1.)

<table>

<tr>

<th>Formal Relationships</th>

<th>Resistor 1</th>

<th>Resistor 2</th>

<th>Operational amplifier</th>

<th>Input</th>

<th>Output</th>

</tr>

<tr>

<td>Resistor 1</td>

<td></td>

<td>Connected at V -</td>

<td>Connected at V -</td>

<td>Connected at input</td>

<td></td>

</tr>

<tr>

<td>Resistor 2</td>

<td>Connected at V -</td>

<td></td>

<td>Connected at V - and connected at output</td>

<td></td>

<td>Connected at output</td>

</tr>

<tr>

<td>Operational Input amplifier</td>

<td>Connected at input at V -</td>

<td>Connected connected at output at V - and</td>

<td></td>

<td></td>

<td>Connected at output</td>

</tr>

<tr>

<td>Output</td>

<td></td>

<td>Connected at output</td>

<td>Connected at output</td>

<td></td>

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</table>

<table>

<tr>

<th>Functional Relationships</th>

<th>Resistor 1</th>

<th>Resistor 2</th>

<th>Operational amplifier</th>

<th>Input</th>

<th>Output</th>

</tr>

<tr>

<td>Resistor 1</td>

<td></td>

<td>Exchanges current at V -</td>

<td>Exchanges current at V - Exchanges</td>

<td>Exchanges current at input</td>

<td></td>

</tr>

<tr>

<td>Resistor 2</td>

<td>Exchanges current at V -</td>

<td></td>

<td>Exchanges current at V - and also at output</td>

<td></td>

<td>Exchanges current at output</td>

</tr>

<tr>

<td>Operational Input amplifier</td>

<td>Exchanges current at input current at V -</td>

<td>Exchanges and also at output current at V -</td>

<td></td>

<td></td>

<td>Exchanges current at output</td>

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<tr>

<td>Output</td>

<td></td>

<td>Exchanges current at output</td>

<td>Exchanges current at output</td>

<td></td>

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2.)

<table border="1">

<tr>

<th colspan="7">Without X-teams</th>

</tr>

<tr>

<th></th>

<th>IBM</th>

<th>Xerox</th>

<th>Sports</th>

<th>News</th>

<th>NAOC</th>

<th>IOC</th>

</tr>

<tr>

<td>Requirements</td>

<td>do</td>

<td>review</td>

<td></td>

<td></td>

<td></td>

<td>review</td>

</tr>

<tr>

<td>Specifications</td>

<td>do</td>

<td>review</td>

<td></td>

<td></td>

<td></td>

<td>review</td>

</tr>

<tr>

<td>Software</td>

<td>do</td>

<td>review</td>

<td></td>

<td></td>

<td></td>

<td>review</td>

</tr>

<tr>

<td>Documentation</td>

<td>do</td>

<td>review</td>

<td></td>

<td></td>

<td></td>

<td>review</td>

</tr>

<tr>

<td>Write test cases</td>

<td>do</td>

<td>do some</td>

<td>review</td>

<td>review</td>

<td>review</td>

<td>review</td>

</tr>

<tr>

<td>Run test cases</td>

<td>do</td>

<td>do, review</td>

<td>review</td>

<td>review</td>

<td>review</td>

<td>review</td>

</tr>

<tr>

<td>Test performance</td>

<td>do</td>

<td>concur</td>

<td>concur</td>

<td>concur</td>

<td>concur</td>

<td>concur</td>

</tr>

<tr>

<td>Training</td>

<td>concur</td>

<td>do, concur</td>

<td>concur</td>

<td>concur</td>

<td>concur</td>

<td>concur</td>

</tr>

</table>

<table border="1">

<tr>

<th colspan="7">With X-teams</th>

</tr>

<tr>

<td>Requirements</td>

<td>

3.)

<table>

<tr>

<th>Technology Readiness Level</th>

<th>Description</th>

</tr>

<tr>

<td>1. Basic principles observed and reported</td>

<td>Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&amp;D). Examples might include paper studies of a technology's basic properties.</td>

</tr>

<tr>

<td>2. Technology concept and/or application formulated</td>

<td>Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions. Examples are limited to analytic studies.</td>

</tr>

<tr>

<td>3. Analytical and experimental critical function and/or characteristic proof of concept</td>

<td>Active R&amp;D is initiated. This includes analytical studies and laboratory studies to physically validate the analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.</td>

</tr>

<tr>

<td>4. Component and/or breadboard validation in laboratory environment</td>

<td>Basic technological components are integrated to establish that they will work together. This is relatively "low-fidelity" compared with the eventual system. Examples include integration of "ad hoc" hardware in the laboratory.</td>

</tr>

<tr>

<td>5. Component and/or breadboard validation in relevant environment</td>

<td>Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so they can be tested in a simulated environment. Examples include "high-fidelity" laboratory integration of components.</td>

</tr>

<tr>

<td>6. System/subsystem model or prototype demonstration in a relevant environment</td>

<td>Representative model or prototype system, which is well beyond that of TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated operational environment.</td>

</tr>

<tr>

<td>7. System prototype demonstration in an operational environment</td>

<td>Prototype near or at planned operational system. Represents a major step up from TRL 6 by requiring demonstration of an actual system prototype in an operational environment (e.g ., in an air-craft, in a vehicle, or in space).</td>

</tr>

<tr>

<td>8. Actual system completed and qualified through test and demonstration</td>

<td>Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation (DT&amp;E) of the system in its intended weapon system to determine if it meets design specifications.</td>

</tr>

<tr>

<td>9. Actual system proven through successful mission operations</td>

<td>Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation (OT&amp;E

4.)

<table border="1">

<tr>

<th>Function</th>

<th>Integrated Concept 1</th>

<th>Integrated Concept 2</th>

<th>Integrated Concept 3</th>

</tr>

<tr>

<td>Connecting local network and ISP</td>

<td>DSL</td>

<td>Coaxial cable</td>

<td>Mobile broadband</td>

</tr>

<tr>

<td>Modulating ISP carrier signal</td>

<td>Dedicated DSL modem</td>

<td>Cable modem in integrated box</td>

<td>Embedded mobile broadband modem</td>

</tr>

<tr>

<td>Managing data on local network</td>

<td>Integrated gateway and switch + WAP connected to switch by Ethernet</td>

<td>Integrated cable modem, gateway, Ethernet switch</td>

<td>Integrated modem + cell phone as tether</td>

</tr>

<tr>

<td>Connecting user devices and local network</td>

<td>WiFi (to laptop and cell phone) + Ethernet (to desktop and printer)</td>

<td>Local cable to TV + Ethernet (to desktop, printer, and VOIP phone)</td>

<td>WiFi</td>

</tr>

<tr>

<td>Interacting with the user</td>

<td>Laptop + cell phone + desktop + printer</td>

<td>VOIP phone + TV + desktop + printer</td>

<td>Laptop</td>

</tr>

</table>

5.)

<table border="1">

<tr>

<th colspan="2">Conceive</th>

<th colspan="2">Design</th>

<th colspan="2">Implement</th>

<th colspan="2">Operate</th>

</tr>

<tr>

<td>Mission</td>

<td>Conceptual design</td>

<td>Preliminary design</td>

<td>Detailed design</td>

<td>Element creation</td>

<td>Integration test positioning</td>

<td>Lifecycle support</td>

<td>Evolution</td>

</tr>

<tr>

<td colspan="8"><b>Downstream influences</b></td>

</tr>

<tr>

<td>

Business strategy<br>

Functional strategies Customer needs<br>

Segments<br>

Competitors<br>

Technology<br>

Regulation<br>

Scope and plan

</td>

<td>

Goals<br>

Function<br>

Concepts<br>

Business/ product plan<br>

Platform plan<br>

Supplier plan<br>

Architecture<br>

Commitment

</td>

<td>

Requirements definition<br>

Model development<br>

Requirements flow down<br>

Detail decomposition<br>

interface control

</td>

<td>

Design elaboration<br>

Goal<br>

verification Failure and contingency analysis<br>

Validated design

</td>

<td>

Sourcing<br>

Implementation ramp-up<br>

Element<br>

implementation Element testing<br>

Element refinement

</td>

<td>

Product integration<br>

Product, system testing<br>

Refinement<br>

Certification<br>

Market positioning<br>

Channels<br>

Delivery

</td>

<td>

Sales distribution<br>

Operations<br>

Logistics<br>

Customer support<br>

Maintenance, repair, overhaul<br>

Upgrades

</td>

<td>

Product improvement<br>

Platform expansion<br>

Retirement

</td>

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</table>

6.)

<table border>

<tr>

<th>Function</th>

<th>General Form</th>

<th>Specific Form</th>

</tr>

<tr>

<td rowspan="6">Connecting local network and ISP</td>

<td rowspan="4">Physical connection</td>

<td>Fiber</td>

</tr>

<tr>

<td>Coaxial cable</td>

</tr>

<tr>

<td>Coaxial cable</td>

</tr>

<tr>

<td>Phone (dial-up)</td>

</tr>

<tr>

<td rowspan="2">Radio Connection</td>

<td>Mobile broadband</td>

</tr>

<tr>

<td>Mobile broadband</td>

</tr>

<tr>

<td rowspan="7">Modulating ISP carrier signal</td>

<td rowspan="2">Embedded modem</td>

<td>Embedded mobile broadband modem</td>

</tr>

<tr>

<td>Embedded dial-up modem</td>

</tr>

<tr>

<td rowspan="5">External modem</td>

<td>DSL modem</td>

</tr>

<tr>

<td>Cable modem</td>

</tr>

<tr>

<td>Fiber modem</td>

</tr>

<tr>

<td>External mobile broadband modem</td>

</tr>

<tr>

<td>Satellite modem and antenna</td>

</tr>

<tr>

<td rowspan="10">Managing data on local network</td>

<td rowspan="5">Single-function hardware</td>

<td>None</td>

</tr>

<tr>

<td>WAP</td>

</tr>

<tr>

<td>Residential Gateway</td>

</tr>

<tr>

<td>Switch</td>

</tr>

<tr>

<td>Tethering Device (hotspot)</td>

</tr>

<tr>

<td rowspan="5">Multi-function hardware</td>

<td>Residential Gateway + Switch</td>

</tr>

<tr>

<td>Switch + WAP</td>

</tr>

<tr>

<td>Modem + Residential Gateway</td>

</tr>

<tr>

<td>Modem + Res Gatewav + Switch</td>

</tr>

<tr>

<td>Modem + Res Gateway + Switch + WAP</td>

</tr>

<tr>

<td rowspan="7">Connecting user devices and local network</td>

<td rowspan="5">Homogeneous</td>

<td>None</td>

</tr>

<tr>

</tr>

7.)

<table border>

<tbody>

<tr>

<th rowspan="4">Matter</th>

<td rowspan="2">Mechanical</td>

<td colspan="1">Mass exchange</td>

<td colspan="1">Passes flow to</td>

</tr>

<tr>

<td>Force/momentum</td>

<td>Pushes on</td>

</tr>

<tr>

<td rowspan="2">Biochemical</td>

<td>Chemical</td>

<td>Reacts with</td>

</tr>

<tr>

<td>Biological</td>

<td>Replicates</td>

</tr>

<tr>

<th rowspan="2">Energy</th>

<td rowspan="2"></td>

<td>Work</td>

<td>Carries electricity</td>

</tr>

<tr>

<td>Thermal energy</td>

<td>Heats</td>

</tr>

<tr>

<th rowspan="4">Information</th>

<td rowspan="2">Signal</td>

<td>Data</td>

<td>Transfer file</td>

</tr>

<tr>

<td>Commands</td>

<td>Triggers</td>

</tr>

<tr>

<td rowspan="2">Thought</td>

<td>Cognitive thought</td>

<td>Exchanges ideas</td>

</tr>

<tr>

<td>Affective thought</td>

<td>Imparts beliefs</td>

</tr>

</tbody>

</table>