

Digitalisasi Pendidikan

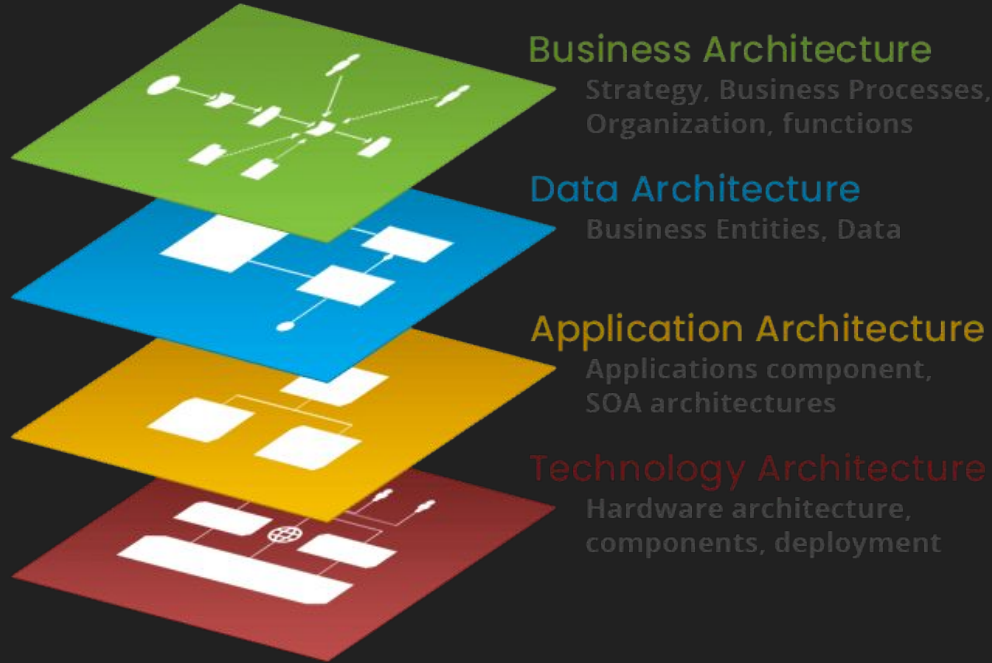
Perkembangan Infrastruktur Penyokong Digitalisasi
Pendidikan di Indonesia

Agung Wahyudi
PhD Candidate TU Delft, PT Telkom Employee

Agenda

- Infrastructure of Digitalization in Education Sector
- Technology Architecture
- Application Architecture
- Data Architecture
- Business Architecture

Infrastructure of Digitalization in Education Sector



Stakeholders: government, research institution, university, company, citizens

Partnership: PPP, triple helix, consortium, community involvement

Offering: SaaS, Pay-As-You-Use, Open/Free

Research data, education data, other data

Learning Management System

Online education

Collaboration

Conferencing

Hardware: computing, memory, storage

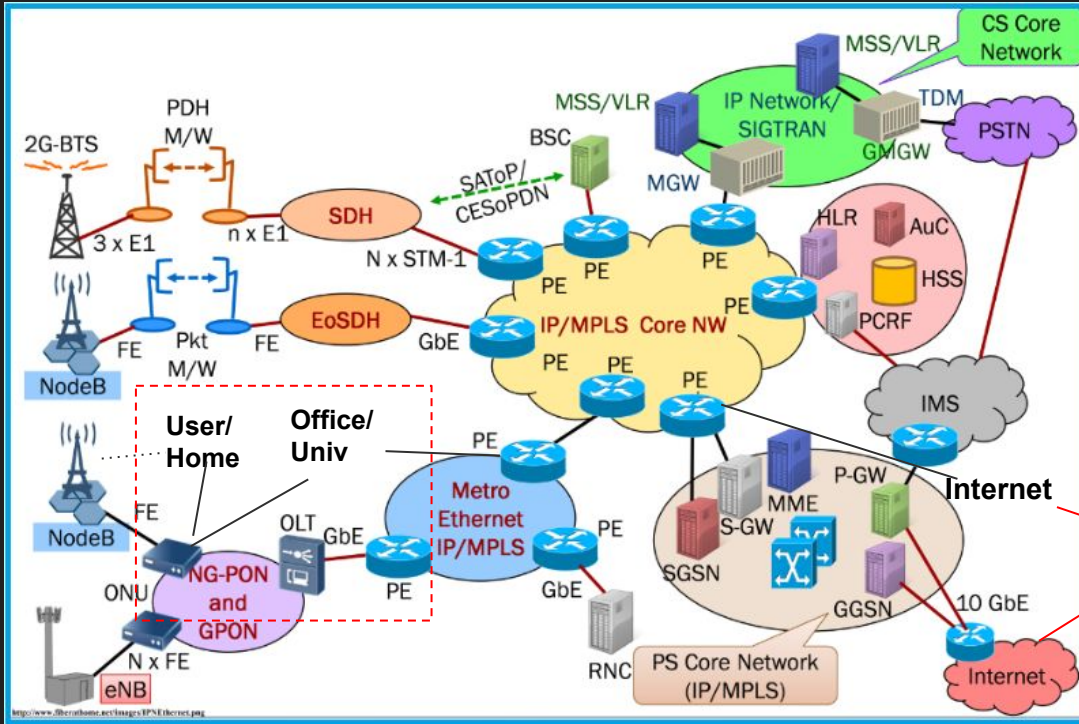
Software: HPC, containerization/virtualization

Networking: LAN, Access, MAN/WAN, Internet

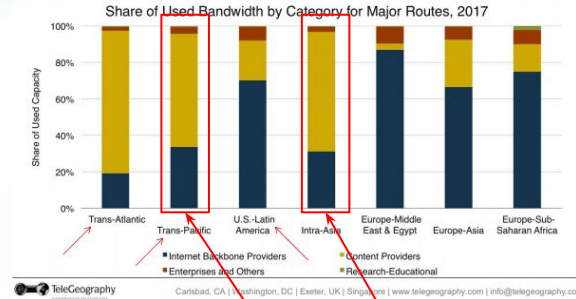
Technology Architecture: In Scope

- Computing & Storage:
 - Data centers ⇒ Provider
 - HPC (supercomputers), Computers, Smartphones, NAS/SAN ⇒ User
- Network:
 - Local Access Network: Ethernet, WiFi ⇒ User
 - Access: Fixed (FTTH, DSL, Docsis), Wireless (Cellular-2G/3G/4G) ⇒ Provider
 - Metropolitan Access Network / Wide Access Network: Metro-E, IP/MPLS Core ⇒ Provider, Own WAN ⇒ User
 - Internet: International backbone (seamarine cable, satellite), Public/private peering, IP Transit ⇒ Mostly provider

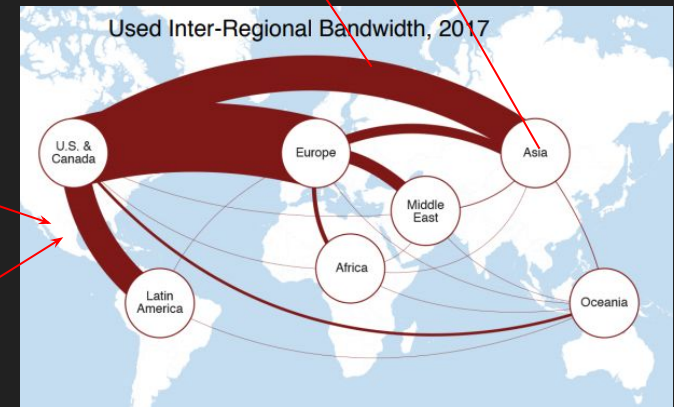
Technology Architecture: Network



Shaping Regional Demand Patterns



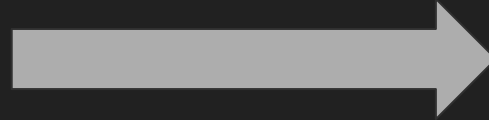
Used Inter-Regional Bandwidth, 2017



Technology Architecture: Current Landscape

Provider

- [Telkom/Telkomsel](#): BTS on-air 228K (+8.8% YoY), 78.0% 3G/4G; Indihome: 7.8M sub (+19% YoY)
- [Indosat](#): BTS on-air 117K (+23% YoY), 77.0% 3G/4G
- [XL Axiata](#): BTS on-air 143K (+10% YoY), 75.0% 3G/4G
- ISP (Biznet, Icon+, MNC/First Media, My Republic)



Penetration

- Homes connected: [~14%](#)
[\[2% of all broadband\]](#)
- Broadband: [~74%](#) with composition:
- Jawa: 55.7%
 - Sumatera: 21.6%
 - Sulawesi: 7%
 - Kalimantan: 6.3%
 - Bali & Nusra: 5.2%
 - Maluku & Papua: 3%

Retail User

Computer ownership [homes]
([BPS, 2018](#))

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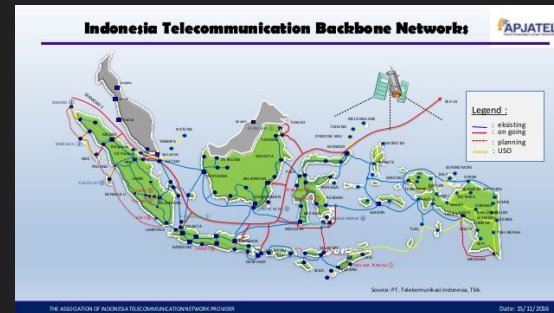
Technology Architecture: Challenge & Opportunity

Challenge

- Geographical landscape (17k+ islands): high investment inter-land connectivity e.g., satellite, submarine cables
- Feasibility for in-land connectivity investment due to widely dispersed income per capita across regions ⇒ “prisoner’s dilemma”?
- Mobile broadband take-up ratio is much bigger than fixed broadband. Mobile broadband is less suitable for many cases of remote education.
- Huge outbound Internet traffic, e.g., Zoom, Udemy, etc., vs. limited international backbone

Opportunity

- Data centers + disaster recovery center across Indonesia
- Worldwide price for hardware and connectivity goes down dramatically
- More public cloud providers enter Indonesia
- More best practises of business models for connectivity



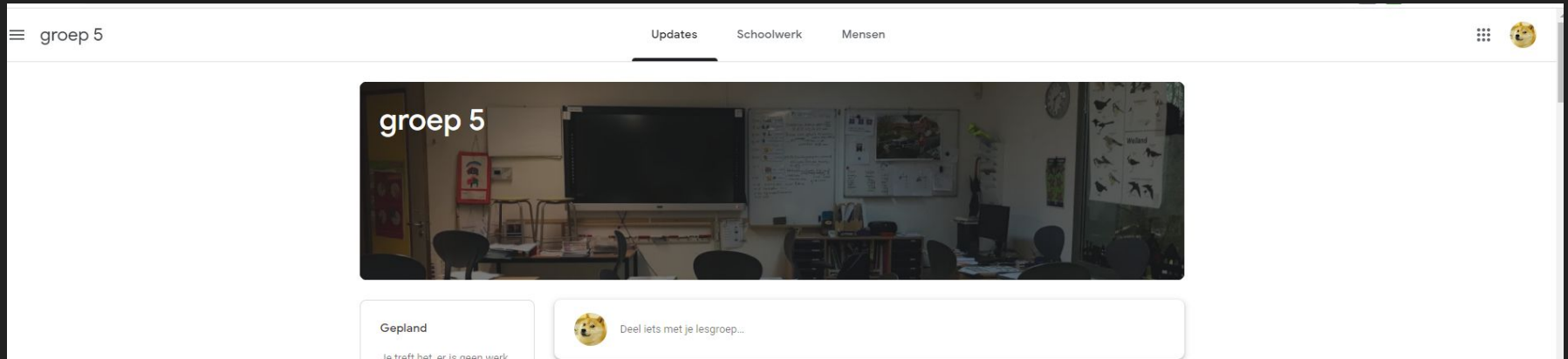
Technology Architecture: Development Example

- PPP: [BcN South Korea](#), [Cartesius](#)
- Consortium: [Lisa HPC Cluster](#), [Large Hadron Collider](#) (100+ universities/labs), [Palapa Ring](#), [Eduroam](#) (inc. [Eduroam.id](#))
- Triple helix: [Horizon 2020](#), [idREN](#)
- Community involvement: [Google Fiber ConnectHome for Community](#)
Telkom's [WiFi corners](#)



Application Architecture

- Learning Management System (e.g., Blackboard, D2L, Sakai, Moodle, Gynzy)
- Online education (e.g., Coursera, edX, OCW, Udemy, Ruang Guru)
- Online assessment/proctoring (e.g., localexam)
- Online collaboration (e.g., Docs, Repository)
- Online forum (e.g., Google Classroom, phpBB, vanillaForum)
- Online communication (e.g., [socialschool](#), whatsapp/group, email/ mailing list, etc.)
- Conferencing/online meeting (e.g., Zoom, Skype, Jitsi)



The screenshot shows a web interface for a group named 'groep 5'. At the top left, there is a hamburger menu icon and the text 'groep 5'. In the top center, there are three navigation tabs: 'Updates', 'Schoolwerk', and 'Mensen'. At the top right, there is a grid icon and a profile picture of a yellow dog. Below the navigation, there is a large banner image of a classroom with a blackboard and whiteboard. The text 'groep 5' is overlaid on the left side of the banner. Below the banner, there are two content boxes. The first box is titled 'Gepland' and contains the text 'Je treft het er is geen werk'. The second box features a yellow dog profile picture and the text 'Deel iets met je lesgroep...'. The page number '9' is visible in the bottom right corner.

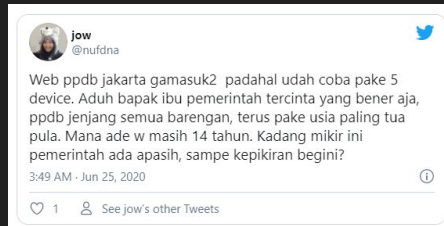
Application Architecture Offering

- Deployment (Extent of support):
 - Private/Public Cloud
 - SaaS / serverless
 - PaaS
 - IaaS
 - On-prem
- Billing
 - Pay-As-You-Use / Pay-As-You-Go
 - Resource-cap (#users, #computers, #active run)
 - Bulk / abonnement
- License:
 - Commercial
 - Education
 - Open source

Application Architecture

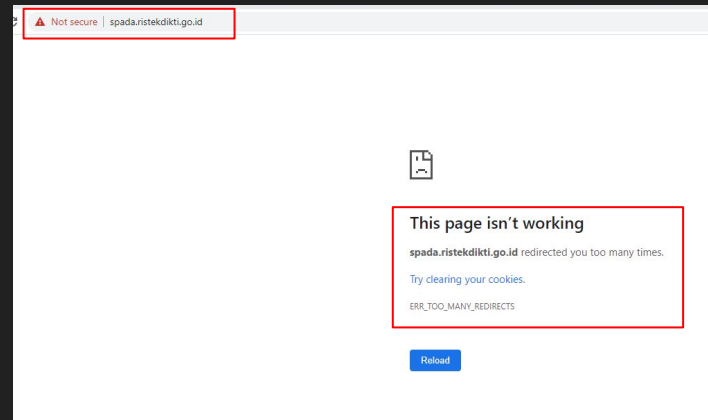
Challenge

- Few local SaaS application providers
- Limited technical administrator expertise and availability \Rightarrow SSL certificate expired, web page down
- High availability & scalability service \Rightarrow not only making it publicly available, but also scalably accessible, e.g., [PPDB DKI sulit diakses](#)



Opportunity

- Variety of software offering
- Hundreds of applications can be picked up



Data Architecture

- Research Data: experiments, surveys, model simulation
- Education Data: course slidedeck, lecture notes, video/audio recordings, text/electronic books, assignments, learning behaviour, scoring, student feedback
- Other data:
 - Open data
 - Commercial data

Data Architecture Development Example

- Research Data: [4TU Research Data for Open Science](#), [Worldbank](#), [European Union](#), [OECD](#)
- Education Data: Shared libraries ([Worldcat](#), [Interlibrary loan](#)), [slideshare](#), [course videos of Walter Lewin](#) (MIT 8.01x Physics)
- Other data:
 - Open data: [Worldbank](#), [European Union](#), [OECD](#), [Kaggle](#), [Google public data explorer](#)
 - Commercial data: [Data from API providers](#), Data marketplace ([bigquery](#), [snowflake](#))

Who

4TU Research Data

Three-partner consortium: TU Delft, TU Eindhoven and [Twente Univ.](#)

Why (our mission)

To ensure the accessibility of technical scientific research data during and after completion of research.

What

General data archive aiming at data from all fields and subjects in science and engineering.

Offer researchers **advice and training** on sharing and safely preserving applied scientific research data.

Business Architecture

Challenge

- Managing trade-off from conflicting requirements from various stakeholders
- Stakeholder like regular citizen might be overwhelmed of everything (choices, information, etc.) in digital world

Opportunity

- Large consumer base
- Many best practice of business models & SLAs are available today

Summary

- Regarding infrastructure readiness not only technology aspect is taken into account, but also other things need to be considered in socio-technical framework, e.g., application that running atop the hardware & connectivity, data that stored and distributed for fulfilling business requirement, and how stakeholders interact each other
- Despite many efforts have put in place for digitalization in education sector, there are also challenges that needs to be overcome as well as opportunities to be captured.