978: Standard Digital Interface for Programmable Instrumentation, IEEE-488-1978 (now 488.1)
  - IEEE-802.1-1992: Standards for LAN/MAN bridging and management and remote media access control (MAC) bridging
  - IEEE-802.11-1997: Standards for Wireless Networking – WiFi
  - IEEE-1003-1997: UNIX compatibility programming standard – POSIX
  - IEEE-P1363-2000: Standards for Public Key Cryptography
  - IEEE-1906.1-2015: Recommended Practice for Nanoscale and Molecular Communication Framework

Conclusions

- New Zealand has a rich history in ICT for more than 50 years
- Technology has evolved dramatically over this period
  - We now have computers in our pockets that are 1000s of times more powerful than those that filled rooms in the 1960s
  - Offers a vast array of opportunity
- We have seen the best and the worst that ICT can bring to society
- Some notable personalities have emerged over the years
- Best practice supported by IEEE over more than 100 years and 50 years in Region 10

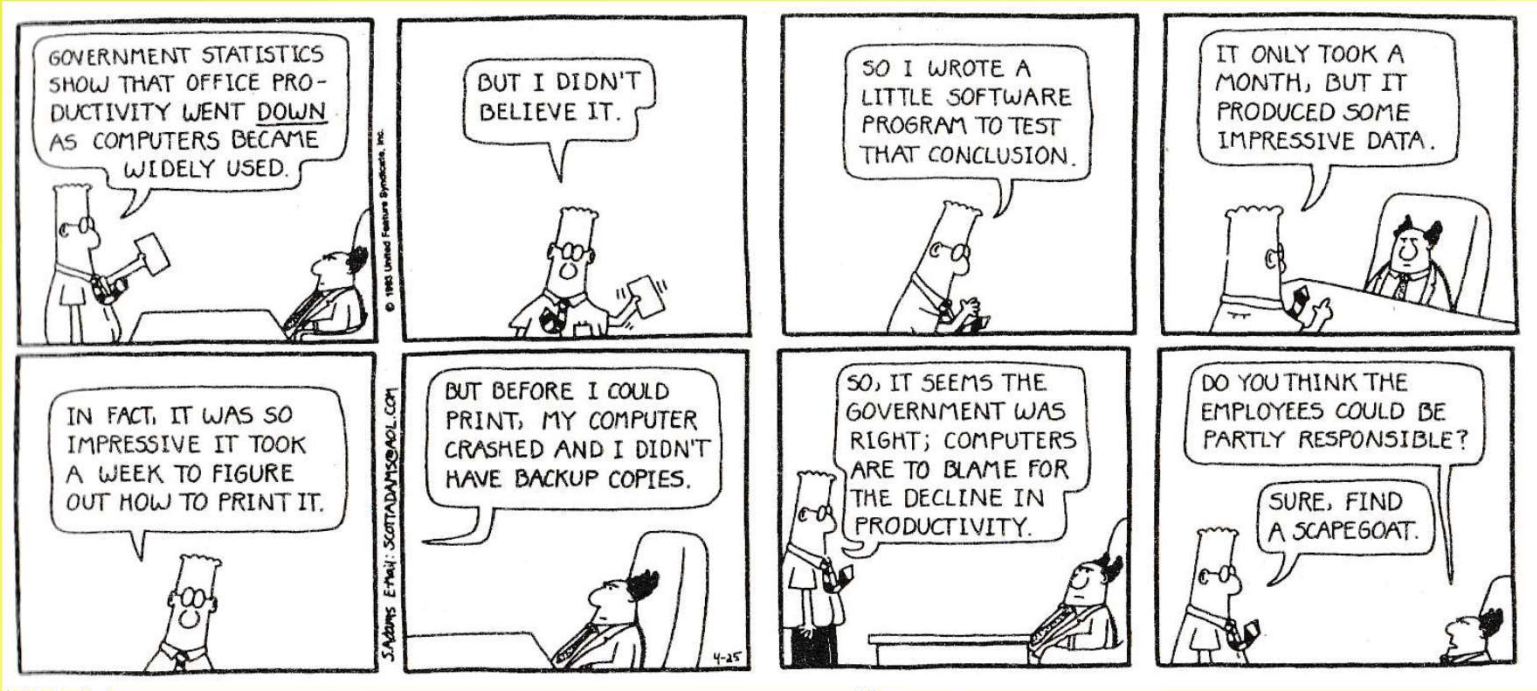


Milner Consulting Limited

Thanks for Your Attention

Questions?

Source: Scott Adams, Dilbert Future, Boxtree, 1997



Dr Murray Milner
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