STUDENTGRADE

Contributors

Name	Organization
José Henriquez	Hyperledger Latinoamérica Regional Chapter
Alfonso Govela	Hyperledger Latinoamérica Regional Chapter

Taxonomy Formula: tF{~d,t,g,SC}

Token Specification Summary

Token Classification

Template Type:	SingleToken	This token has no sub or child tokens.
Token Type:	Fungible	Tokens have interchangeable value with one another, where any quantity of them has the same value as another equal quantity if they are in the same class or series.
Token Unit:	Whole	There can be many instances of this token, but they cannot be divided.
Value Type:	Intrinsic	This token is purely a digital token represents value directly, it represents no external physical form and cannot be a receipt or title for a material item or property.
Representation Type:	Common	This token is simply represented as a balance or quantity attributed to an owner address where all the balances are recorded on the same balance sheet, like a bank account. All instances can easily share common properties and locating them is simple.
Supply:	Infinite	Infinite supply indicates that tokens in the class can be created and removed with no cap and also potentially reflect negative supply for certain business cases.

This is a Transferable Whole Fungible Token that uses the behavior group Supply Control to manage the circulating supply, so at creation can be set an initial supply that can be increased or removed as needed. It is whole by setting the decimals property onthe dividable behavior to 0, that way it cannot be fractioned. It is Transferable, which means that the owner can transfer the ownership of the tokens to another party.

Example

This token definition's purpose is to register and reflect the grade obtained by a student after completing a course. This will help to determine how successful was the course for the student, and also a way to register student's final grade of the course, that way if obtained a satisfactory grade the student will receive a StudentSkills non-fungible token as certificate.

Analogies

Name	Description
Grading Points	A student can earn a point/token based on the grade obtained after completing each test/assignment of the course, and then redeem a certificate (NFT) with these points/tokens once the course is completed.

StudentGrade is:

- Indivisible
- Transferable
- Delegable
- Burnable
- Roles
- Mintable

StudentGrade Details

Whole Fungible

Type:	Base
Name:	Whole Fungible
Id:	b1eacdf8-35d8-454a-b1af-92eb0b6f45d4
Visual:	τ_F{~d}

Tooling:	tF{~d}
Version:	1.0

Definition

Whole Fungible tokens have interchangeable value with each other, where any owned sum of them from a class has the same value as another owned sum from the same class. A whole token cannot be sub-divided so it doesn't support the notion of 'making change'.

Example

An inventory item or SKU, where an item is treated as a whole because it makes no sense to own a fraction of a SKU or loyalty point.

Analogies

Name	Description
Loyalty Points	Most credit card or retail loyalty point programs deal with whole numbers so that redeeming points is easy to understand for their customers.
General Admission Movie Ticket	Purchasing a general admission ticket to a movie only allows for you to have a seat, but the seat that you actually get depends on factors like when you arrive. Your not likely to want to share a seat with another adult.

Dependencies

Artifact Type	Symbol	Description
Base	t	Base Token Definition

Incompatible With

Artifact Type	Symbol	Id
Behavior	d	6e3501dc-5800-4c71-b59e-ad11418a998c

Influenced By

Description	Symbol	Applies To

Artifact Files

Content Type	File Name	File Content
Control	whole-fungible.proto	
Uml	whole-fungible.md	

Code Map

Map Type	Name	Platform	Location
SourceCode	Open Zeppelin - ERC-1155	EthereumSolidity	https://github.com/OpenZeppelin/openzeppelin-contracts/tree/master/contracts/token/ERC1155

Implementation Map

Map Type	Name	Platform	Location
Implementation	Open Zeppelin - ERC-1155	EthereumSolidity	https://docs.openzeppelin.com/contracts/4.x/api/token/erc1155

Resource Map

Map Type	Name	Location	Description

Base Details

Token Name:	
Token Type:	Fungible
Representation Type:	Common

Value Type:	Intrinsic
Token Unit:	Whole
Symbol:	
Owner:	
Quantity:	0
Decimals:	0
Constructor Name:	Constructor

Behaviors

Specification Behavior

Indivisible

Taxonomy Symbol: ~d

An ability or restriction on the token where it cannot be divided from a single whole token into fractions. Sets the base token Decimals property to 0 which will make the token indivisible and a whole token is the smallest ownable unit of the token.

Example

Indivisible is common for items where division does not make sense, like a property title, inventory item or invoice.

Analogies

Name	Description
Non-Fractional	It is not possible to own a fraction of this token.
Barrel of Oil	Barrels of Oil don't make sense to divide.

Type:	Behavior
Name:	Indivisible

Id:	d5807a8e-879b-4885-95fa-f09ba2a22172
Visual:	~d
Tooling:	~d
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id
Behavior	d	6e3501dc-5800-4c71-b59e-ad11418a998c

Influenced By

Description	Symbol	Applies To

Artifact Files

Content Type	File Name	File Content
Control	indivisible.proto	
Uml	indivisible.md	

Code Map

Map Type	Name	Platform	Location

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

Is External:	True
Constructor:	

Indivisible responds to these Invocations

Properties

Name: Decimals

Value Description: Set to Zero, not allowing any division, usually this is applied to the base token.

Template Value: 0

Invocations

GetDecimals

Id: 2ca7fbb2-ce98-4dda-a6ae-e4ac2527bb33

Description: Should return 0

Request

Control Message: GetDecimalsRequest

Description:

Parameters

Name	Value

Response

Control Message: GetDecimalsResponse

Description: Return 0

Parameters

Name	Value
Decimals	0

GetDecimals

Id: 2ca7fbb2-ce98-4dda-a6ae-e4ac2527bb33

Description: Should return 0

Request

Control Message: GetDecimalsRequest

Description:

Parameters

Name	Value

Response

Control Message: GetDecimalsResponse

Description: Return 0

Parameters

Name	Value
Decimals	0

Specification Behavior

Transferable

Taxonomy Symbol: t

Every token instance has an owner. The Transferable behavior provides the owner the ability to transfer the ownership to another party or account. This behavior is often inferred by other behaviors that might exist like Redeem, Sell, etc. This behavior is Delegable. If the token definition is Delegable, TransferFrom will be available.

Example

Analogies

Name	Description
Analogy 1	transferable analogy 1 description

Type:	Behavior
Name:	Transferable
Id:	af119e58-6d84-4ca6-9656-75e8d312f038
Visual:	t
Tooling:	t
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id
Behavior	~t	a4fa4ca8-6afd-452b-91f5-7103b6fee5e5

Influenced By

Description	Symbol	Applies To
If the token is Delegable, TransferFrom should be enabled.	g	[ ]
If Compliance is present, a CheckTransferAllowed request has to be made and verified before a Transfer request or a TransferFrom request.	c	[ ]
If issuable is present, an AcceptTokenRequest from the token issuer, in response to a RequestTokens, has to be made and verified before a Transfer request.	i	[ ]

Artifact Files

Content Type	File Name	File Content
Control	transferable.proto	
Uml	transferable.md	

Code Map

Map Type	Name	Platform	Location

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

Is External:	True
Constructor:	

Transferable responds to these Invocations

Transfer

Id: 5d4b8f10-7857-4a2f-9b8c-d61e367a6bcc

Description: >A transfer request will invoke a transfer from the owner of the token to the party or account provided in the To field of the request. For fungible or dividable non-fungible tokens, this request may also include value in the Amount field of the request to transfer more than one token of the class in a single request.

Request Message:

TransferRequest

Description: The request

Request Parameters

Name	Value
To	AccountId to transfer ownership to.
Quantity	Number of tokens to transfer.

Response Message

TransferResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the owner based on the outcome of the transfer request.

TransferFrom

Id: 516b4e2f-4a14-4c4f-a6f2-1419d4af35c6

Description: >A transfer request will invoke a transfer from the owner of the token to the party or account provided in the To field of the request. For fungible or dividable non-fungible tokens, this request may also include value in the Amount field of the request to transfer more than one token of the class in a single request.

Request Message:

TransferFromRequest

Description: The request

Request Parameters

Name	Value
From	AccountId to transfer ownership from.
To	AccountId to transfer ownership to.
Quantity	Number of tokens to transfer.

Response Message

TransferFromResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the owner based on the outcome of the transfer from request.

Specification Behavior

Delegable

Taxonomy Symbol: g

A token class that implements this behavior will support the delegation of certain behaviors to another party or account to invoke them on the behalf of the owner. When applied to a token, behaviors that are Delegable will enable delegated request invocations. This is useful to provide another party to automatically be able to perform the behaviors that can be delegated without seeking permission up to a certain allowance.

Example

Analogies

Name	Description
Broker	You may allow a broker to transfer your tokens as a part of an investment strategy. Setting an allowance can cap the total number of tokens the broker is allowed to perform delegated behaviors, when exceeded a new allowance request will need to be granted.

Comments

Applied to behaviors that are Delegable.

Type:	Behavior
Name:	Delegable
Id:	a3d02076-6009-4a65-9ed4-2deffe5291e1
Visual:	g
Tooling:	g
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id

Influenced By

Description	Symbol	Applies To

Artifact Files

Content Type	File Name	File Content
Control	delegable.proto	
Uml	delegable.md	

Code Map

Map Type	Name	Platform	Location

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

Is External:	True
Constructor:	

Delegable responds to these Invocations

Allowance

Id: 2e0fd8e5-2090-4c62-b094-232c32a78022

Description: A Request by a party or account to the owner of a token(s) to have the right to perform a delegated behavior on their behalf.

Request Message:

AllowanceRequest

Description: The request

Request Parameters

Name	Value
Quantity	Number of Tokens to be allowed.

Response Message

AllowanceResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation receipt or denial be returned to the allowance requestor.

Approve Allowance

Id: 6d5df99d-2f5e-4c7a-aea4-d2d54176abfd

Description: Same control message as the AllowanceRequest. This could allow for an AllowanceRequest to be forwarded to multiple parties needed to Approve and shield this from the requestor. When all Approvals are obtained, an AllowanceResponse could be sent.

Request Message:

AllowanceRequest

Description: The request

Request Parameters

Name	Value
Quantity	Number of Tokens to be allowed.

Response Message

ApproveResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation response from the owner approving the an allowance request, indicating a allowance quantity the requestor has the option to invoke the Delegable behaviors on the token(s).

Specification Behavior

Burnable

Taxonomy Symbol: b

A token class that implements this behavior will support the burning or decommissioning of token instances of the class. This does not delete a

token, but rather places it in a permanent non-use state. Burning is a one way operation and cannot be reversed. This behavior is Delegable. If the token definition is Delegable, BurnFrom will be available.

Example

When a token is used in a certain way, you may want to remove it from circulation or from being used again. Since the ledger doesn't allow for deletions, burning a token essentially 'deletes' the token from being used, but not from history.

Analogies

Name	Description
Oil Barrels	If you mint a new token for each barrel of oil created, you may transfer ownership several times until the barrel is refined. The refining process should burn the barrel of oil to remove it from circulation.
Redeem	A token that is a coupon or single use ticket, should be burned when it is redeemed.

Type:	Behavior
Name:	Burnable
Id:	803297a1-c0f9-4898-9d44-29c9d41cca97
Visual:	b
Tooling:	b
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id

Influenced By

Description	Symbol	Applies To
Delegable or not, will determine if the BurnFrom Control will be available in the implementation.	g	[ ]
If Compliance is present, a CheckBurnAllowed request has to be made and verified before a Burn request or a BurnFrom request.	c	[ ]

Artifact Files

Content Type	File Name	File Content
Control	burnable.proto	
Uml	burnable.md	

Code Map

Map Type	Name	Platform	Location
SourceCode	Open Zeppelin	EthereumSolidity	https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/token/ERC20/ERC20Burnable.sol

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

Is External:	False
Constructor:	

Burnable responds to these Invocations

Burn

Id: f063dcaa-49f9-4c49-bf0f-2766301e1033

Description: A request to burn a token instance(s) in the class by the owner of the token instance(s). Optional Quantity field in the request.

Request Message:

BurnRequest

Description: The request to Burn or Retire tokens.

Request Parameters

Name	Value
Quantity	The number of tokens to burn, might not apply to the implementation.

Response Message

BurnResponse

Description: The response from the request to burn.

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the invoker based on the outcome of the burn request

BurnFrom

Id: 49b53152-3360-426f-9e0a-24a0b4e7c881

Description: Requires Delegable. A request to burn token instance(s) in the class by a party or account that has allowance to do so. Requires a From and Quantity fields in the request.

Request Message:

BurnFromRequest

Description: The request to Burn or Retire tokens.

Request Parameters

Name	Value
From	AccountId from which tokens are burnt
Quantity	The number of tokens to burn, might not apply to the implementation.

Response Message

BurnFromResponse

Description: The response from the request to burn.

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the invoker based on the outcome of the burn from request

Specification Behavior

Roles

Taxonomy Symbol: r

A token can have behaviors that the class will restrict invocations to a select set of parties or accounts that are members of a role or group. This is a generic behavior that can apply to a token many times to represent many role definitions within the template. This behavior will allow you to define what role(s) to create and what behavior(s) to apply the role to in the TemplateDefinition.

Example

Analogies

Name	Description

Minters	A role called 'Minters' for a token can have accounts in the role. The MintTo behavior invocation will be bound to the role check to ensure only account in the 'Minters' role are allowed to mint new instances in the class.

Comments

Roles has a constructor control that creates roles and applies them to certain behaviors of the token at creation of the class from the template.

Type:	**Behavior**
Name:	Roles
Id:	c32726da-9787-4dd8-8de3-d07d1733d0f6
Visual:	r
Tooling:	r
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id

Influenced By

Description	Symbol	Applies To

Artifact Files

Content Type	File Name	File Content
Control	roles.proto	

Uml	roles.md	

Code Map

Map Type	Name	Platform	Location
SourceCode	Open Zeppelin - Roles	EthereumSolidity	https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/access/Roles.sol

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

Is External:	**False**
Constructor:	

Roles responds to these Invocations

RoleCheck

Id: 00a665e3-1dda-441e-8262-5750435c153c

Description: Internal invocation when the applied behavior is called to check if the requestor is a member of the role.

Request Message:

IsInRole

Description: The request

Request Parameters

Name	Value
AccountId	AccountId of the requestor.

Response Message

True/False

Description: The response

Response Parameters

Name	Value
IsInRole	True/False

Properties

Name: Role

Value Description: A group or list an account can be a member or be in.

Template Value: Minters

Invocations

GetRoleMembers

Id:

Description: Request the the list of member accounts in the role.

Request

Control Message: GetRoleMembersRequest

Description: The request

Parameters

Name	Value

Response

Control Message: GetRoleMembersResponse

Description: The response

Parameters

Name	Value

Members	Returning the list of accounts in the role.

AddRoleMember

Id: 600357f8-0499-47f8-87a5-eedf4ad034af

Description: Add a member to the group or role property.

Request

Control Message: AddRoleMemberRequest

Description: The request

Parameters

Name	Value
RoleName	Name of the role you are adding a member to. Optional parameter if there is only one role.
AccountAddress	Address, name or identifier of the account to be added to the role.

Response

Control Message: AddRoleMemberResponse

Description: The response

Parameters

Name	Value
Added	True or False.

RemoveRoleMember

Id: 97e160bb-6c60-4f1d-923b-813b07b89638

Description: Remove a member to the group or role property.

Request

Control Message: RemoveRoleMemberRequest

Description: The request

Parameters

Name	Value
RoleName	Name of the role you are adding a member to. Optional parameter if there is only one role.
AccountAddress	Address, name or identifier of the account to be removed from the role.

Response

Control Message: RemoveRoleMemberResponse

Description: The response

Parameters

Name	Value
Added	True or False.

IsInRole

Id: e42b1b16-074a-4d7d-b9f9-f69a2397a21b

Description: Check to see if an account is in the role.

Request

Control Message: IsInRoleRequest

Description: The request may be internal only and not exposed externally.

Parameters

Name	Value
RoleName	Name of the role you are checking membership of. Optional parameter if there is only one role.
AccountAddress	Address, name or identifier of the account to be checked.

Response

Control Message: IsInRoleRequestResponse

Description: The response

Parameters

Name	Value
InRole	True or False.

GetMinters

Id:

Description: Request the the list of member accounts in the 'Minters' role.

Request

Control Message: GetMintersRequest

Description: The request

Parameters

Name	Value

Response

Control Message: GetMintersResponse

Description: The response

Parameters

Name	Value
Members	Returning the list of accounts in the 'Minters' role.

AddRoleMember

Id: 600357f8-0499-47f8-87a5-eedf4ad034af

Description: Add a member to the group or role property.

Request

Control Message: AddRoleMemberRequest

Description: The request

Parameters

Name	Value
RoleName	Value is always set to 'Minters'
AccountAddress	Address, name or identifier of the account to be added to the 'Minters' role.

Response

Control Message: AddRoleMemberResponse

Description: The response

Parameters

Name	Value
Added	True or False.

RemoveRoleMember

Id: 97e160bb-6c60-4f1d-923b-813b07b89638

Description: Remove a member to the group or role property.

Request

Control Message: RemoveRoleMemberRequest

Description: The request

Parameters

Name	Value
RoleName	Always set to 'Minters'
AccountAddress	Address, name or identifier of the account to be removed from the role.

Response

Control Message: RemoveRoleMemberResponse

Description: The response

Parameters

Name	Value
Added	True or False.

IsInRole

Id: e42b1b16-074a-4d7d-b9f9-f69a2397a21b

Description: Check to see if an account is in the role.

Request

Control Message: IsInRoleRequest

Description: The request may be internal only and not exposed externally.

Parameters

Name	Value
RoleName	Always be bound to 'Minters'
AccountAddress	Address, name or identifier of the account to be checked.

Response

Control Message: IsInRoleRequestResponse

Description: The response

Parameters

Name	Value
InRole	True or False.

Specification Behavior

Mintable

Taxonomy Symbol: m

A token class that implements this behavior will support the minting or issuing of new token instances in the class. These new tokens can be

minted and belong to the owner or minted to another account. This behavior may be invalidated by a restrictive behavior like Singleton, where only a single instance of the token can exist. Mintable is technically delegable, but it's delegation should be controlled by a behavior like Roles.

Example

A consortium of oil producers needs to create tokens for each barrel of oil they are putting on the market to trade. There are separate classes of tokens for each grade of oil. Producers of barrels will need be have the ability to mint new tokens in order to facilitate the trading of them in the supply chain.

Analogies

Name	Description
SKU	A token class can represent a particular item SKU, where the manufacturer of the item has the ability to mint or issue new inventory of the SKU into the supply chain.

Type:	Behavior
Name:	Mintable
Id:	f9224e90-3cab-45bf-b5dc-0175121e2ead
Visual:	m
Tooling:	m
Version:	1.0

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id

Influenced By

Description	Symbol	Applies To
Roles is common to implement to provide authorization checks for invoking the behavior. Highly Recommended that Role restrictions be applied to MintTo invocations.	r	[ ]
If Compliance is present, a CheckMintAllowed request has to be made and verified before a Mint request or a MintTo request.	c	[ ]

Artifact Files

Content Type	File Name	File Content
Control	mintable.proto	
Uml	mintable.md	

Code Map

Map Type	Name	Platform	Location
SourceCode	Open Zeppelin	EthereumSolidity	https://github.com/OpenZeppelin/openzeppelin-contracts/blob/master/contracts/token/ERC20/ERC20Mintable.sol

Implementation Map

Map Type	Name	Platform	Location
Implementation	Implementation 1	ChaincodeGo	

Resource Map

Map Type	Name	Location	Description
Resource	Regulation Reference 1		

Is External:	False
Constructor:	

Mintable responds to these Invocations

Binding Is Influenced by Roles's Invocation RoleCheckRoles's Invocation RoleCheck Intercepts this behavior's invocation.'

RoleCheck

Id: 00a665e3-1dda-441e-8262-5750435c153c

Description: Check to see if the account is in the Role called 'Minters'

Request Message:

IsInRole

Description: Checking the 'Minters' role.

Request Parameters

Name	Value
AccountId	AccountId of the requestor.

Response Message

True/False

Description: Respond true if the account is in the 'Minters' role.

Response Parameters

Name	Value
IsInRole	True/False

MintTo

Id: 70499b23-a1dd-4c87-90d6-6e45400f28b5

Description: A request to create new token instances in the class by the owner or a party or account in a role that is granted this permission to another party or account. Requires a To and Quantity fields in the request.

Request Message:

MintToRequest

Description: The request

Request Parameters

Name	Value
ToAccount	Account Id to mint the tokens to.
Quantity	Number of new tokens to create.

Response Message

MintToResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the invoker based on the outcome of the MintTo request.

Mint

Id: 3ddf15db-c919-4f72-a57b-d089931bc901

Description: A request to create new token instances in the class by the owner or a party or account in a role that is granted this permission. Minted tokens using this invocation will be owned by the owner or token pool account. Requires a Quantity field in the request.

Request Message:

MintRequest

Description: The request

Request Parameters

Name	Value
Quantity	Number of new tokens to create.

Response Message

MintResponse

Description: The response

Response Parameters

Name	Value
Confirmation	A confirmation receipt or error may be returned to the invoker based on the outcome of the mint request.

Supply Control

Type:	BehaviorGroup
Name:	Supply Control
Id:	91cb89b6-a2ce-44ff-b3a0-f0cb3f117e56
Visual:	SC
Tooling:	SC
Version:	1.0

Definition

A token class that implements this behavior will provide controls to increase and decrease supply of tokens within the class. Additionally, it will include the ability to support a role, like Minters, that will be allowed to invoke the Mintable behavior. The owner can add accounts to the role and any account that is a member of the role will be able to mint tokens in the class.

Example

Analogies

Name	Description
Central Bank	Implementing monetary policy for this token.

Comments

Define a Minters role and apply the role to the mintable behavior.

Dependencies

Artifact Type	Symbol	Description

Incompatible With

Artifact Type	Symbol	Id
Behavior	s	c1189d7a-e142-4504-bf26-44c35b76c9d6

Influenced By

Description	Symbol	Applies To
Create a Minters Role and apply it to the Mintable behavior to provide authorization checks for invoking the behavior.	r	[ ]

Artifact Files

Content Type	File Name	File Content
Control	supply-control.proto	
Uml	supply-control.md	

Code Map

Map Type	Name	Platform	Location

Implementation Map

Map Type	Name	Platform	Location

Resource Map

Map Type	Name	Location	Description

The behaviors belonging to this group are included in the Behaviors section of this specification.