Connectivity Efficiency Strategies are delivering sustainable, equitable, accelerated digital transformation – Partner2Connect pledge progress report
The world has changed...

- 2030’s global vision conceived before the pandemic
  - 10-year long trajectories made sense

- Impact of the pandemic
  - Online activity evolved at unpredicted rates
  - Systemic change in how we communicate, work, and learn

- Both
  - The urgency for digital in Education multiplied
  - Digitalisation of the workplace accelerated
The world has changed…

We must rethink connectivity, NOW!

- Developed nations
  - Responded instantly
  - Broadened reach of digital learning…

- Less developed countries
  - Unable to respond - learning all but stopped
  - National connectivity schemes halted:
    - Wider gaps to bridge
    - Less time
Enabling Accelerated Digital Transformation in Under-Served Schools

Effective Access
Narrows the skills gap
21st Century skills
Bridging digital & educational divides

The SAMR Model, Dr. Ruben R. Puentedura (2013)
20 years – a unique insight – schools connectivity & traffic profiles

160 countries

- Unique visibility
  - Trends
  - Successes/failures
  - Data
20 years data, accumulated from 160 countries, 130 million lessons/year
The Connectivity Problem for Schools

- Rural/economic digital divide
- Ever-increasing costs
- Poor bandwidth ROI
THE CONNECTIVITY PROBLEM
Inclusion, equitable access, availability, cost, rural lag

Last mile connectivity

Core Internet connection

Rural School

Urban School

Ministry HQ

$\$\$\$

$
THE CONNECTIVITY PROBLEM

Ever-increasing cost along the e-learning journey - sustainability

1. Initial Connections
2. Integrate with curriculum
3. Multimedia classrooms
4. Full e-Learning
Schools internet traffic vs non-schools internet traffic

Typical day – hour by hour

Other industries
Contended (shared) connectivity issues by use-case

Contention (connection sharing)

Problematic

Works OK
Contended (shared) connections don’t work in schools

One pair = One player at a time  A pair each = Play real football
T&L: inherently INEFFICIENT network utilisation

**ISP:**
A single day’s traffic

**School:**
A single day’s traffic
What if airports were as inefficient as schools?

All flights would leave at the same time…
Bandwidth is inequitably distributed - but using a small amount wisely can be SUFFICIENT.

Bandwidth \times \text{Using it wisely} = \text{Effective Access}
Rural schools, Lower-bandwidth nations MUST be careful stewards…

The West

2000 to 2008
2 – 5 Mbps

But…

2008 to 2015
20 – 200 Mbps

2015 to 2023
1 – 10 Gbps

Gain focus = efficiency

Good Husbandry
a MUST

Education

Transforming

Pedagogy

Content

ICTs

Assessment

Organisation

Training

Problem Fixed

ROI: Dollars + Performance

Consumption

Good Husbandry
a NEED
Inefficient Process

**Filament lightbulb**

- 100 J electrical energy (input)
- 90 J electrical energy (wasted)
- 10 J electrical energy (output)
- 10% efficient

**Energy efficient lightbulb**

- 100 J electrical energy (input)
- 50 J electrical energy (wasted)
- 50 J electrical energy (output)
- 50% efficient

Gain-focus: efficiency gains:

40% efficiency improvement = 5x output
Highly efficient process

Gain-focus: building capacity:

Minimal scope for efficiency improvement

100 J hydro energy (input) → 90 J hydro energy (output)

Hydro-electric
90% efficient

200 J hydro energy (input) → 180 J hydro energy (output)

Hydro-electric
90% efficient

x2
Teaching & Learning uses internet exceptionally inefficiently

Bandwidth-only approach
- 2.5% efficient
- Requested content fetched 40 times from internet
- 40 x users access the same content

C.O.R.E. Efficiency approach
- 97.5% efficient
- Requested content fetched once from internet, recycled
- 40 x users access the same content

Gain-focus:
**efficiency gains:**
50%-95% efficiency improvement = 20-40x effective access
C.O.R.E. Strategies

C

conserve

Don't use it unless you have to!

Make it as lite as possible

Only use the internet link for the highest priority activities

Reduce file sizes

Best-practice web design

QoS network traffic shaping
C.O.R.E. Strategies

**R** recycle

Avoid redoubling. Don't use the same content over and over again.

- Overnight static content sync
- Off-peak cache pre-population
- Community Internet share
- Network-managed distribution
- Mirrored & intranet websites

Don't overload peak times. Reuse those usable times.
C.O.R.E. Strategies for Meaningful Connectivity

**C** - Conserve
- Only use the internet link for the highest priority activities
- Local Learning Object Repositories
- Offline-ready sites

**O** - Optimise
- Make content smaller and easier to transmit
- Reduce file sizes
- Best-practice web design
- QoS network traffic shaping

**R** - Recycle
- Avoid downloading the same content over and over again
- Content delivery networks
- Web Caching
- Peer-to-peer
- Network-managed distribution
- Mirrored & intranet websites

**E** - Extend
- Put unused bandwidth to work outside school hours
- Overnight static content sync
- Off-peak cache pre-population
- Community Internet share
C.O.R.E. Strategies for Meaningful Connectivity

- **C**onserve: Only use the internet link for the highest priority activities
  - Local Learning Object Repositories
  - Offline-ready sites

- **O**ptimise: Make content smaller and easier to transmit
  - Reduce file sizes
  - Best-practice web design
  - QoS network traffic shaping

- **R**ecycle: Avoid downloading the same content over and over again
  - Content delivery networks
  - Web Caching
  - Peer-to-peer
  - Network-managed distribution
  - Mirrored & intranet websites

- **E**xten: Put unused bandwidth to work outside school hours
  - Overnight static content sync
  - Off-peak cache pre-population
  - Community Internet share
What is unique about the data

- The Key Efficiency/Inefficiency Parameters in Schools
  - Peaks
  - Repeats
  - Speed

- Cross Reference
  - Inefficiency / Efficiency
  - Efficacy / value / effect / benefit of CORE strategies
  - Trends, patterns

- Standard network

- 160 countries
- Tracking:
  - Some schools for a decade
  - Journey development

- Anonymized
- Aggregated
- Protected
20 years data, accumulated from 160 countries, 130million lessons/year
Toluca School, State of Mexico, Mexico

Impact data

Bandwidth: **5Mbps**
From cache: 93.8Mbps

Testimony

"**Before** caching, the only application the school could use was Gmail.

"**Since** caching, **75 students** can **Google-search**, use **social networks**, and download **videos** from the education authority web-page hosted on YouTube."

*Prof. Almarosa Gutierrez Moran*
Senegal MoE speed increase vs 4G

SPEED from **CACHE** – 50-100Mbps

SPEED from **INTERNET** 100-300Kbps

**AVERAGE ACCELERATION**

~ 250x faster from cache

“The Ministry needs to get **CACHEBOX** into all schools in the country as soon as possible. **It is EXTRAORDINARY!”**

Ms Ndiaye, Math Teacher, CEM Oukam 2, Dakar
20 students on 5Mbps – Gauteng Schools, Johannesburg, SOUTH AFRICA

<table>
<thead>
<tr>
<th>Domain</th>
<th>VOLUME of DATA</th>
<th>AVERAGE SPEED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of total</td>
<td>% cached</td>
</tr>
<tr>
<td>gdecontent.co.za</td>
<td>99.4%</td>
<td>97.9%</td>
</tr>
</tbody>
</table>

- **97.9%** bandwidth savings after populating the cache

- **Without cache** - students need **>3.5Mbps each** to avoid congestion

- **With cache** - **1Mbps easily supports 20 students**
Kenya - Access Agriculture: multi-user performance – 20 students

### Traffic Summary

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bandwidth Total</td>
<td>5.01 GB</td>
</tr>
<tr>
<td>Bandwidth Saved</td>
<td>4.42 GB</td>
</tr>
<tr>
<td>Bandwidth Savings (%)</td>
<td>88.2%</td>
</tr>
<tr>
<td>Requests Total</td>
<td>482</td>
</tr>
<tr>
<td>Requests Saved</td>
<td>335</td>
</tr>
<tr>
<td>Request Savings (%)</td>
<td>69.5%</td>
</tr>
</tbody>
</table>

### Domain (Full) - Objects Requested

<table>
<thead>
<tr>
<th>Domain (Full)</th>
<th>Objects</th>
<th>% of total</th>
<th>% cached</th>
<th>Transfer</th>
<th>% of total</th>
<th>% cached</th>
<th>Miss</th>
<th>Hit</th>
</tr>
</thead>
<tbody>
<tr>
<td>cdn.accessagriculture.org:443</td>
<td>206</td>
<td>42.7%</td>
<td>90.8%</td>
<td>5.01 GB</td>
<td>99.9%</td>
<td>88.2%</td>
<td>143 KB/s</td>
<td>4.48 MB/s</td>
</tr>
<tr>
<td>assets.accessagriculture.org:443</td>
<td>45</td>
<td>9.3%</td>
<td>88.9%</td>
<td>4.58 MB</td>
<td>0.1%</td>
<td>81.1%</td>
<td>98.6 KB/s</td>
<td>2.41 MB/s</td>
</tr>
<tr>
<td><a href="http://www.accessagriculture.org:443">www.accessagriculture.org:443</a></td>
<td>176</td>
<td>36.5%</td>
<td>47.2%</td>
<td>606 KB</td>
<td>0.0%</td>
<td>5.4%</td>
<td>13.3 KB/s</td>
<td>-</td>
</tr>
<tr>
<td>safecert.googleapis.com:443</td>
<td>11</td>
<td>2.3%</td>
<td>0.0%</td>
<td>349 KB</td>
<td>0.0%</td>
<td>0.0%</td>
<td>4.16 MB/s</td>
<td>-</td>
</tr>
<tr>
<td>edgdel.me.govt1.com:80</td>
<td>5</td>
<td>1.0%</td>
<td>0.0%</td>
<td>209 KB</td>
<td>0.0%</td>
<td>0.0%</td>
<td>2.55 MB/s</td>
<td>-</td>
</tr>
<tr>
<td>clientservices.googleapis.com:443</td>
<td>27</td>
<td>5.6%</td>
<td>92.6%</td>
<td>197 KB</td>
<td>0.0%</td>
<td>76.8%</td>
<td>460 KB/s</td>
<td>-</td>
</tr>
</tbody>
</table>
Evidence-data Type B: anonymised global aggregate

Global data is sliced & diced to interrogate various efficiency parameters, including snapshots, long-term trends.
Global “Average” performance v “3rd Quartile” performance

Low-bandwidth schools employ C.O.R.E. more widely for >80% savings

Median Saving 74.1%

3rd Quartile: 79.9%

Mean Saving 67.7%

>50% savings for the majority of schools
Meaningful Connectivity for Schools = Effective Access

Transformation

RMAS

Improvement

### Mbps

Meaningful Connectivity means Effective Access online activities
Bandwidth Achieves Very Little in Schools

Efficiency

Equitable

Sustainable

Transformation

R
M
A
S
20 years data, accumulated from 160 countries, 130 million lessons/year
UN ITU Partner2Connect Digital Coalition

Multilateral Agencies, ODA
Govt
NGOs, CSR
Private sector
Best practice
ISPs
Funders

LDCs, LLDCs, SIDS

Meaningful Connectivity
Hard-to-Connect Countries
Digital Transformation
## UN’s ITU-D Partner-2-Connect coalition

<table>
<thead>
<tr>
<th>PLEDGE 1</th>
<th>PLEDGE 2</th>
<th>PLEDGE 3</th>
<th>PLEDGE 4</th>
<th>PLEDGE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support</td>
<td>Offer</td>
<td>Provide</td>
<td>Advocate</td>
<td>Support</td>
</tr>
</tbody>
</table>

### WHO

The international community includes UNICEF, ITU, GIGA, World Bank, GPE, EIB, FCC, SETDA, GIZ, KWF, etc.

### WHAT

- Development of a new paradigm for Meaningful Connectivity for Education
- Ministry of Education, Education Authorities, learning environments
- Stakeholders and CSPs/RENs
- Content and Education Application creators
- Training and Certification: sharing evaluation methodology, data insights
- Expert solutions, support, services that help to mobilize funding
- International standards that support equitable & sustainable access

Support & understand how to support schools’ efficient use of the internet.
Reporting Pledge Progress - slides to follow

TBC
EDUGATEBOX Connectivity & Pedagogy Project with MoE Ecuador

Community Development & Learning

34 Communities

BENEFICIARIES

Rural Schools

- Teachers
- Students
- & the rest of the educational community

MoE project phases

1. Pandemic Response
2. Light Intervention Model
3. Sustainable Rollout
4. Demo the MOST transformative

Victoria Teran
Educational Psychologist
C.O.R.E. Strategies for Meaningful Connectivity

**C**onserve
- Only use the internet link for the highest priority activities
- Local Learning Object Repositories
- Offline-ready sites
- QoS network traffic shaping

**O**ptimise
- Make content smaller and easier to transmit
- Reduce file sizes
- Best-practice web design

**R**ecycle
- Avoid downloading the same content over and over again
- Content delivery networks
- Web Caching

**E**xextend
- Put unused bandwidth to work outside school hours
- Overnight static content sync
- Off-peak cache pre-population
- Community Internet share
- Mirrored & intranet websites

Best-practice web design
- Network-managed distribution
- Peer-to-peer
Sustainability questions for VSAT to remote locations

- Initial plan 20Mbps VSAT “Ku band” – unaffordable/unsustainable

- “Ka band” VSAT lower cost, but only 512Kbps - 1Mbps

- CORE Efficiency Strategies makes it work
Home-schooling in a single-teacher rural Elementary, Ecuadorean Coast

Bandwidth: **1-2Mbps per school**
MoE content: **2Mbps per student**
Students are served **90Mbps**
93-99% from cache

“very useful for home-schooling… I upload material to Media Library and students download to parent’s phones
“all of us connect to the Ministry’s web page, which has been essential for all the educational community
“Kids really like it!”

Jonni Lozano, educational leader, teacher
4G Connectivity Project with MoE Senegal

PILOT SCENARIO

3.5Mbps 4G internet

IT Lab rarely used – insufficient connectivity

PILOT OUTCOMES

CLASSROOM

✔ Whole-class online learning
✔ Video – all students engaged
✔ Offline working with pre-downloaded resources
✔ Raised teacher confidence & skills
✔ Inclusive: all students engaged
✔ Lesson objectives reached faster

National

✔ Low cost connectivity – now!
✔ Equity, sustainability – no school left behind
✔ Only lite teacher interventions needed

Mr Bassirou BODIAN
Physics Teacher
CEM Ouakam 2
Dakar, Senegal
Access a manual version of the presentation (URL tbc)

Access a recording of the complete presentation with audio (URL tbc)