Defining technical specifications for the African Rail Network: possible methods and associated effects

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Outline

• Background
• African rail network
• Proposed technical specifications
• Intergovernmental agreement
• 85,000 route-km and uses multiple standards
• Gauge:
  ✓ 61% of OL: cape gauge (1,067 mm),
  ✓ 20% of OL: standard gauge (1,435 mm).
• Electrification:
  ✓ 15% with 3kV direct current (DC) the most common standard,
  ✓ 25 kV alternating current.
• Majority: Rolling stock: Association of American Railroads (AAR) (Janney) type couplers
• Axle load: new railways >= 22.5 t per axle.
Background

- Need of “connexity” and connectivity
- Need to support the AfCFTA
- Need of efficiency
- Need to achieve the green need of the transport sector
- Recommendation STC-TTIIEET

- SCOPE + Concept + ToRs + Stakeholders consultation
- Benchmarking + Draft TSI + Draft IGA + Stakeholders consultation
- Continental validation + Adoption by policy organs
### Scope

#### Level of Standardization:

**Why** are we standardizing

- **Intergovernmental Agreements and Conventions**, 
- **Multi-National Treaties**, 
- **International Resolutions**, 
- **EU Directives**, 
- **Inter-Railway Agreements**

**What** are we standardizing

- **National Legislation**, 
- **Implementation Regulations**, 
- **Establishing Standard-Setting Bodies and Regulators**

**Who** is responsible

- Standards as set by standards-setting bodies (national and international) and industry associations

#### Examples of Legally-Binding Standard-Setting Documents

- US (ANSI)
- European Norms
- Russia (GOST)
- China (GB)
- Korea (KS)
- Japan (JIS)

#### Industry Associations

- IEC
- ISO
African Rail Network (Contintental Freight Rail Backbone) and Its Relationship with AIHSRN and Other Rail Lines

All rail lines on African continent

African Integrated High Speed Railway Network (AIHSRN), comprising conventional lines, semi high-speed lines, and passenger-only high-speed lines, and all SGR, connecting all national capitals

Africa Rail Network (ARN) = Continental Freight Rail Backbone (must be fully interoperable, applying the common standards)

Regional and national/domestic lines

Isolated lines (e.g. mining railway, urban railway)
## Benchmarking: Recent SGR Projects in Africa - Standards

<table>
<thead>
<tr>
<th>Railway</th>
<th>Stage</th>
<th>Track gauge</th>
<th>Passenger Design (or maximum operating) speed (km/h)</th>
<th>Freight Design (or maximum operating) speed (km/h)</th>
<th>Permissible (design) axle load (tonnes)</th>
<th>Kinematic envelope to permit double-stacked containers</th>
<th>Traction</th>
<th>Signalling</th>
<th>Control &amp; Communications</th>
<th>Crossing loops length / Design length of trains (m)</th>
<th>Couplers</th>
<th>Freight Train Brakes</th>
<th>Design standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dar es Salaam - Kigali (Tanzania to Rwanda)</td>
<td>Under construction (part)</td>
<td>Feasibility Study (part)</td>
<td>Operational</td>
<td>160</td>
<td>35</td>
<td>Yes</td>
<td>Electric - Overhead 2x25 kV AC Auto-transformer</td>
<td>Centralized Traffic Control (CTC) with ETCS/ERTMS based systems</td>
<td>Railway (GSM-R) base stations and Signaling system with continuous Fiber Optic system</td>
<td>2,000</td>
<td>Janney (AAR)</td>
<td>Compressed Air</td>
<td>AREMA</td>
</tr>
<tr>
<td>Mombasa - Nairobi (Kenya)</td>
<td>Operational</td>
<td>Standard</td>
<td>120</td>
<td>120</td>
<td>25</td>
<td>Yes</td>
<td>Diesel-electric with provisions for future electrification.</td>
<td>Automatic Block System (ABS)</td>
<td>Microwave backbone</td>
<td>880</td>
<td>Janney (AAR)</td>
<td>Compressed Air</td>
<td>National standards for PRC; China Railway Class I</td>
</tr>
<tr>
<td>Addis Ababa–Djibouti (Ethiopia to Djibouti)</td>
<td>Operational</td>
<td>Standard</td>
<td>120</td>
<td>80</td>
<td>25</td>
<td>yes</td>
<td>Electric - Overhead 25 kV AC / 50 Hz</td>
<td>Semi-automatic and Automatic Block and ETCS Level 2</td>
<td>Fibre optic based; Fixed Line and mobile telephones.</td>
<td>880</td>
<td>Janney (AAR)</td>
<td>Compressed Air</td>
<td>National standards for PRC; China Railway Class II</td>
</tr>
<tr>
<td>Benin City - Obudu (Nigeria)</td>
<td>Feasibility assessment complete</td>
<td>Standard</td>
<td>120</td>
<td>80</td>
<td>25</td>
<td>yes</td>
<td>Diesel-electric</td>
<td>&quot;Colour Light&quot; Signalling System</td>
<td>Microwave Backbone System with on-board computer system</td>
<td>2,500</td>
<td>Janney (AAR)</td>
<td>Compressed Air</td>
<td>TBD</td>
</tr>
<tr>
<td>Trans-Maghreb (Morocco-Algiers-Tunisia)</td>
<td>Under Construction</td>
<td>Standard</td>
<td>120</td>
<td>80-120</td>
<td>22.5</td>
<td>No</td>
<td>Electric 25 kV AC 50 Hz</td>
<td>CTC with ETCS/ERTMS</td>
<td>GSM-R</td>
<td></td>
<td></td>
<td>Similar to EU/France</td>
<td></td>
</tr>
</tbody>
</table>

### Details:

- **Track gauge**:
  - Standard

- **Passenger Design (or maximum operating) speed**: 160 km/h
- **Freight Design (or maximum operating) speed**: 120 km/h

- **Permissible (design) axle load**: 35 tonnes

- **Kinematic envelope to permit double-stacked containers**:
  - Yes

- **Traction**:
  - Electric - Overhead 2x25 kV AC Auto-transformer
  - Diesel-electric with provisions for future electrification.
  - Electric - Overhead 25 kV AC / 50 Hz
  - "Colour Light" Signalling System
  - Diesel-electric
  - Electric 25 kV AC 50 Hz

- **Signalling**:
  - Centralized Traffic Control (CTC) with ETCS/ERTMS based systems
  - Automatic Block System (ABS)
  - Semi-automatic and Automatic Block and ETCS Level 2
  - "Colour Light" Signalling System
  - CTC with ETCS/ERTMS

- **Control & Communications**:
  - Railway (GSM-R) base stations and Signaling system with continuous Fiber Optic system
  - Microwave backbone
  - Fibre optic based; Fixed Line and mobile telephones.
  - Microwave Backbone System with on-board computer system
  - GSM-R

- **Crossing loops length / Design length of trains**: 2,000 m

- **Couplers**: Janney (AAR)

- **Freight Train Brakes**: Compressed Air

- **Design standards**: AREMA
# System Standardization Parameters

<table>
<thead>
<tr>
<th>Rail System Parameter</th>
<th>Impact where not interoperable</th>
<th>Importance to System Interoperability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Track gauge</td>
<td>Rolling stock cannot pass between lines</td>
<td>Critical</td>
</tr>
<tr>
<td>Axle load</td>
<td>Possibility that locomotives and loaded freight wagons cannot pass onto line with lower permissible axle loads</td>
<td>Moderate</td>
</tr>
<tr>
<td>Structure gauge/kinematic envelope</td>
<td>Possibility that locomotives, double-stacked wagons and passenger coaches cannot pass onto line with more restrictive structure gauge. Most critical are tunnels and overpasses, which cannot be easily changed.</td>
<td>Moderate</td>
</tr>
<tr>
<td>Signalling, Control &amp; communication systems</td>
<td>Possibility that locomotives and operating employees (unless trained on both systems) cannot pass between lines</td>
<td>Moderate</td>
</tr>
<tr>
<td>Traction/Electrification</td>
<td>Locomotives from electrified line will not be able to pass onto line that is not electrified</td>
<td>Moderate</td>
</tr>
<tr>
<td>Overhead line and pantograph</td>
<td>Locomotives cannot pass between lines with different overhead and pantograph systems</td>
<td>Moderate</td>
</tr>
<tr>
<td>Couplers</td>
<td>Rolling stock cannot pass between lines with different coupler systems unless a transition wagon (wagon with different couplers at each end) is used.</td>
<td>High</td>
</tr>
<tr>
<td>Brakes</td>
<td>Rolling stock cannot pass between lines with different braking systems.</td>
<td>High</td>
</tr>
</tbody>
</table>
**Proposed ARN**

- **44 links proposed links**
  - East-West Links;
  - North-South Links;
  - *North-South Spine*

- **Numbering**
  - The network numbering system ensures that any additional lines that are added may be incorporated in the line numbering system.
  - Line numbers may range from 1 to 100. Each line may have one or more segments, appended to the line number by a decimal point (e.g. “1.1” means line 1, segment 1)
  - North-south lines: end in odd numbers (e.g. 1, 3, 5, 7, and 9).
  - East-west lines: end in even numbers (e.g. 0, 2, 4, 6, and 8).
  - The continent will be roughly divided into 10 sections, so that the line numbers will increase by 10 as they move 10% across the continent.
Proposed ARN: Other considerations

- ARN will be a freight-focused network:
  - Fully interoperable freight backbone network for the continent
  - Does not include any passenger-only lines.
  - Interconnects different regions of the continent and provide seaport access to landlocked countries
  - Subject to common standards to ensure interoperability
  - Scope: lines of continental importance

- Transition/applicability period
  - New Lines: at time of entry into service
  - Existing lines: 30 years

- Exceptions for some lines (southern Africa)

- While ARN standards **DO NOT APPLY** to lines that are not part of the network, use of these standards is encouraged
## Proposed Common Technical Standards

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recommendation</th>
<th>Exception or further consideration</th>
<th>Importance for Interoperability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Standards</td>
<td>AREMA or UIC</td>
<td>With consideration given to China Railway Class I standards</td>
<td>High</td>
</tr>
<tr>
<td>Design Speed</td>
<td>Freight: 120 km/h</td>
<td>Reduction to 80 km/h and 90 km/h, respectively, is possible provided that a cost-benefit analysis is carried out to justify the reduction in initial investment costs vs. lifetime operating costs</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Passenger: 160 km/h</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Track Gauge</td>
<td>Standard</td>
<td>With the possibility of dual gauge track on some lines</td>
<td>High</td>
</tr>
<tr>
<td>Loading Gauge, relevant</td>
<td>AAR plate H (double-stacked container</td>
<td>The goal is to transport double-stacked containers. This may be lowered to AAR plate F on existing lines where upgrade not possible.</td>
<td>Very High</td>
</tr>
<tr>
<td>Structure Gauge</td>
<td>transport)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Axle load</td>
<td>30 tonnes per axle</td>
<td>Could be greater on lines expected to have high levels of bulk traffic. May be lowered to 25 tonnes per axle on existing lines where upgrade is not feasible.</td>
<td>High</td>
</tr>
</tbody>
</table>
## Proposed Common Technical Standards (2/2)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Recommendation</th>
<th>Exception or further consideration</th>
<th>Importance for Interoperability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Platform Height</td>
<td>High: 760 mm Low: 550 mm</td>
<td>Existing platforms should be upgraded to 550 mm or 760 mm, depending on the type of rolling stock used.</td>
<td>Medium</td>
</tr>
<tr>
<td>Passenger Train Length</td>
<td>600 metres</td>
<td>-</td>
<td>Medium</td>
</tr>
<tr>
<td>Freight Train Length</td>
<td>2,000 metres</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Diesel versus Electric Traction</td>
<td>Case-by-case basis</td>
<td>If a decision is made to opt for diesel operation from the outset, certain provisions should be made to implement electrification in the future. Line design should not preclude electrification (e.g., loading gauge)</td>
<td>Medium</td>
</tr>
<tr>
<td>Electric Traction Voltage</td>
<td>25 kV 50 Hz AC</td>
<td>In the event there is a decision to opt for electrification</td>
<td>Medium</td>
</tr>
<tr>
<td>Signalling &amp; Control System</td>
<td>ETCS with the level determined by the specific operating requirements and environment</td>
<td>-</td>
<td>Medium</td>
</tr>
<tr>
<td>Communications System</td>
<td>GSM-R and its subsequent upgrades</td>
<td>-</td>
<td>Medium</td>
</tr>
<tr>
<td>Couplers (Freight trains)</td>
<td>Janney (AAR) couplers</td>
<td>-</td>
<td>High</td>
</tr>
<tr>
<td>Train Brakes (Freight trains)</td>
<td>Compressed Air</td>
<td>-</td>
<td>High</td>
</tr>
</tbody>
</table>
Intergovernmental Agreement – Key Points

• Vision
  • Standardized Network
  • Framework for regulating safe, efficient, effective and seamless operation

• Standards (as set out previously)

• Transition Period

• African Railway Network Standards Committee – governs standards

• Annexes
  • Enumeration of the baseline network
  • Enumeration of the standards
  • Enumeration of transition period
    • New Line: entry into service
    • Existing line: 30 years after entry into force of agreement
    • Exception: Southern African Network
Thank you
Merci
شكرا
Obrigado

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